

**Using business intelligence to support the process of
organisational sensemaking**

by

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Submitted in fulfilment of the requirements for the degree of

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To my loving father

(November 1951– September 1998)

who touched the minds and lives of those he came in contact with,

and who taught me the importance of believing in myself.

Abstract

As the volume of potentially useful information available to organisations grows at a rapid pace, the ensuing complexity, fluidity and ambiguity of business situations become a serious obstacle to the effectiveness and accuracy of management decision-making processes. Making sense of an organisational environment that is overwhelmed with the abundance of data becomes a challenge at all levels of business planning and operation. Although several technological solutions – such as the use of business intelligence (BI) – have been previously suggested as capable of aiding executives in decision-making, the processes of assisting business stakeholders in making sense of their organisational environment is still largely unexplored. Against this backdrop, this thesis leverages theories of organisational sensemaking to investigate how BI can improve the process of organisational sensemaking necessary for making quality decisions.

By adopting hermeneutic phenomenology, BI stakeholders' experiences of using BI in organisations were explored from a variety of personal, organisational and social perspectives. The study participants included the primary organisational users of BI technology, such as consultants, decision-makers, developers and analysts, who were all relying on a set of common BI practices within their work portfolios.

All insights synthesised in this study represent the views and experience of BI practitioners and thus could be of value to the BI community. The results indicate that, for using BI in the process of organisational sensemaking, organisations need to support the creation and consistent utilisation of BI

capabilities at organisational and individual levels. Also, decision-makers need to interact with BI systems and use their own BI-generated insights.

From the theoretical perspective, this research brings two distinct theoretical fields together – sensemaking and BI – and demonstrates how the two approaches can be put into practice with applications for BI-based sensemaking. It extends the theory of sensemaking by firmly grounding in a modern data-driven organisational environment, where tools such as BI can assist decision-makers in making sense of ongoing changes in the business environment. It also contributes to the literature of BI and analytics by investigating what BI and analytics can do before decision-making and actions occur. From a practical perspective, this study clarifies that BI can assist not only decision-making but also sensemaking and identifies those BI elements needed for the sensemaking process to succeed in organisational settings and provides guidelines for creating BI capacity within organisations.

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1 Introduction

Making sense of an organisational environment that is overwhelmed with the large volume of data becomes a challenge for decision-makers. Although business intelligence (BI) has been previously suggested as capable of improving decision-making, the processes of assisting BI users in making sense of their organisational environment, well before making any decisions, has not yet been addressed. This thesis, therefore, leverages theories of organisational sensemaking to investigate how BI can improve the process of organisational sensemaking, which in turn could have a positive effect on decision-making.

This chapter briefly defines the notion of BI and its tools and techniques. It also describes the notion of sensemaking. Then, these two concepts are used to construct the main research question and objectives of the thesis. The motivation for the thesis is explained and the success criteria for this research are also defined. Finally, the chapter presents the structure of the entire thesis.

1.1 Background

In today's business world, organisations face constant environmental volatility and change, which results in an enormous amount of corporate data being available. To harness the potential of this change, many organisations now strive to transform large volumes of available data into a genuine understanding of business. To this end, BI empowers companies by providing them with insights about their processes and allowing them to monitor their activities. Consequently, such organisations are able to base their decisions on insights derived from facts via BI processes. While there exist several different definitions of business intelligence

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(BI), this thesis adopts Wixom and Watson's definition, which stated that (Wixom and Watson, 2010, p. 13) BI is a "broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing" business data. It assists analysis of business data with a view for the organisational stakeholders to understand business and markets, as well as for making better business decisions (Chen et al., 2012).

There are various objectives of using BI in organisations, starting with the simplest being a single BI application, then a suite of applications, through to the entire BI infrastructure to facilitate transformation of an organisation (Wixom and Watson, 2010) to a data-centric firm. BI can be used to measure performance via enterprise-wide performance metrics and can deliver value for business processes which rely on the effective use of information (Bertram, 2010). Organisations can base their decisions on available information at various levels. In most of the organisations, however, BI and information are loosely coupled with decision-making (Davenport, 2006). In such circumstances, the source of data for decision-making is commonly transactional and BI outputs are usually presented in the form of standard reports, scorecards or dashboards (Davenport, 2006).

Despite BI being one of the most important elements of modern decision-support systems (Arnott and Pervan, 2005; Namvar et al., 2011), many researchers observe that the use of BI for decision-making involves several issues (Chen et al., 2012) for dealing with fuzzy (Meyer and Zimmerman, 2011) and inexact situations (Smietana, 2010). BI users also work in groups (Stoodley, 2012), and the social aspects are indispensable in making their informed decisions (Imhoff and White, 2010) specially when encountering non-linear situations. Indeed, what decision-makers need from new BI tools is some capabilities that enhance their

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understanding (Davenport, 2010), non-rational decision-making and satisficing (Namvar et al., 2016). The new BI tools also need to assist decision makers in collaboration (Smietana, 2010) and undertaking strategic decision based on the available BI reports in groups (Imhoff and White, 2010).

The sequence of business activities leading from understanding to decisions, and further to actions, is at the crux of organisational sensemaking, a process used to facilitate understanding of a business context and its problems (Weick, 1995). Weick (1995; 2005) discussed that sensemaking is the process that can be undertaken individually or collectively, however, in both cases it can be characterised by seven unique properties, which include the sensemaker's capacity for retrospection (or giving meaning to past events), cue extraction (or detection of important events), dealing with plausibility (or inexactness and fuzziness of observations), the social and ongoing nature of the sensemaking process, as well as the willingness to create and enact one's identity (the capacity for sensemaking). In this line, Maitlis and Christianson noted that sensemaking is accomplished through three sensemaking moves, namely "noticing or perceiving cues, creating interpretations, and taking action" (2014, p. 59).

Sensemaking describes the foundations for mental models of reality and its causes (Woodside et al., 2005) and is an important prerequisite to reaching informed decisions and involving processes that could potentially be supported with current or future BI technology. In the context of organisational behaviour, sensemaking is the structured process of dealing with ambiguity and uncertainty in organisational settings (1995; 2005), aimed at giving meaning to objects and events from the past. Sensemaking can be used to investigate how intersubjective meanings are constructed by multiple actors in organizations (Maitlis and

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Christianson, 2014). In specific, sensemaking activities can address the challenges for using organisational information systems for decision-making (Hasan and Gould, 2001), and indeed they can sit between BI and decision-making (Namvar and Cybulski, 2014).

Weick's (1995) model of sensemaking offers an appropriate theoretical framing for the study. It provides the most comprehensive framework for studying and understanding sensemaking in equivocal business situations. It considers sensemaking as a concrete organisational process which relies on human cognition to capture and process information cues. Its concepts are also derived from business cases and is considered as a practical business problem which sets its focus firmly on people making sense of the structural and social complexity of their organisations, making decisions and acting in an organisational context.

Decision-making, however, focuses on evaluating a range of possible actions and selecting the best alternative. While sensemaking "includes automatic and controlled scanning of memory and environments for framing issues" (Woodside, 2001, p. 415), the attention of a decision-making is directed almost completely and without exception to the future impact of decisions, actions and their outcomes (Boland, 2008). Sensemaking is commonly considered a continuous process (Maitlis and Christianson, 2014), however, decision-making occurs occasionally during this process when decision-makers, or sensemakers, use BI reports in action or contribute in reshaping BI environment.

In this thesis, sensemaking and decision-making are considered as distinct but inter-dependent activities, both are equally important, and each is used in its most appropriate context. From the BI perspective, a decision-maker and

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sensemaker are often the same person, especially at the strategic level, where quality decisions could only happen after a lengthy and thorough process of sensemaking. In this study, therefore, both of these terms will be used to refer to the end user of BI who aims at understanding business environment with BI tools.

1.2 Research question

Organisational researchers have captured that sensemaking has been helpful in investigating management practices (Drazin et al., 1999; Gioia and Chittipeddi, 1991); supporting decision-making processes (Taylor and Bogdan, 1998); health information system implementation (Jensen et al., 2009; Jensen and Kjaergaard, 2010); understanding communication channels (Cooren, 2004; Manning, 1992); marketing and management (Craig-Lees, 2001; Hopkinson, 2001; Rosa, 2001); information technology (Lewis et al., 2011; Ramiller and Burton Swanson, 2009; Swanson and Ramiller, 2004); process management (Maitlis and Lawrence, 2007; Maitlis and Sonenshein, 2010); electronic communication (Bansler and Havn, 2003); and organisational change (Sonenshein, 2010). The concept of sensemaking was born in the context of organisational theory, and yet, it has strong links with information processing and information quality, which have given it credence as an important research topic in information systems. Few studies, however, link BI and organisational sensemaking, with the majority of BI research focused on the provision of support for decision-making (Arnott and Pervan, 2005; Bucher et al., 2009; Davenport, 2010; Shim et al., 2002), but not business understanding. The main objective of this study is, therefore, to explore how BI technologies could assist decision-makers to engage in a continuous process of sensemaking with a

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view to gaining insight into their business environment. Consequently, this study aims to address this problem by exploring the following research question:

How can BI improve the process of organisational sensemaking necessary for making decisions?

The research question could be divided into several sub-questions. First, to determine how BI could be used in understanding an organisation, and how BI systems could potentially be extended and enriched to better support decision-making, it is necessary to review sensemaking theories, which are designed for understanding organisations and their environments in order to make better decisions. So the first sub-question can be articulated as:

Sub-question 1: What is organisational sensemaking and how does it help decisions?

It is important to determine what BI functionality is necessary to collect business data and subsequently generate information capable of assisting decision-makers. Therefore, the second sub-question could be stated as:

Sub-question 2: What is BI and how does it help decision-making?

Companies and individuals using BI tools in their decision-making have accumulated years of experience that could be relied on in determining sensemaking processes. Such experience could include different ways of using BI tools, methods of data processing, insights gained, decisions taken and actions followed, as well as the successes and failures of such processes, which could all contribute to better understanding of organisational sensemaking. Thus, the next sub-question relates to the identification of real-life experiences of senior decision-

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makers and other BI stakeholders, who rely on BI tools to make sense, take decisions and act in their organisation:

Sub-question 3: How do decision-makers currently use BI to make sense of their organisation?

Although several studies have been conducted on the role of BI and its effectiveness in decision-making, there is no consensus on an optimum approach to using this technology for the purpose of strengthening sensemaking. Having investigated BI tools and their use in decision-making, it would be opportune to fuse all these insights to arrive at a methodological framework about using BI to improve the process of organisational sensemaking and to assess the value of such an approach. In view of this, it is necessary to address not only the requirements for effective BI, but also to discover how an understanding of the organisation and, consequently, decision-making happens (inspired by Davenport, 2010). This will result in determining requirements for organisations that not only use BI for everyday operational tasks but also for understanding and making sense of their business environment.

Finally, it is important for any research project to clearly define at what point in time and under what conditions the research objectives have been met and the research question answered satisfactorily, so that all research activities could subsequently stop and ultimately the success of the project properly determined. To this end, the following success criteria have been explicitly stated.

Success Criteria: This research will be deemed completed when the above research questions are explicitly answered, saturation point on data

collection and analysis relevant to the research question is reached, and key quality issues (see Section 3.3) of the study are addressed.

1.3 Importance and motivation of the research

Although BI already supports decision-making, in the majority of cases organisations use BI only for day-to-day decision-making (LaValle et al., 2011) and, currently, BI capabilities are not being used for understanding business environments which can potentially enhance the process of undertaking strategic decisions (Chen et al., 2012). By making sense of an organisation, however, managers could understand the organisational environment and make better decisions (Weick, 2012). In this context, BI is capable of assisting organisational management not only in decision-making but also in making sense of business structures, events and processes. In other words, BI tools and their associated business processes could potentially assist sensemaking, or BI could be extended to do this in addition to decision-making.

Although several models for the use and adoption of BI within organisations have been proposed by different authors (e.g. Marjanovic, 2010; Yeoh and Koronios, 2010) the notions of decision-making and understanding organisations are not central to the exploration of these organisational characteristics. Therefore, BI-based sensemaking leading to effective decision-making is a novel approach, which requires a new theoretical and methodological framework, and which could potentially result in new enterprise tools.

The innovation of this research is twofold; first, it integrates two research areas for decision-making, namely BI and sensemaking, which have never been

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considered together as aiding decision-making. Second, it adapts aspects of some better known theories of sensemaking, which consider sensemaking from cognitive and organisational viewpoints, and expand them to include a unique approach of relying on the emerging enterprise-level analytics, as well as, information and technological viewpoints.

1.4 Scope of the research

The proposed research questions and sub-questions have helped to define the boundaries in which this research resides. The following points delineate a number of research areas that lie outside the scope:

- This research undertakes a study of managers who are decision-makers using BI tools, data analysts, consultants and developers who provide BI tools. Other professionals who may be involved in the acquisition, implementation or tailoring of BI tools, but who do not contribute to decision-making process and organisational aspects of BI will be excluded from this study.
- The research focuses on the study of Australian organisations, which represent typical Western values and culture, as well as those that adopt commonly understood business processes. This excludes other types of organisations, such as those present in the Eastern tradition or those that operate in different legislature that could impose certain conditions on the use of BI systems to collect and analyse business information.
- This research primarily studies managers' day-to-day approaches for decision-making using BI. While the issues of specific decisions and their

outcome may be discussed in the course of this study, the effectiveness of these decisions using BI are not in the focus of this study. Therefore, only the interaction of decision-makers with BI tools, which can potentially leverage their understanding of environment, will be considered.

1.5 Thesis structure

Chapter 2 introduces sensemaking and consequently compares and contrasts its properties with BI tools and capabilities. Different sensemaking theories will be compared and contrasted in this chapter, and finally the chosen model for the rest of this study will be discussed in detail. BI and its use within the organisation also will be explained. BI maturity models and critical success factors of BI will be presented. Finally, Chapter 2 will conclude with a critical analysis on how the extant literature of BI addresses properties of organisational sensemaking.

Hermeneutic phenomenology, involving a broad range of BI stakeholders, is then selected and discussed as the research methodology of this study in Chapter 3. The research design and the required steps, methods and procedures are also explained in this chapter. Then, the key quality issues of this study will be explained. Finally, the consideration for relevant ethical issues will be explained.

Chapter 4 will deal with data collection and its analysis. Twenty-three interviews with 27 participants will be explained in this chapter. Then, it will show the steps of applying epoché and phenomenological reduction to the collected data. At the end of this chapter, individual textual descriptions of three study participants will be presented.

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Chapter 5 will present composite textural descriptions of the investigated phenomena. Then, in Chapter 6, imaginative variation as the next step in the hermeneutical phenomenological analysis of collected data will be discussed. It will present the textural-structural description of the investigated phenomena.

Chapter 7 synthesises the findings by proposing a framework for BI-based sensemaking. It reveals the emerging insights into designing a process for organisational sensemaking using BI. The conflicts between the points of views of different study participants will be addressed. Also, it will be explained how the shortage of BI for the use of sensemaking for understanding the organisation should be combated. Finally, this chapter presents the essence of this study.

Chapter 8 concludes the study by explaining how the findings answer the research question and fulfil the research success criteria. It then discusses the contributions of this research in practice and theory. Finally, the research limitations along with some suggestions for future research are discussed.

1.6 Thesis style

In line with the commonly adopted conventions of interpretive research, in the following chapters, I will discuss the conducted research from the position of a researcher who cannot be separated from the research process and will use the first form “I” (Moustakas, 1994). Since research method is reviewed and designed in Chapter 3, the future tense will be used in this chapter; however from Chapter 4 onward, past tense will be used as the work which is actually done for data collection and analysis will be discussed.

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Finally, as will be discussed in Chapter 3, the adopted research approach for this research, hermeneutics phenomenology, requires cycles of growing understanding of the phenomena under study (Crotty, 1998). Therefore, several hermeneutic cycles resulted in considerable repetitions that will be included to show the rigour and exactness of the undertaken processes.

1.7 Summary

Today organisations are facing rapid changes – many initiated from their business environment. These changes can act as a two-edge sword. On the one hand they can add to complexities within organisations, hindering decision-makers from taking the right decisions, while on the other hand organisations can learn to master these changes and turn them into competitive advantage. Many organisations understand the importance of engaging in the process of collecting environmental data, then analysing and reporting them to assist management decisions that either initiate change or deal with their consequences.

Several studies have been undertaken in the area of BI to facilitate decision-making. These studies mostly have aimed at providing BI tools that facilitate decision-making. However, there is no major investigation for understanding organisations through the use of BI tools in this prior research. Sensemaking theories could be used as a response to the research problem. Thus, this research aims at bringing sensemaking and BI together to propose a framework for BI-based sensemaking.

This chapter first presented the concepts of BI and sensemaking, and then it discussed the research problem. The research question was formulated, and the

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scope of research was also discussed. Finally, the thesis structure for the rest of study was presented. In the next chapter a comprehensive review of the literature of sensemaking and BI will be presented.

2 Literature review

As argued in Section 1.1 sensemaking theory is an appropriate method that can help in the process of using BI in understanding business environments. In this chapter, therefore, first the literature of sensemaking will be reviewed and some well-known conceptualisations of sensemaking will be introduced. Subsequently, the best known sensemaking framework proposed by Weick (1995), which was selected as the theoretical framework for the presented study, will be described and its advantages and disadvantages as compared with other sensemaking models will be explained. Then the framework's main properties will be defined, clarified and illustrated. Finally, business intelligence (BI) as the technology able to address the fundamental requirements of sensemaking will be introduced and its strengths and weaknesses in this endeavour will be evaluated.

As different approaches exist for conducting a literature review (Webster and Watson, 2002), before embarking on a literature review it is important to specify and outline the streams of literature that were searched. In this study, a structured approach - using the "keyword sieve" over journal databases - was employed to determine the source material for review (Webster and Watson, 2002). First, as the major contributions were likely to be found in the leading BI and Information Systems journals, including MIS Quarterly, Information Research and Journal of Management Information Systems, their tables of contents were investigated to find sources not yet identified by the keyword search. I also examined the tables of content of specific journals to BI, including Business Intelligence Journal, and investigated selected conference proceedings, especially those with a reputation for quality, including International Conference on Information Systems. Then, I

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reviewed the citations in articles from the selected sources to determine articles to be considered. Finally, I went forward to identify academic writing which cited the key articles identified in the previous steps.

2.1 Sensemaking

Literature on sensemaking goes back to the 1980s and provides several different conceptualisations of its core concepts that “challenged notions of an objective reality and instead emphasized the social construction of reality” (Maitlis and Christianson, 2014, p. 60) As already explained in Chapter 1, Weick (1995) defined sensemaking as a structured process of removing ambiguity and uncertainty from executive decision-making. The person involved in the process of making sense is referred to as a “sensemaker”. While the concept of sensemaking was conceived in the context of organisational theory, it has a strong emphasis on information processing and information quality, which have given it credence as an important research topic in information systems.

While sensemaking is usually a part of the decision-making process, the two concepts need to be distinguished. As decisions are commonly preceded by initial fact-finding and acts of discovery, Weick (1995) suggested that sensemaking occurs in those exploratory phases, especially when faced with equivocal situations where decisions cannot be readily taken. Sensemaking is the structured process of dealing with ambiguity and uncertainty in organisational settings, aimed at giving meaning to objects and events from the past (Weick, 1995). In contrast, decision-making focuses on evaluating a range of possible actions and selecting the best alternative (Boland, 2008). Weick clarified the notion of sensemaking by

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describing its seven key characteristics, which he referred to as properties and which are considered the foundation of his framework. While other scholars write about Weick's "sensemaking framework", they often refer to the seven properties of sensemaking (Maitlis and Christianson, 2014).

According to Weick (1995) :

- Sensemaking is retrospective, meaning the sensemaker looks back and reviews events or situations that make sense in respect of the current situation.
- Sensemaking is a social phenomenon, such that making sense of the environment is never a solitary activity. Even personal or cognitive tasks are influenced by people around us and are contingent on those people and their actions.
- Sensemaking is focused on cues extracted from the organisational context to help sensemakers determine current and relevant information.
- Sensemaking relies on plausibility rather than accuracy of observations and predications. Under normal business conditions, accuracy of management insights and perceptions is never assured, yet decisions based on information derived from merely plausible premises often lead to positive consequences. Most organisational actions are time-sensitive, which means that instead of accuracy managers favour efficacy and thus rely on plausibility of evidence and inferences.
- Sensemaking is an ongoing process in which individuals "shape and react to the environment they face". Weick (1995) noted this process never stops as it never starts as people are always in the middle of sensemaking.

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- Sensemaking is about enactment. Sensemakers “often produce part of the environment they face”, which either empowers them or constrains their actions. In turn, the constructed environment shapes the identity of sensemakers and determines their interpretation of situations.
- Finally, “sensemaking is grounded in identity construction”. This key proposition states that sensemaking, and thus perceived reality, depends on how sensemakers describe and perceive themselves.

Weick et al. (2005) further discussed the notion of organised sensemaking (see Figure 1). They suggested “that sensemaking can be treated as reciprocal exchanges between” sensemakers “and their environments that are made meaningful and preserved” (Weick et al., 2005, p. 414).

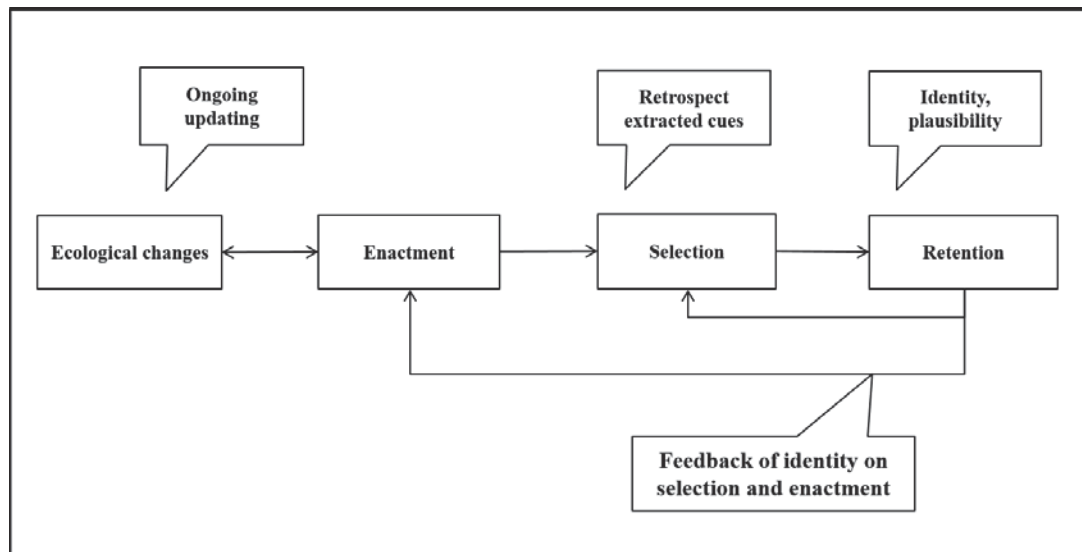


Figure 1: Enactment, organising and sensemaking (Weick, 2005)

In this figure, organised sensemaking is conceptualised as a sequence of ecological change, enactment, selection and retention. The results of retention feeds back to all three prior processes. In Figure 1, ecological changes are captured by sensemakers in an ongoing manner. Sensemakers detect anomalies and enact by

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sensemaking activities of noticing and bracketing. The process of selection reduces the number of possible meanings. During this process a combination of retrospective views and extracted cues are used to generate a plausible story, which is tentative and provisional. This story increases its “solidity in the process of retention” (Weick et al., 2005, p. 414). When this story is retained, “it tends to become more substantial because it is related to past experience, connected to significant identities, and used as a source of guidance for further action and interpretation” (Weick et al., 2005, p. 414).

Initially, some theorists (such as Russell et al., 1993) explained sensemaking as a sequential process. Weick however, noted that the sequence of sensemaking actions is often confounded by feedback loops and simultaneous processing, and that in other cases, over time with reuse of business or individual processes, some of the sensemaking steps may eventually be omitted. Indeed, sensemaking can be referred to as a process or recurring cycle that is unfolded as a sequence (Maitlis and Christianson, 2014). Weick further remarked on the complexity of this process:

Sensemaking involves the ongoing retrospective development of plausible images that rationalise what people are doing. Viewed as a significant process of organising, sensemaking unfolds as a sequence in which people concerned with identity in the social context of other actors engage ongoing circumstances from which they extract cues and make plausible sense retrospectively, while enacting more or less order into those ongoing circumstances (Weick et al., 2005, p. 409).

Several scholars have also reviewed sensemaking models (e.g. Dervin and Naumer, 2010; Maitlis and Christianson, 2014). To a larger extent, all previously

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discussed models share Weick's core concepts of sensemaking. The following section will review five alternative models of sensemaking; namely, Russell et al.'s Learning Loop Complex (1993), Snowden's Cynefin (2002), Pirolli and Card's Notional Model of Sensemaking (2005), Dervin's Sense-Making Methodology (2008) and Klein et al.'s Data/Frame Theory (2006). Section 2.1.2 will further compare and contrast the properties of alternative modes of sensemaking with Weick's (1995) model of sensemaking. This comparison will be conducted across Weick's seven properties of sensemaking.

2.1.1 Alternative models of sensemaking

2.1.1.1 The Learning Loop Complex

One of the better known studies of sensemaking was led by Russel et al. (1993), which resulted in the Learning Loop Complex model of sensemaking. Their work investigated the process of arriving at a representation of some environmental phenomena to support learning. The emphasis of this learning process, which they refer to as sensemaking, is about organising the available facts to facilitate a search for information at minimal cost to the process of retrieving previously acquired data and knowledge that could fulfil the search criteria. The proposed conceptualisation of sensemaking describes a triple-loop process of learning in question-answering (or problem-solving).

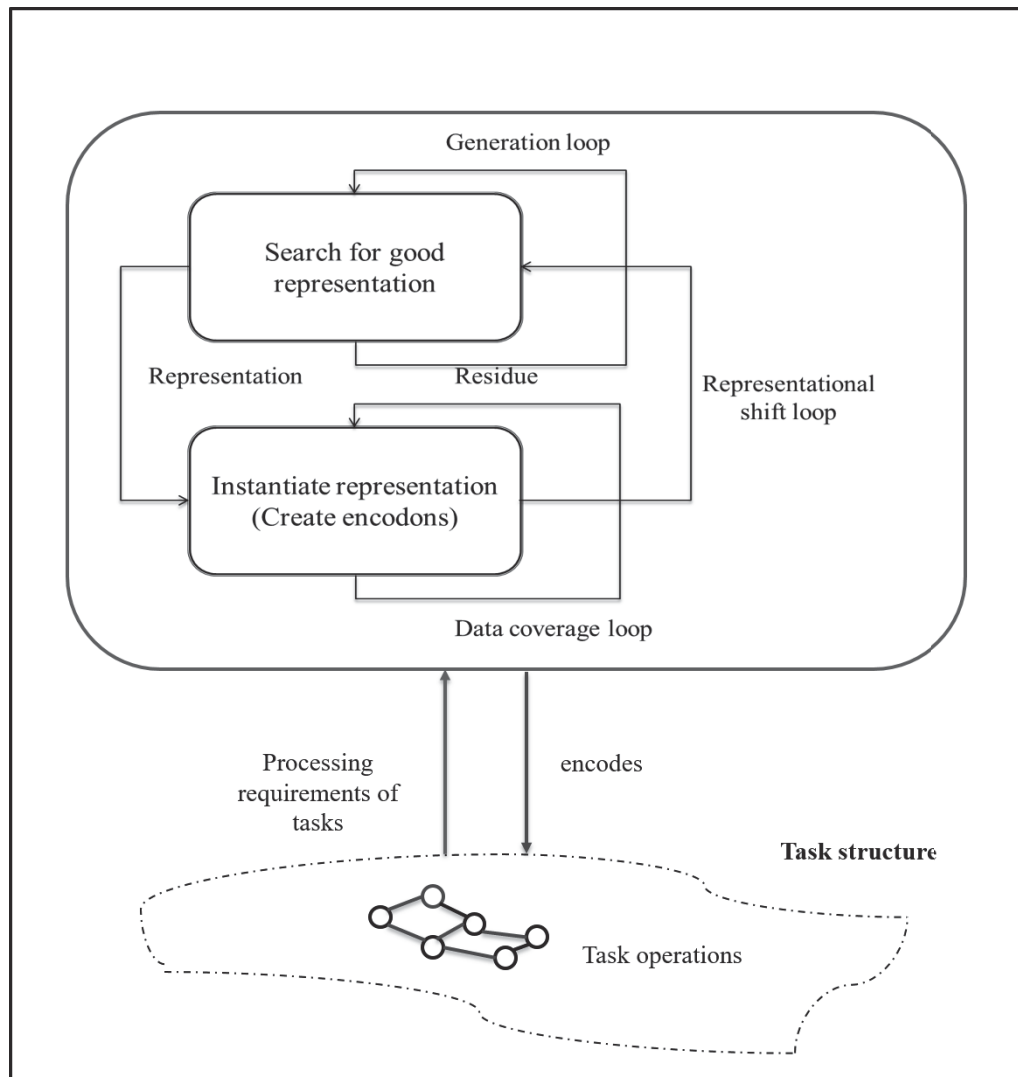


Figure 2: The Learning Loop Complex (Russell et al., 1993)

The model asserts the need for managing a structural representation of data in learning processes (see Figure 2), which starts with search and construction of suitable representations (generation loop), then fitting of data (or evidence) into the representational structure (data coverage loop), and continuous redesign of representations when data could not be completely accommodated (representational shift loop).

The authors explained the model with a case study of designing a curriculum for laser printer repairmen at Xerox. In line with the proposed model, when

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considering “printer faults” four sensemaking processes can be designed to support learning about printers; that is:

- Search for representations: The initial problem representation may include documents describing “printers” and “scanners”. As the generation loop commences, additional documents may be added, such as those describing “functions” and “faults”.
- Instantiate representation: All interrelated documents are then fitted into an overarching scheme of understanding about printers, their faults, components and functions.
- Shift representations: As some concepts, and their corresponding document, may not easily fit into the selected representation, a representational shift may be triggered to search for additional information and better suited representations.
- Consume representations (called “encodons”): Finally, the generated best-fitting representation for the problem at hand can be used as an effective “query” to initiate an information retrieval task.

In this model, representation search is not necessarily top-down. If there is no ambiguity in creating encodons, sensemaking would be trivial, consisting of defining the schemas and then their instantiation. Sensemaking occasionally works in this trivial way as usually surprises are involved in creating encodons, or in new task requirements. In this situations the schemas should be reviewed.

The model focuses primarily on the abstract processes of forming representations of problems and their solutions, and the use of and shifts in those representations. While the model explains the process of matching possible

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solutions to problems at hand, it does not consider socio-organisational aspects of capturing and manipulating information for and by sensemakers. In order to construct a comprehensive understanding of sensemaking, it is also important to contemplate an individual's ability to perceive and interact with information in its business context.

2.1.1.2 The Sense-Making Methodology

Dervin (Dervin, 2008, 1998, 1983) investigated sensemaking in individuals attempting to make sense of observed data. The results of her work are presented in the Sense-Making Methodology, which postulates that the never-ending process of understanding occurs iteratively in time and space, in response to new experiences and encountered situations. In her view, the sensemaking is “embedded in time and space, moving from a history toward a horizon, made at the juncture between self and culture, society, organisation” (Dervin, 1998, p. 36).

Dervin used the metaphor of a journey to arrive at understanding. She suggested that the process of sensemaking is needed when an individual is confronted with a situation which prevents further problem-solving and decision-making – this is termed as a cognitive gap (that is, questions, confusions, muddles, riddles and angst). In dealing with such situations, the sensemaker must first define the nature of the gap (e.g. question or muddles) and then select the optimum tactics to bridge the gap, which may involve ideas, attitudes, feeling and memories. Finally, as depicted in Figure 3, the sensemaker metaphorically crosses the cognitive bridge and continues on the journey.

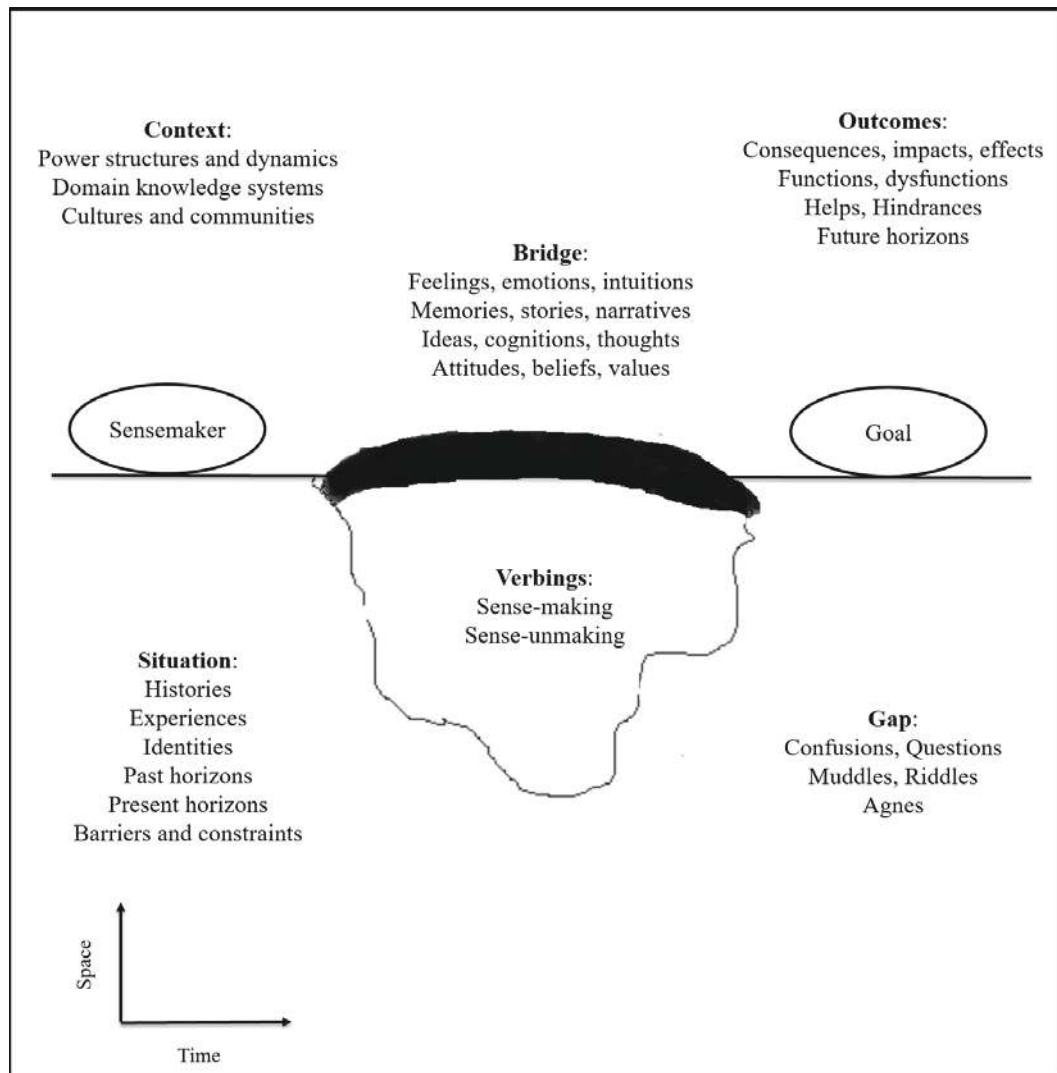


Figure 3: Sense-Making Methodology's central metaphor (Dervin, 2008)

The following describes three main elements of Sense-Making Methodology:

- Gap indicates where the sensemaker needs to stop and leads to making the bridge. It identifies the barriers in the process of problem-solving.
- Situation denotes the time-space context in which sensemaking occurs.
- Outcome/use describes how cognitive bridges are put to work, for example how the answers to the questions are derived.

Understanding how an individual identifies a gap situation and how the gap could subsequently be bridged is central to Sense-Making Methodology. However,

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Dervin's metaphor (2008) does not clarify the nature of the processes used in finding the gaps or methods that should be used to bridge these gaps. While Sense-Making Methodology describes sensemaking in terms of the steps taken in its process, the very nature of sensemaking phenomena and their properties are not explained in detail. Dervin's model (2008) focuses primarily on individual sensemakers; however, a larger context of socio-organisational sensemaking is not considered. When compared with the Learning Loop Complex, the role of information representation and information seeking in Sense-Making Methodology is not explained either. The value of this model, however, is to recognise the need for finding and identifying mental gaps, as well as seeking solutions required in bridging these gaps.

2.1.1.3 Cynefin: the common model of sensemaking

Snowden (2002) proposed Cynefin as a common model of sensemaking based on knowledge management theories and models. He used complex adaptive system theory to create a sensemaking model that used self-organising capabilities of the informal capabilities of informal communities, and he identified a flow of knowledge which created, disrupted and utilised naturally (Snowden, 2002). Snowden (2002) proposed this framework in knowledge management domain.

Cynefin consists of five domains, four of which are named as complex, knowable, chaos and known, and a fifth central area, which is the domain of disorder (see Figure 4). In contrast to categorisation frameworks, none of the domains in Cynefin are more desirable than others as there are no implied value axes. However, in order to improve sensemaking prior to decision-making under

uncertainty, this framework can be used to consider “the dynamics of situations, decisions, perspectives, conflicts, and changes” (Kurtz and Snowden, 2003, p. 468).

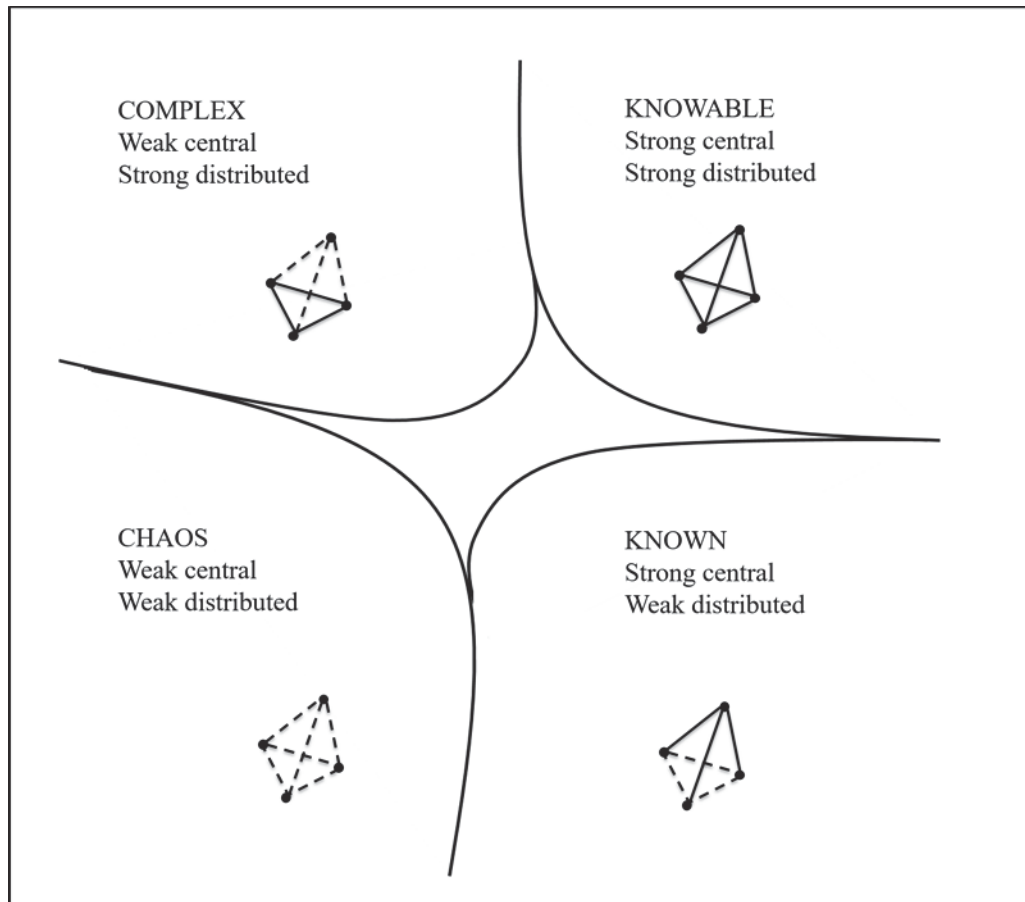


Figure 4: Cynefin's domains (Kurtz and Snowden, 2003)

In this framework, as originally formulated and as developed to this day, it is suggested that the knowable domain describes formal organisations with open, explicit and known language. The existing cause and effect relationships are stable in this domain, however, they may not be fully known by all individuals within the organisations. The known domain is not open to dispute as the linear relationship between cause and effect exist (Kurtz and Snowden, 2003). The complex domain accounts for informal organisations in which complex network of obligations, experience and mutual commitments are the vital elements. In the chaotic domain

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there is neither experience nor expertise, as the organisation and the situation in which it operates are often newly established.

The above description of the Cynefin domains is based on an understanding of the distinctiveness of two different types of system: complicated and complex. Snowden (2002) noted that in a complicated system all of its components are knowable, definable and it is possible to catalogue all of the relationships between those components. He further explained that human systems are complex, which means they include many interacting agents that exist in a variety of identities. Snowden noted that “organisations tend to study past events to create predictive and prescriptive models for future decisions based on the assumption that they are dealing with a complicated system in which the components and associated relationships are capable of discovery and management” (Snowden, 2002, p. 14). The purpose of the Cynefin model, therefore, is to enable sensemaking by increasing the awareness of the borders and triggering the transition between borders. It contradicts single models that cover all different scenarios. Instead it focuses on “diversity as the key to adaptability” (Snowden, 2002, p. 17) in sensemaking.

This framework, however, does not describe the general process of sensemaking and subsequently cannot be considered as a framework that explains sensemaking. Kurtz and Snowden consider Cynefin a sensemaking framework as its value “is not so much in logical arguments or empirical verifications as in its effect on the sense-making and decision-making capabilities of those who use it. We have found that it gives decision-makers powerful new constructs that they can use to make sense of a wide range of unspecified problems” (Kurtz and Snowden, 2003, p. 468). Therefore, Cynefin does not describe what sensemaking is, instead

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it provides a tool for decision-makers to make sense of wide range of unspecified problems.

2.1.1.4 Notional Model of Sensemaking Loop

The Notional Model of Sensemaking Loop was proposed by Pirolli and Card (2005), who previously collaborated with Russell (1993) on the Learning Loop Complex; however, this new conceptualisation of sensemaking was a significant departure from their earlier work. In the revised model, sensemaking is considered an important part of human cognition. It aims at developing understanding of situations and entities of strategic, operational or tactical importance, with a view to describing their known properties and predicting the future events as derived from those situations. The model also offers suggestions as to how technology might be applied in sensemaking (see Figure 5).

In this model, sensemaking is a process with multiple interlinked activities and feedback loops. The model describes two loops of analytic activities: the first is related to finding information (information foraging loop) and the second is related to making sense of information (sensemaking loop). These two loops are highly interrelated. The information foraging loop includes processes that aim at seeking information in the analysed environment, by searching, filtering, reading and extracting the data. The sensemaking loop, on the other hand, is a process of iterative development of mental models (or conceptualisations) from the schemas that best fit the available evidence (as that available to an intelligence analyst).

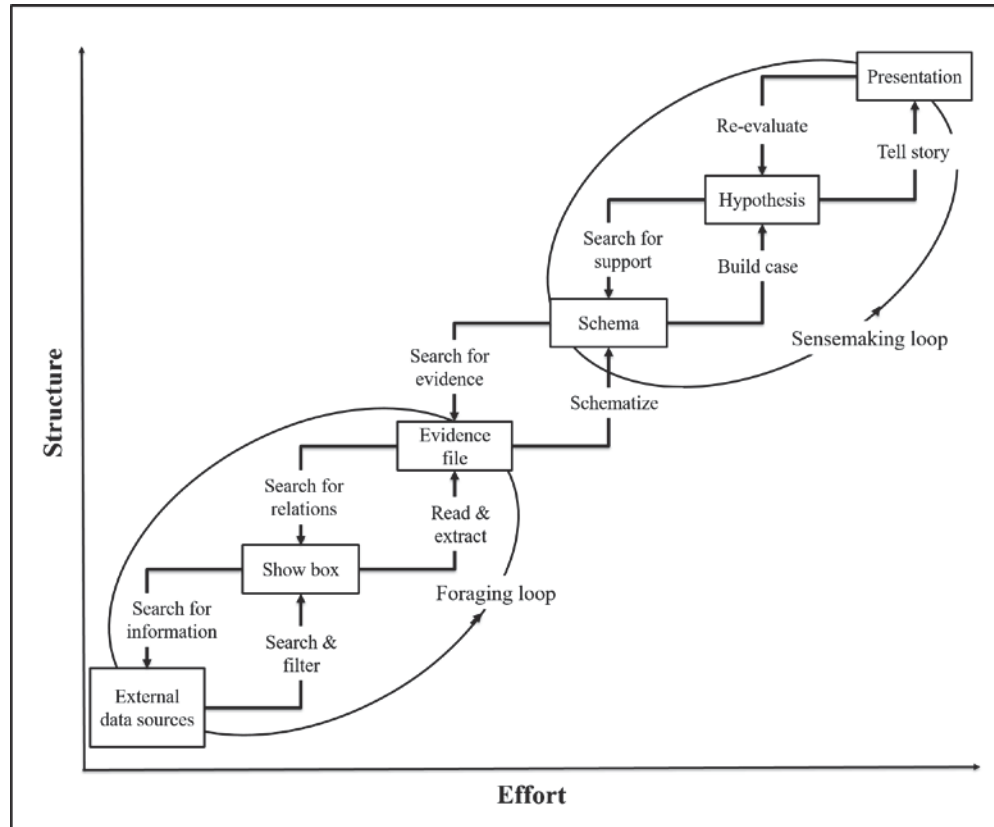


Figure 5: Notional Model of Sensemaking Loop (Pirolli and Card, 2005)

This model describes data flow and process flows, both of which aim at transferring raw data into a form suitable for sensemaking. The processes and data are organised by degree of effort and degree of information complexity in this figure. The data flows in this model are as follows:

- External data sources are collected from various sources such as web or structured databases that provide a repository which then can be queried by data analysts.
- Shoebox is considered as the smaller subset of the external data that is adequate for processing.
- The evidence file denotes the parts that are extracted from items in the shoebox that are low-level inferences that may trigger new hypotheses and searches.

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- Schemas are the re-representation (also called “organised marshalled representations”) of the information so that it can be used more easily to make conclusions. This may occur in the mind of the analyst or be facilitated by the computer system.
- Hypotheses provide “tentative representation of those conclusions with supporting arguments”.
- Presentation, which can take on a variety of forms, including charts, tables and stories.

The Notional Model presented in Figure 5 attempts not only to describe the processes surrounding sensemaking but also to identify new technologies, such as decision-support systems, for improving intelligent decision-making based on data. In Pirolli and Card’s (2005) model, intelligence data analysis is considered as a form of sensemaking and the sensemaking itself is considered merely a cognitive aspect of the sensemaker’s activity. However, Pirolli and Card’s model does not explain the nature of sensemaking and does not expound on how flows of data could be channelled and managed in order to facilitate sensemaking to occur.

2.1.1.5 Data/Frame Theory of Sensemaking

Klein et.al (2006) believed that a person’s perspective and viewpoint are the starting points in the process of making sense of the environment, and they called this a “frame”. Frames represent understanding and provide meaning to data, which can be facilitated by several different data forms, such as stories, maps, organisational diagrams or scripts, and which can be used in subsequent or parallel processes. Frames not only define data; they also shape it. Frames describe and explain the relevant data, relationships and operations on data.

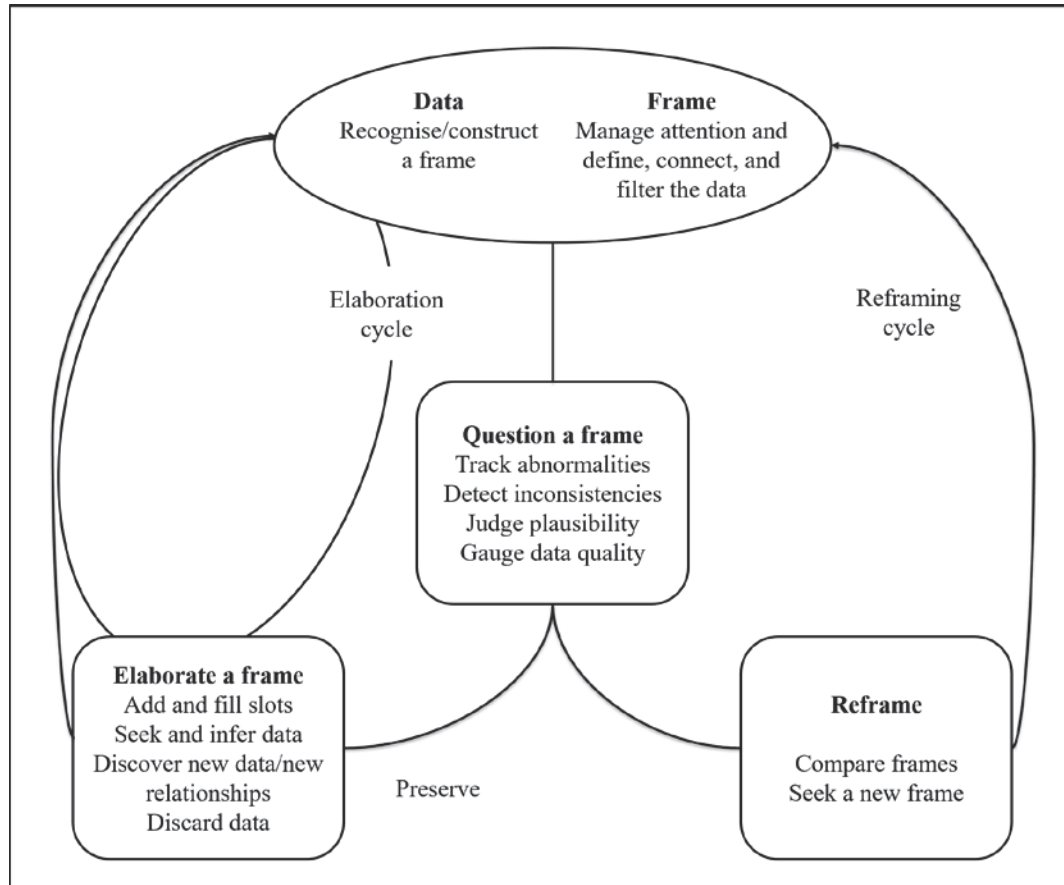


Figure 6: The Data/Frame Theory of Sensemaking (Klein et al., 2006)

In this model, data–frame relationships form the activities and the cycle of sensemaking (see Figure 6). Sensemaking activities include expanding the frame (by adding details) and doubting the frame and its explanations. A frame acts as an assumption about the connections between data. To remove the doubt is to clarify problematic data and preserve the frame. Indeed, elaborating the frame and preserving the frame construct the elaboration cycle of sensemaking. In his model, reframing is another cycle of sensemaking (see the figure’s right side). Questioning the frame leads to reassessing the initial frame and looking to replace it with another. Then, the alternative frames will be compared to determine the most accurate one.

2.1.2 The comparison between different models

The preceding sections have reviewed six distinct models of sensemaking; namely, Weick's model of sensemaking (1995), Russell et al.'s Learning Loop Complex (1993), Snowden's Cynefin (2002), Pirolli and Card's Notional Model of Sensemaking (2005), Dervin's Sense-Making Methodology (2008) and Klein et al.'s Data/Frame Theory (2006). Several scholars also collected and reviewed sensemaking models (e.g. Dervin and Naumer, 2010; Maitlis and Christianson, 2014). To a larger extent, all previously discussed models share Weick's core concepts of sensemaking. However, their studies does not provide a comprehensive comparison between sensemaking properties. Therefore, in this part the comparison of all models will be conducted across Weick's seven properties of sensemaking, which in turn can be viewed, analysed and understood from the perspective of the remaining five models (see Table 1).

The competitive models consider sensemaking from very different vantage points; namely, information science, management and human-computer interaction. However, providing a mapping between Weick's sensemaking model and the features of the alternative frameworks will clarify what "making sense" exactly means for individuals and organisations. In doing so, several separate notions of sensemaking will converge into a single conceptualisation and a single understanding of sensemaking processes. Furthermore, Weick's seven properties of sensemaking will be reflected on and evaluated from a number of distinct viewpoints. After this comparison it will be possible to provide a better description of seven properties of sensemaking which is applicable in various domains. Specially, comparing properties of Weick model of sensemaking with proposed

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models by Pirolli and Card (2005) and Klein et al. (2006), which focus on information processing, will assist in translating Weick model in the context of information systems and BI.

Table 1: Six models of sensemaking

Weick 1995	Russell et al. 1993	Dervin 1998	Snowden 2002	Pirolli and Card, 2005	Klein et al. 2009
Retrospect	Instantiate representation (data)	Horizon of past, present and future, narrative and metaphor	Known and knowable spaces	Sensemaking and foraging loop (data)	Data
Social context	Individual in a team	Social, participatory and dialogic	Ecologies of self-organising communities	Individual	Individual
Cue extraction	Mismatch, omission and misuse of data and its representation	Gaps, questions, confusions, muddles, riddles, angst	Probe, sense and pattern management	Searching for evidence, information and relations	Question a frame:, detect inconsistencies, track anomalies
Plausibility	Cost-driven shift in representation	Use/outcome, sense-unmaking, emotions, feelings	Cyclical disruption of entrained thinking	Trade-off between accuracy and cost	Question a frame: judge plausibility, gauge data quality
Ongoing use	Generation and representational shift loop	Ongoing circling and re-circling	Continuous flow of knowledge in communities	Sensemaking and foraging loop	Ongoing cycle of elaboration, preserving and reframing
Enactment	Search for representation	Bridging gaps	Transforming chaos into complexity	--	Frame, reframe
Identity creation	--	Situation – history, experience, habits/skills	Understanding leads to new domains of experts and creation of their communities	--	Learning and skill development

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Weick (2005) considered the fundamental notion of the past, as captured and represented in historical data – what he referred to as “retrospection”. In Russell and colleagues’ (1993) terminology, retrospection equates with information instantiation; that is, learning and representation information acquired from a variety of sources. In Snowden’s model of sensemaking (2002), retrospection defines the space of what is known and what is knowable, whereas in Pirolli and Card’s model (2005) and Klein’s model (2006), “data” is the notion used for referring to past events. Dervin (2008), on the other hand, relied on a broader notion of the horizon of understanding that helps information users in making sense of their past, present and future circumstances.

Weick in his model explained that sensemaking is a social activity that deals with communication of organisational “stories”, assessing their plausibility, preservation, retention and sharing. The model proposed by Snowden (2002) fully addresses the social aspect of organisational sensemaking as well; however, Snowden set the notion of social sensemaking in the context of self-organising communities of experts, who engage in the collective processes of learning, knowing and self-awareness. Dervin’s Sense-Making Methodology (2008) was designed to explain individual sensemaking phenomena, however with a particular focus on interpersonal communication, such as that taking place in the process of interviewing or academic discourse. Dervin thus envisaged sensemaking as an integral element of social and cultural life, seen as participatory and dialogic, indispensable for communication purposes and the creation of personal connections with broad audiences and society as a whole (Dervin, 2008; Dervin and Foreman-Wernet, 2012). Pirolli and Card (2005) did not emphasise the need for socio-organisational grounding of sensemaking activities. And yet, Pirolli and Card

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defined their concept of sensemaking in organisational context by explaining the transformation and flow of information around organisational boundaries from its source to its use. Klein et al. (2006) considered sensemaking as part of an individual's determination to mentally connect people, places and events, focusing on relevant information and turning it into deep understanding.

Weick (1995) attached primacy to a sensemaker's ability to plan actions by continuously sensing environmental cues and deriving meaning from their relationships and structures. In fact, extracting cues is an element of all sensemaking models. Klein (2006), for example, suggested that cues for action also occur by self-reflecting on atomic meanings and their combinations, with a view to tracking semantic anomalies and detecting inconsistencies. The nature of cues is often considered very broadly, to include mismatch, omission and misuse of data or its representation (Russell et al., 1993), or questions, gaps, confusions, muddles, angst and riddles (Dervin, 2008). In Pirolli and Card's model (2005), cues are extracted by searching for evidence, information and relations whereas in Snowden's model (2002), they are extracted by probing, sensing and managing patterns.

Russell et al. (1993) provided many insights to sensemakers' abilities to cost-effectively use a combination of mental representations and documents, especially in the face of mismatches, misuse and omission of vital information, all of which are capable of altering or invalidating the meaning of incoming cues, thus triggering further search, reinterpretation and refinement of information representations. Dervin (2008) further recognised the need for bridging the gaps in understanding and, in the process, dealing with subjective views and opinions, emotions and

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feelings, diversities of meaning and plausible outcomes. Pirolli and Card (2005) also emphasised the priority of plausibility over truth; their motives, however, are purely pragmatic as they consider a trade-off between the cost of information seeking and accuracy while searching for, extracting and reusing relevant information, subjecting it to detailed analysis and eventually acting on information cues. Snowden (2002) explained plausibility by highlighting the cyclical disruption of entrained thinking during sensemaking. In Klein's model of sensemaking, the plausibility of information is counter-positioned against its quality, where plausibility is considered the result of human judgment while quality is the outcome of measurement.

Russell et al.'s (1993) original conceptualisation defines sensemaking as a simple and rigid process of transforming information into action. Their model features three processing loops, aimed at information search, representation and use. In each loop, sensemakers (or analysts) follow an ongoing process of making sense of their environment. Pirolli and Card's sensemaking model (2005), however, identifies the need for a more complex iterative process of interlocking loops and information transformation. Klein (2006) addressed the cyclicity of data elaboration during sensemaking. Dervin (1998) took the most extreme view of sensemaking and described it metaphorically as the eternal creation of meaning and its use by communicating individuals moving through time and space in an ongoing life-journey. Finally, Snowden (2002) referred to the ongoing aspect of sensemaking by referring to the continuity of knowledge flow in the community of sensemakers.

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By acting on their environment, people enact their organisation by bringing into existence a variety of organisational structures and events, which in turn continuously shape their own identity and their understanding of the changing environment, and which over a period of time help them to organise their own experiences, bring environmental stability and reduce complexity. In Snowden's (2002) conceptualisation of sensemaking the ultimate aim of this process is to transform information complexity and chaos into clarity, thus reaching understanding and sharing knowledge. Interestingly, Snowden suggested the need to reintroduce chaos and complexity to trigger sensemakers' creativity and pursuit for originality. In each loop of Russell's sensemaking model (1993) enactment occurs indirectly as a search for suitable information representations to support the analysts' cognitive needs, whereas in Klein's sensemaking model a sensemaker enacts through framing and reframing of available data. In Dervin's Sense-Making Methodology, enactment occurs after individuals manage to bridge their mental gaps, thus allowing them to move forward with their plans and activities.

While Weick (1995) claimed that enactment is central in the process of identity creation, he distinguished two distinct perspectives on this process, namely that taken by an individual and that resulting from a concerted effort of the community of individuals in an organisation. Interestingly, Russell (1993) explored the mechanism of organisational learning (via sensemaking); however, he did not consider sensemaking as a concrete organisational process. Similarly, Pirolli and Card (2005) did not recognise the necessity for individuals to enact their work environment in the effort to recreate their own identity. In Klein's view (2006), sensemaking allows personal identity development through a process of improving one's own skills and knowledge, as well as through life-long management of

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knowledge structures. Dervin (1998) used terms such as “situation”, “history”, “experience”, “barriers”, “habits” and “skills” to refer to organisational and individual identity. The enactment process, in Snowden’s conception (2002), is heavily influenced by individuals’ subjective views of the world and the consequent perception of gaps in their understanding, feelings and emotions, as well as by the strategy used to close these gaps. In his view, this understanding leads to new domains of experts and the creation of their communities, the requirement of organisational identity.

Some aspects of sensemaking are not directly mentioned in Weick’s model (1995; 2005), for example the importance of processing cost, which was introduced by Russell et al. (1993) and expanded by Pirolli and Card (2005), who also stressed the significance of information flow and its conversion in different stages of their sensemaking model. Dervin (2008) and Snowden (2002) explored the need for meaning diversity, and Snowden also found benefits in chaos and complexity as means of releasing sensemakers’ creativity. They have also noted a wide range of aspirational targets in sensemaking models, from applications in designing intelligent systems (Klein et al., 2006) and assisting intelligence analysts (Pirolli and Card, 2005), through knowledge management in organisations (Snowden, 2002), to providing guidance for the life-journey (Dervin, 2008).

From the discussion so far it can be concluded that the best known sensemaking model was proposed by Weick (1995). The model provides the most comprehensive framework for studying and understanding sensemaking in equivocal business situations. Alternative models of sensemaking, as reported by other authors, lack the level of sophistication and completeness of Weick’s conceptualisation. For example, Russell et al. (1993) focused on the mechanism of

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organisational learning (via sensemaking); however, they did not consider sensemaking as a concrete organisational process. Pirolli and Card (2005) did not rely on human cognition to capture and process information cues and instead focused on information representation or its flow within an organisation. While Weick (1995) established his model in part on cognitive dissonance theory (Festinger, 1962), unlike other theorists such as Dervin (2008), he derived his concepts from business cases and considers sensemaking to be a practical business problem. He set his focus firmly on people making sense of the structural and social complexity of their organisations, making decisions and acting in an organisational context, especially when faced with equivocal (or confounding) situations. Unlike the works by Klein (2006) and Pirolli and Card (2005), which only focus on how making sense of information and data is achieved, Weick also elaborated on the process within organisations and the communications between individuals which improves both individual and organisational sensemaking. Finally, Weick's framework provides flexibility to address not only individual sensemaking, as Klein et al. (2006) and Snowden (2002) did, but also organisational sensemaking, thus subsuming the features of other models. Consequently, this study will adopt Weick's model to investigate BI in support of sensemaking.

2.1.3 Sensemaking and decision-making

The main similarity between decision-making and sensemaking is that both of their processes are conceptually rich and are intimately related to the human being as an actor who aims to deal with equivocal situations; however, while decision-making is about evaluating alternative courses of action, sensemaking is

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concerned with giving meaning to things that have already happened to sensemakers (Boland, 2008).

Simon used a computer analogy (1957 quoted in Boland, 2008) to explain that decision-making is a type of general problem-solving taking place in a problem domain, which is explored and analysed in search of a solution. In decision-making, as opposed to other kinds of problem-solving, the attention on the future is of primary importance, to the extent that decision-makers “are instructed to avoid the fallacy of considering the past in making decisions” (Boland, 2008, p. 56).

Sensemaking reduces the equivocality of decision-making by giving meaning to what was done before. Weick (1995) pictured sensemaking as an evolutionary process of enactment, selection, and retention (see Figure 1). In sensemaking time and space are treated differently than in decision-making. While sensemaking starts by observing events in the present but pursues meaning in the past, decision-making considers both past and present to consider decisions and actions to be taken in the future (Boland, 2008, p. 58). Decisions are occasionally made and are relatively rare occurrences in comparison to the continuous process of sensemaking (Weick, 1995).

The process of sensemaking is the main attention of this study, however, in some parts decision-making is used to refer to the outcome of this process. Also, this study does not distinguish between sensemakers and decision-makers as BI end users make decisions occasionally during the process of sensemaking by undertaking actions based on BI reports or contributing in shaping BI environment.

2.2 Business intelligence

Previous sections elaborated on sensemaking as a theory that can enhance the use of BI in organisations (see Section 1.1). This section will consequently define the notion of business intelligence (BI) and discuss it from different points of view. Then, the use of BI within the organisation, and in business decision-making, will be discussed. Critical success factors for the use of BI will be also discussed in this section.

In general, BI systems have been shown to facilitate understanding of business issues in the context of decision-making by clarifying and explaining business opportunities and problems (Truxillo et al., 2012); by identifying and quantifying stakeholder needs (Elbashir and Williams, 2007); by helping to determine business objectives and matching them with the resources available (Elbashir and Williams, 2007; Foody, 2009); and by detecting operational patterns and trends via performance indicators (VanDiver et al., 2009). Business analytics, characterised by the extensive use of data, statistical and algorithmic data manipulation, as well as the ability to produce explanatory and predictive models of business processes, can also significantly improve the quality of fact-based decisions and associated action plans (Davenport, 2006). There are several outcomes for pursuing BI and analytics; namely, achieving a competitive advantage, supporting of an organisation's strategic and tactical goals, better organisational performance, informed decision processes and knowledge production (Holsapple et al., 2014). Interestingly, all of these goals are closely tied in with the aims of organisational sensemaking, mentioned in Section 1.1.

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Luhn (1958) provided one of the earliest definitions of BI, which emphasised the support (technological and organisational) for understanding information and its subsequent use to effectively guide business actions toward desired goals. In more recent times, “BI” is used commonly as an umbrella term to describe technologies, applications and processes for gathering, storing, accessing and analysing data to help its users make better decisions (Wixom and Watson, 2010). It is generally understood that to accomplish its objectives, BI needs to possess capabilities such as capturing and storing organisational memory, abilities for data integration, and insight creation and presentation (Sabherwal and Becerra-Fernandez, 2009).

Chen et al. (2012) discussed the evolution of BI and analytics with regard to their key characteristics and capabilities. In their study they used “BI and analytics” (BI&A) as a unified term. Interestingly, along the lines of the research question of this thesis (see Section 1.2), they referred to BI&A’s capacities for understanding organisations, which result in further decisions:

The opportunities associated with data and analysis in different organisations have helped generate significant interest in BI&A, which is often referred to as the techniques, technologies, systems, practices, methodologies, and applications that analyse critical business data to help an enterprise better understand its business and market and make timely business decisions (Chen et al., 2012, p. 1166).

As noted in Section 1.1, this study adopts Chen et al.’s definition of BI, which refers to BI as a “broad category of technologies, applications, and processes for gathering, storing, accessing, and analysing data to help its users make better

decisions”. In their study, analytics is considered as an application of BI and the terms “BI” and “analytics” are used together (making “BI&A”). Consequently, in this study the same approach is employed and the term “BI” entails the use and involvement of analytics. On some occasions, the term “BI and analytics” is used to emphasise on BI techniques and tools that can be used for developing analytical models such as predictive and forecasting one.

2.2.1 Linking decisions with data

Before embarking on BI concepts and models, it is important to explain how this study distinguishes between data, information and insight. Data is used in BI systems to generate information in the form of reports (Demirkan and Delen, 2013). However, within the provided reports for BI end users, insights can be highlighted in various forms such charts, figures or dashboards (Ghazisaeidi et al., 2015).

As organisations base their decisions on available information, it is crucial to ensure that the right information is collected and analysed for supporting business decisions. Davenport (2006) suggested three different levels of relationship between information and decisions; namely, loosely coupled, structured human, and automated (see Figure 7).

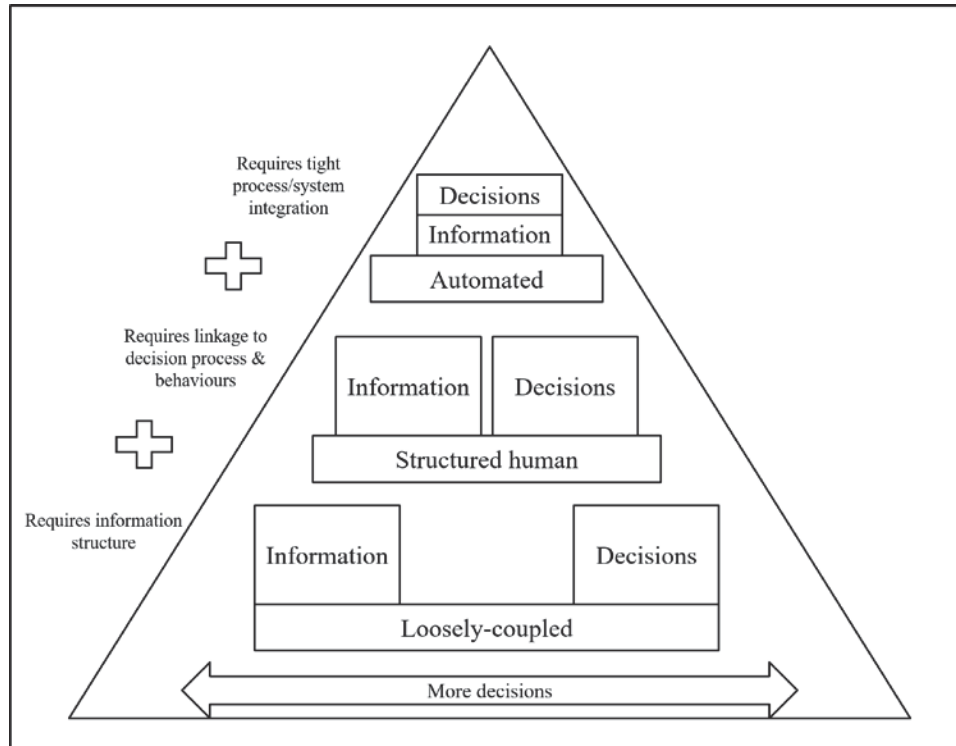


Figure 7: Linking information and decisions (Davenport, 2010)

What differentiates these three levels is the degree of structure in the ensuing decisions. This categorisation is closely coupled with sensemaking and understanding organisations, as the more that information is coupled with decisions the more making sense of organisations will occur by the user of BI. In the first level, information is loosely linked to decisions (see Figure 7). This level characterises most organisational approaches to BI. In such circumstances, the source of data for decision-making is commonly transactional and BI outputs are usually presented in the form of standard reports, scorecards or dashboards. The aim of this level is the provision of information infrastructure that could support organisations with preliminary information for their decisions.

In the second level, which supports a structured human environment, organisations aim at creating an overall decision-making platform that goes beyond establishing an information infrastructure (Davenport, 2010). In such situations,

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organisations aim to align business processes with the required information (see Figure 7). To do so, decision processes are designed by determining what information and process resources are required to make better decisions quicker (Davenport, 2010).

In the third level, the links between information and decisions are the tightest, and decisions can be automated (e.g. with a computer). Decision-support systems can be employed in those circumstances when information can be transformed into decisions in a highly structured fashion, which may involve four components; that is, strategic focus on key decisions, information provision, decision design and decision execution (Davenport, 2010). Figure 7 illustrates that the more organisations move to automated decisions, the more opportunity there is to use information to its fullest for decision-making (Işık et al., 2013). However, this figure does not explain how understanding of organisations occurs in each layer and, more importantly, the role of decision-makers in the automated layer is not clarified.

In line with Davenport's study for linking decisions and information, Hackathorn (2004) highlighted the importance of time taken between the business event and the use of BI-provided information. He defined the action distance as the amount of time that passes to take action based on the event and its collected data. He noted that when the action distance increases, the value of a decision based on the data would be lost. He further introduced three main reasons for action distance; namely, data latency, analysis latency and decision latency (see Figure 8).

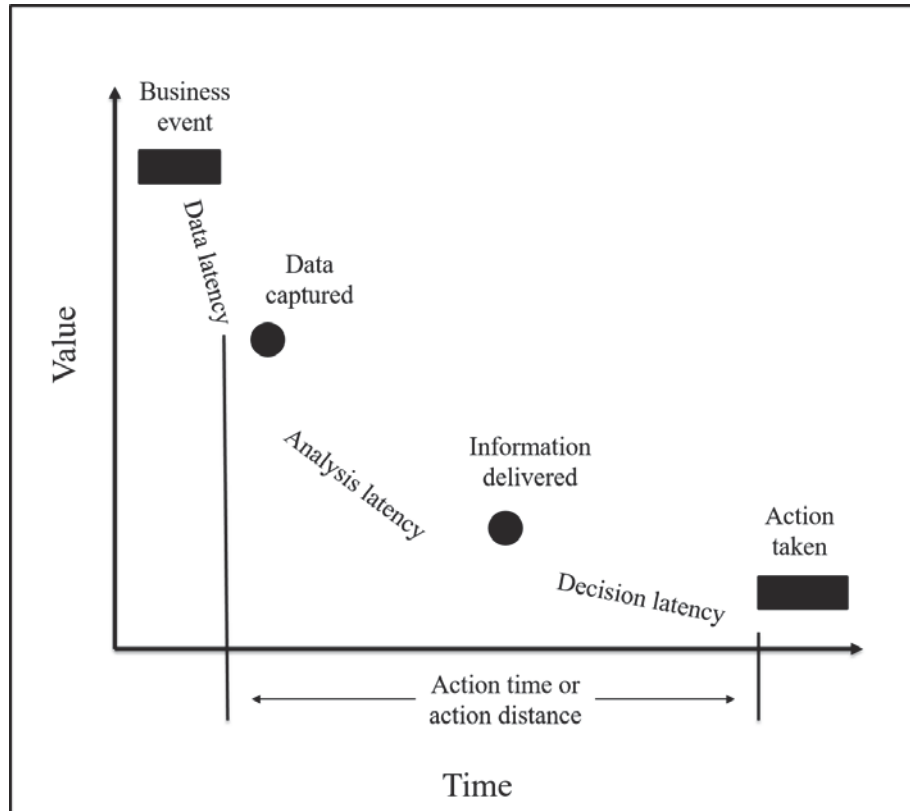


Figure 8: Components of action time (Hackathorn, 2004)

Data latency refers to time taken to collect data and prepare it for further analysis. In modern BI systems, this time can be reduced easily unless the data is low quality, which increases the required time for an extract-transform-load process. Analysis time refers to the time that a data analyst requires to prepare reports or generate analytical models. Finally, the decision time denotes the required time for decision-makers to take action based on the provided BI reports or models.

Watson (2009) further explained that while data and analysis latency can be reduced through the use of real-time BI, decision latency is more challenging as it mainly depends on the BI end user's action. While Figure 8 highlights the importance of quick actions based on BI reports, it does not show the feedback loops between decision-making and data analysis. Indeed, it lacks enough

elaboration on the required time for collaboration between decision-makers and data analysts. As data-centric organisations mainly use BI in an evolutionary approach, with several feedback loops between decision-making and data analysis (Krawatzek and Dinter, 2015), this model needs further improvement to show the fundamental requirements for understanding organisations over an extended period of time that can eventually result in quality decisions.

The following section will elaborate on the various elements of a generic BI environment, and will explain the position of analytics in current BI systems.

2.2.2 The BI environment

A generic BI environment, which is applicable for enterprise-wide BI, is best illustrated with the model adopted by Watson (2009). The model (see Figure 9) uses several source systems which are responsible for the collection of data from the business environment, so that it could later be used to support decision-making processes. In modern organisations, big data, with its three characteristics, volume, velocity and variety, (Laney, 2001 cited in Clarke, 1992), can also be new way of creating a retrospective view of organisations. The available data is processed and prepared for use in data marts and data warehouses with the use of data integration technologies. A variety of architectures, technologies and data models such as multidimensional data modelling can be used in data warehouses. Also, different tools and applications, such as dashboards and predictive analytics, could be employed by the BI end users to use the available data. Finally, metadata, which describes the structure and content of the collected data, data quality and

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governance processes must be in place to ensure BI meets its planned commitments. The following elaborates on various elements of this model.

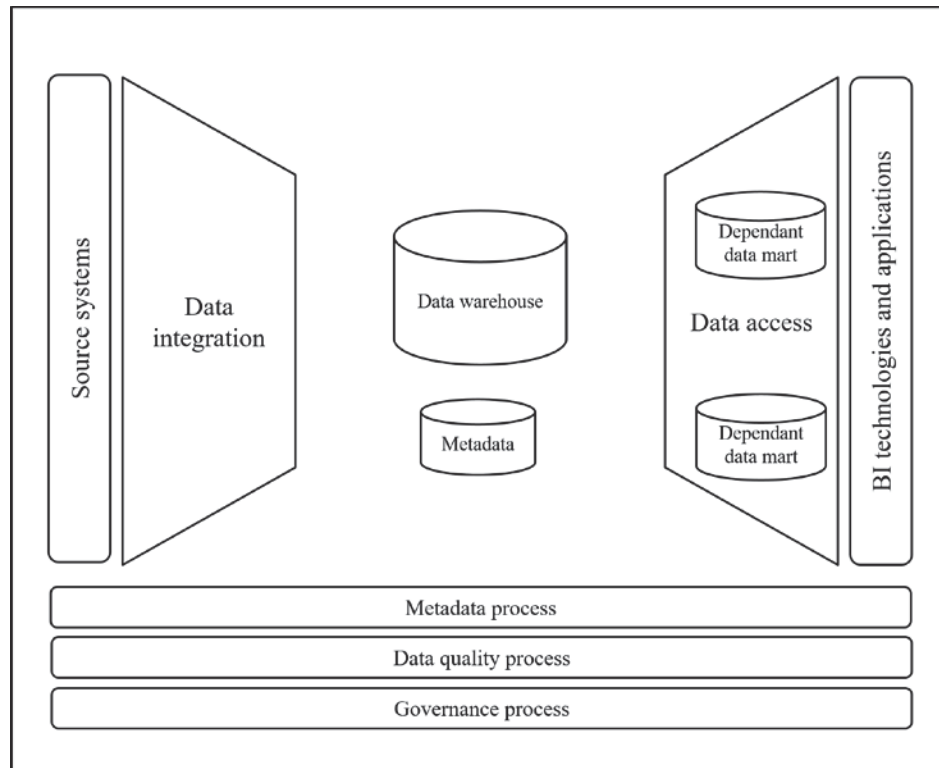


Figure 9: A generic BI environment (Watson, 2009)

Source systems: BI includes various source systems such as enterprise resource planning (ERP), operational systems (Zhu and Lin, 2012), social media data (Weinberg et al., 2013) and external data (Ramakrishnan et al., 2012). However, modern BI tools try to capture and use even more data types such as radio-frequency identification (RFID) tags, used for automatic product identification to support business transactions (Chongwatpol, 2015). Different platforms such as Oracle are used to store data in different formats. As source systems usually contain missing or incorrect data and are poorly documented (Watson, 2007), for BI development, data should first be integrated and quality issues should be addressed (Popovič et al., 2012).

Data integration: the available data is processed and prepared with the use of data integration technologies for storage in enterprise databases (such as data marts and data warehouses). This is done by an extract-transform-load process. Data can be extracted by hand-written code or by data integration software (Deufemia et al., 2014). Then, following business rules, the data should be transformed to more useful formats. Also, some aggregations may be performed. Finally, data from various sources should be loaded into the warehouse. This step is the period of time for loading new data in the warehouses (Khan and Quadri, 2012).

Storing data: a variety of architectures, technologies, and data models such as multi-dimensional data modelling can be deployed for designing data warehouse. BI has its roots in the information management field which relies greatly on data collection, extraction, and analysis technologies (Chaudhuri et al., 2011). Data warehouses as enterprise-wide data repositories are usually designed based on two competing architectures for data warehousing, recommended by two well-known authors in this field (Breslin, 2004), Inmon (Inmon and Hackathorn, 1994) and Kimball (Kimball, 1998). The development of the data warehouse architecture begins with the identification of business requirements (Inmon, 2005) for a specific business process, such as billings or deliveries orders (Kimball and Ross, 2011). Using this enterprise view of data, the architecture is developed in an iterative manner (Watson, 2007). The dependent marts, which are either physical in a separate server or logical (Inmon, 1996) with a new view within the warehouse, are then created from the developed data warehouse. Since the data is extracted from a single data warehouse, a single version of truth within different departments and applications will be maintained. The dependent data marts can be developed

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for a specific application, such as predictive analytics, for a specific department or for a specific function.

Metadata is developed during the data warehouse development and used by both data analysts and BI users to gain an understanding of data. Data analysts use metadata to know about the overall structure of data warehouse and data models (Foshay et al., 2007). For example, they use information about mapping of data flows from source to applications and logic of data transformation and business rules. BI end users also use metadata for various purposes, including detailed descriptions of the available data and the level of access to specific data and reports (Watson, 2009).

Data quality is one of the longstanding issues for using BI within organisations. Source data systems usually reveal several problems, including dummy values, missing data or multipurpose fields (Redman and Blanton, 1997). Using special software, data quality problems could be resolved from the source systems to benefit from that in long term. However, sometimes the business units that own the data should be persuaded that there is value in spending resources to correct problems (Shanks and Corbitt, 1999). Although it is very challenging, data quality must be assured, otherwise the usefulness of BI within organisations will be significantly affected (Watson, 2007). In this line, high-level executive sponsorship and data governance is required to consider data as a strategic resource, and one that should be treated accordingly. Several other considerations should be taken into account to improve data quality; human resources should be trained and educated to leverage their interaction with source systems (Shanks and Corbitt, 1999) and processes should be put in place to deal with this regard (Laudon, 1986). Finally, it is important to note that high data quality doesn't necessarily mean

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complete accuracy and “quality is relative to business need and user expectations” (Watson, 2009, p. 409).

BI governance is commonly defined across a broad scope of activities. At the operational level, it makes sure data quality issues and metadata are addressed. At the tactical level, it helps to ensure that BI delivery is on time and schedule. At the strategic level, it tries to ensure the alignment between BI efforts and an organisation’s objectives and strategies (Watson et al., 2004).

The above discussion elaborated on the model of BI environment proposed by Watson (2009); however, organisations employ all or part of the mentioned elements in a BI environment based on their requirement and capabilities. To use BI to its fullest, and especially for the continuous understanding of organisations, inevitably a high level of BI maturity is required. Eckerson (2004) uses a metaphor of the human life cycle, and includes six stages of BI growth and improvement. The stages are characterised and defined by a set of organisational characteristics, including BI scope, analytic structure, executive perceptions, types of analytics, stewardship, funding for BI, available technology platforms, and change management and administration (Eckerson, 2004). In the prenatal stage, the retrospective view is achieved by generating some standard set of static reports through management reporting systems. Reports are usually printed and distributed regularly to large numbers of employees (Eckerson, 2004). In such settings, the IT department cannot respond rapidly to management’s needs for custom reports, as the reports are hand-coded against legacy systems. In the infant stage, there is no data mart; instead, spreadsheets or desktop databases are used. In this stage, each data source includes a distinctive set of data that do not integrate with other spreadsheets, management reports or analytical systems. In the child stage,

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departments identify the necessity of providing business analysts and executives with integrated data from various sources. Data marts are, therefore, created to integrate data and provide decision-makers with timely information and insights. In the teenager stage, a shared definition of data is created within the organisation to avoid data inconsistency between various departments. In the adult stage, although many benefits are delivered by the data warehouse, analytic capabilities are still not used to their fullest. Finally, in the sage stage, the data warehouse is a strategic enterprise asset that drives the business with critical applications (Eckerson, 2004). Wixom and Watson (2010) further added that in BI-based organisations, BI systems are well-established, used organisation-wide and used in mission critical tasks. BI-based organisations are fully transformed toward effective use of analytics (Wixom and Watson, 2010) and can be placed in the adult and sage stage of Eckerson's maturity model (2004). To use BI for understanding organisations and making data-centric decisions, organisations need to be fully transformed. This means, they should fundamentally change their way of operating by taking advantage of business data. They have to focus on supporting and enabling a "new strategic business model" (Wixom and Watson, 2010, p. 17) that is aligned with BI, and "make high level of commitments" (Wixom and Watson, 2010, p. 17) for using BI in their strategic decisions.

Users, tools and applications: once a data warehouse is deployed, different tools and applications, such as dashboards and predictive analytics, could be employed to use the available data. Chen et al. (2012) outlined the characteristics of common BI technologies in industry. In these systems, structured data is collected through several sources, and often stored in database warehouses. Data warehousing and management is considered as the foundation. Ad-hoc queries,

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online analytical processing, reporting tools and visualisation tools are used to illustrate required information. Business performance measures are provided using dashboards and scorecards. Dashboards are mainly used to present key performance indicators (KPIs) with easy-to-understand visuals (Frolick and Ariyachandra, 2006). Most modern BI tools support interactive dashboards that can be manipulated by BI end users. Along with reporting functions, the BI systems use data mining and statistical analysis techniques for providing various analyses, including classification, segmentation, association analysis and regression analysis (Jourdan et al., 2008).

In advanced BI systems, user interaction with the organisation is collected in the form of user logs (Hu and Cercone, 2004). Details of user search and interaction with websites have become a “new gold mine for understanding customers’ needs and identifying new business opportunities” (Chen et al., 2012). The unstructured data from social media (Doan et al., 2011) is a new area for BI and analytics. Huge amount of data about products and customers can be gathered from the web, and organised and visualised through various text mining techniques (Kosala and Blockeel, 2000). Analysing customer clickstream data can assist organisations to extract their customer’s online activities (Hu and Cercone, 2004). Product placement optimisation and product recommendations can be enhanced through web analytics (Cho and Kim, 2004). In addition, Web 2.0 applications can collect timely feedback and opinions from customers for different types of products and businesses (Pang and Lee, 2008). In fact, social media analytics provides organisations with a unique opportunity to initiate a “conversation” with their customers, instead of the traditional one-way marketing that does not consider contributes customer feedbacks (Lusch et al., 2010).

Mobile analytics is also used for collecting, processing, analysing and visualising large amounts of customer data. Mobile devices are transforming the way communications accrue in various sectors from education to healthcare and from entertainment to governments (Kim et al., 2008). This device, when connected to the internet, can support location-aware services which offer unique opportunities for BI end users. Mobile interfaces, visualisation and human-computer interaction design, when combined, facilitate the use of modern BI tools for decision-making. Although mobile BI is not included in current BI platform core capabilities, it is considered as an emerging trend in the area of BI that has the potential to improve the use of BI in the market (Bitterer, 2011).

2.2.3 Success of BI within organisations

According to Abai (2006), in data-centric organisations, data is considered an organisational asset, IT and business work in unison, data quality is the first priority, and data is disseminated uniformly throughout the organisation. To better understand the nature of BI-based organisations, Davenport (2006) proposed a layered view of BI architecture, which includes a variety of tools for data management, presentation and use. Davenport (2006) asserted that organisations can use BI to increase their competitiveness provided that a number of critical organisational prerequisites are satisfied; namely, business processes, executive support, fact-based decision-making and development of user skills. Davenport (2006) further explained the organisation's requirements for moving toward analytics to actually competing on analytics. In his view (1) effective information systems and effective analysis should be applied to core business capabilities and also to a range of business functions such as marketing and human resource

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services; (2) the senior executive team should recognise the importance of using BI and analytics capabilities and also should make acquisition and use of such capabilities a primary focus; (3) fact-based decision-making should be treated as best practice and also as a part of the organisational culture, which has to be constantly emphasised and communicated by senior executives; (4) organisations should hire individuals with analytical skills and they should be considered as critical contributors to the organisation's success; (5) organisations ought to consider BI and analytics as strategically important, and something that makes crucial impacts at the enterprise level on decisions; (6) organisations should invent proprietary indicators based on available data for use in key business processes; (7) organisations should share their data and its analysis with their customers and suppliers; (8) organisations should grasp every opportunity to generate information along with utilising existing data; (9) organisations should have established long-term analytics to be able to adopt new trends in BI and analytics for their competitive advantage and; (10) they should make analytical abilities part of their intellectual capital, presented in annual reports along with their financial capital.

Davenport (2006) stressed that commonly, when companies wish to compete on analytics, they are concerned primarily about technological tasks for data collection and integration, storing data in warehouses, implementing analytic tools, and providing the required infrastructure. However, organisations will also have to recruit people with the knowledge of how to use data in making sense of the organisation and further decision-making. Existing employees will also need to learn analytics approaches for data analysis, reporting and acting on those reports.

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LaValle et al. (2011) classified organisations who use BI based on their analytics power and the level of their analytical capabilities; namely, aspirational, experienced and transformed. The main difference between these stages is the influence of analytics on organisational decisions. While at the aspirational level, analytics is used for justifying actions, at the experienced level analytics is used for guiding actions. At the transformed level, however, organisational needs are understood and actions are prescribed with the use of analytics. Based on a worldwide survey of more than 3000 participants from more than 30 industries, LaValle's team concluded that BI-based organisations are at the transformed level and they demonstrate the highest level of analytical capability compared to aspirational and experienced levels. They compared and contrasted the characteristics and requirements of these levels from different points of views, namely, their motivation, functional proficiency, business challenge, key obstacles, management and actions. They indicated that if organisations aim at using BI and analytics for understanding the business environment, they need to fulfil certain requirements. For instance, insights should be shared effectively between various BI end users, which means the right information should be delivered to the right person. Organisations also need to use BI and analytics not only in everyday operational decisions, but BI's extracted insights should also be used in strategic decisions. LaValle's team further mentioned that the main impediments to organisations becoming BI-based are individuals' lack of BI skills and the lack of organisational culture of reliance on BI as a tool for decision-making.

As the implementation of a BI system is a complex task requiring considerable resources (Yeoh and Koronios, 2010), the success of implementation and adoption of BI needs to be measured; critical success factors were suggested as

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one way of achieving this aim. Daniel (1961) first introduced the need for clarifying success factors in different business domains. He mentioned that success factors are at the macro level and each industry would have three to six crucial success factors. Organisations, therefore, need to identify these factors to succeed in their business goals.

Shanks and Bekmamedova (2012) argued that dynamic capabilities and analytical capabilities lead to business value and enhanced competitive advantage. Through a case study, they exposed the importance of embedding analytics systems within the organisation at five levels. First, a high-quality technology and data infrastructure was found to be of critical importance in providing valuable insights and embedding analytics systems into the operational systems of the enterprise. Second, analytics systems should be firmly aligned with business processes. Third, they need to be coupled with BI end user decisions. Recruiting people with mixed skills in analytics, business and communication is also of crucial importance. Fourth, analytics systems should be aligned with business strategy and its development. Finally, they should be embedded into capability renewal procedures.

Holsapple et al. (2014) noted that organisations need to employ evidence-based problem-solving approaches to use BI and analytics for understanding the business environment. At the individual level, a suitable capability set is needed. Without the required capability, BI and analytics will fail to leverage decision-making within organisations (Holsapple et al., 2014). Also, even if these capabilities exist within the organisation, they should be applied in a consistent, committed, coordinated and focused way. Otherwise, a robust set of competences to use for business analytics will be relatively unsuccessful. Consequently, a solid

alignment between an organisation's BI aims and its set of business analytics capabilities is required (Holsapple et al., 2014). They noted that a transformational process is needed to align organisational capabilities and BI and analytics goals. This alignment works in two ways; first, a BI process for transforming evidence into decisions may be planned depending on the business analytics competences. Then, the transformational design can inform the competences structure, by identifying capability requirements (Holsapple et al., 2014).

The discussion so far clarifies the need for organisations to consider a variety of technological and structural requirements to use BI for understanding their business environment and making further actionable decisions. It explained that the diversity of these needs from data requirement to communication skills and management support. The most common success factors in the proposed models are high-quality data, the alignment of BI and business processes, and technical and communication skills of BI developer and end users. In the next section, the strengths and weaknesses of BI in supporting sensemaking, as the precursor to making quality decisions, will be explored. This will be done by addressing the previously reviewed properties of organisational sensemaking.

2.3 Sensemaking in the BI literature

The main objective of this study is to explore how BI technologies could assist decision-makers to engage in a continuous process of sensemaking with a view to gaining insight into their business environment (see Section 1.2). Previously reported BI tools and systems, as well as their use in organisational settings, are certainly capable of supporting the selected aspects of the sensemaking

process. It will, however, be shown that there are significant gaps in BI capabilities to effectively aid sensemakers. To this end, the seven properties of Weick's model of sensemaking (1995; 2005) will be compared and contrasted with the features of existing BI technologies to highlight their strengths and identify their weaknesses.

Weick's model of sensemaking (1995) defines an organisational process of continuous insight generation, which can be characterised by seven properties (see Section 2.1). Remarkably, a variety of components of BI could be readily mapped into the properties of organisational sensemaking. The following sections will discuss how the extant literature of BI addresses the seven properties of sensemaking.

2.3.1 Retrospection

Sensemaking is retrospective, meaning that the sensemaker looks back and reviews events or situations that make sense in respect of the current situation. In a broader view, retrospection is the space of what is known and what is knowable (Snowden, 2002). Pirolli and Card (2005) and Klein et al. (2006) consider data acquisition and creation of data repositories as essential for referring to past events (see Section 2.1.2). In the context of technological support for retrospection, BI systems are eminently suited to the task as they efficiently process vast amounts of structured data about an organisation's past events, transactions and situations (Wixom et al., 2014). Large volumes of data generally enhance retrospection and create new opportunities for organisational change and improvement, as well as facilitating trend predictions (Russom, 2011). Not surprisingly, all such historical

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accounts could facilitate retrospective views of an organisation and may thus provide active support for sensemaking.

BI makes use of historical data to promote organisational-wide understanding of products, services and customers (VanDiver et al., 2009), business processes (Briggs, 2009; Golfarelli et al., 2004), benchmarking (Smietana, 2010) and so on. Modern BI tools also employ unstructured data, such as text drawn from websites and social media, to form a retrospective view of the organisation and its larger social context (Negash, 2004).

Different aspects of retrospection are discussed in the BI literature; namely, organisational objectives, timeliness, changes to data structures and data quality requirements. The purpose of capturing past events for business has been elaborated by VanDiver et al. (2009), who discussed the integration of customer data (for future leveraging of the data) with BI tools. In addition to data integration, Smietana (2010) briefly mentioned the use of BI analysis and results, together with benchmarking information, for determining the position of the organisation in a competitive market. The notion of retrospection is intrinsically linked to the quality of historical data. In fact, Briggs (2009) highlighted the challenges of ensuring data quality during BI implementation (e.g. in a hospital setting), which usually requires the time consuming process of ETL (Extract-Transform-Load) (Cheng et al., 2009; VanDiver et al., 2009).

Negash (2004) emphasised the use of unstructured data, such as text, which is essential in retrospection for a modern business environment. Smietana (2010) further highlighted the role of external data for a full understanding of a business and its operation in a larger market context; in particular he was able to show how

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a more complete understanding of a supply chain could be achieved by manipulating external data about weather and commodity prices. Strenger (2008), however, raised concerns about the age of data used in the creation of a retrospective view and emphasised on the importance of contemporaneity and up-to-date data stored and managed in data warehouses. For example, for strategic purposes data should have a longer shelf life and be of archival value, while for operational purposes data should be live, updated and analysed real-time (Strenger, 2008). Table 2 summarises different BI elements that assist in the provision of a retrospective view of an organisation.

Table 2: Retrospective aspects of BI in the literature

	BI aspects	Authors
Purpose	Benchmarking	Smietana, 2010
	Integrated view	VanDiver et al., 2009, Briggs, 2009
Age of data	Historical data	Strenger, 2008
	Live and Up-to-date data	Strenger, 2008
Type of data	Data warehouse/ data mart	Briggs, 2009; Golfarelli, 2004; Negash, 2004
	Unstructured data (e.g. data from social media)	Negash, 2004
	Big data, external Data	Smietana, 2010; Strenger, 2008; Negash, 2004

2.3.2 Social aspects of sensemaking

Sensemaking is a social phenomenon, such that making sense of the environment is never a solitary activity. It “occurs between people, as meaning is negotiated, contested, and mutually constructed” (Maitlis and Christianson, 2014, p. 66). Weick explained (1995) that sensemaking is a social activity that deals with communication of organisational “stories”, assessing their plausibility,

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preservation, retention and sharing (see Section 2.1.2). In organisations, sensemaking happens in the context of self-organising communities of experts, who engage in the collective processes of learning, knowing and self-awareness (Snowden, 2002). In the context of BI, access to shared data repositories, which are often growing rapidly and continuously, commonly requires a concerted team effort in their management, analysis and understanding (Stoodley, 2012).

As management of large organisational units often requires a broad range of knowledge and experience, the real power of modern-day BI and analytics actually lies in the collaboration among the users of this technology (Stoodley, 2012). This is especially pronounced in those cases when a broad spectrum of information could be leveraged by a large number of BI users or stakeholders across the organisation (Imhoff and White, 2010) and where the interactions among BI users, their communications and collaborations are directly facilitated by modern BI systems. Typically, such interactions occur through distribution of live and interactive reports for feedback and action, sharing of comments and opinions on these reports, messaging between contributing parties and circulation of reports within and without the business community (Briggs, 2009; Smietana, 2010).

There exist various tools and services that provide a platform for social interaction in BI spaces. These include online collaborative tools and portals, mobility and cloud services, as well as active reporting and interactive content management systems for engaging BI users. The power of analytics lies in user collaboration, especially when BI-provided information is leveraged across organisational boundaries (Stoodley, 2012). In fact, when different stakeholders put their minds together to create new ideas and innovative approaches, organisations derive tangible benefits (Stoodley, 2012).

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As Stoodley observed, collaboration and communication between geographically dispersed BI users bring benefits in the form of streamlined services to customers and reduced costs (2012). The notion of providing collaborative functionality in BI is further supported by Imhoff and White (2010), who identified different collaborative tasks that positively impact the maturity of BI environments. These included sharing of data, reports, ideas, query tactics, techniques, insights and best practices (Imhoff and White, 2010; Smietana, 2010; Stoodley, 2012). The use of emails and mobile messages, could further improve communication and interactivity for BI users (Briggs, 2009; Smietana, 2010). In addition, Watson (2008) discussed the potential of social networking for the new generation of BI users. Table 3 summarises different BI interaction methods and tools in support of social aspects of organisational sensemaking.

Table 3: Social aspects of BI in the literature

BI aspects	Authors
Sharing and circulating reports	Imhoff and White, 2010; Stoodley, 2012
Notifications	Smietana, 2010
Mobile BI	Smietana, 2010; Briggs, 2011
Cloud BI and online communities	Watson, 2008
Interactive BI	Smietana, 2010; Briggs, 2011

2.3.3 Cue extraction

Sensemaking is focused on cues extracted, such as issues, events, or situations for which “the meaning is ambiguous and/or outcomes uncertain” (Maitlis and Christianson, 2014, p. 70), from the organisational context to help sensemakers determine current and relevant information. Weick (1995) attached primacy to a person’s ability to plan actions by continuously sensing environmental

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cues and deriving meaning from their relationships and structures. The nature of cues is often considered very broadly, to include mismatch, omission and misuse of data or its representation (Russell et al., 1993), or gaps, questions, confusions, muddles, riddles and angst (Dervin, 2008). Cues can be extracted by searching for evidence, information and relations (Pirolli and Card, 2005), by probing, sensing and managing patterns (Snowden, 2002), or by self-reflecting on atomic meanings and their combinations, with a view to tracking semantic anomalies and detecting inconsistencies (Klein et al., 2006) (see Section 2.1.2). Indeed, BI technology can assist decision-makers and other organisational stakeholders in monitoring the flow of business data, alerting users to important changes in their environment and supplying the relevant information to make sense of evolving business situations. This is achieved with automatic generation of insights from the collected data for the purpose of identifying business problems, strategy gaps, emerging opportunities or activity patterns (Davenport, 2010). Insights themselves are communicated to decision-makers in a variety of forms, such as interactive reports, alerts, dashboards or scorecards (Davenport, 2010; Wixom and Watson, 2010).

Table 4: Cue extraction aspects of BI in the literature

		Authors
Purpose	Performance monitoring	Negash and Gray, 2008; Amburgey and Yi, 2011
	Gap and opportunity identification	Watson and Wixom, 2007
BI tools and techniques	KPIs	Lönnqvist and Pirttimäki, 2006; Elbashir et al., 2008
	Metrics, scorecards	William and William, 2003; Elbashir et al., 2008; Negash and Gray, 2008;
	Patterns and insights	VanDiver et al., 2009
	Alerts and notifications	Negash and Gray, 2008; Rouibah and Ould-ali, 2002

BI tools also can potentially identify and sense problems, gaps and opportunities in organisations and notify BI end users about them via alerts (Negash

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and Gray, 2008a). There have been several studies to demonstrate methods of BI insight generation and their applicability (e.g. Elbashir et al., 2008; Lönnqvist and Pirttimäki, 2006; VanDiver et al., 2009; Williams and Williams, 2003). Amburgey (2011) reported the application of a BI system to determine the likelihood of academic success for first-year university students, as well as their ongoing monitoring, with a consequent reduction in failure rates. For example, in this case, a change in student population demographics can be considered as a cue which provides the “prompt for sensemaking about different aspects of environmental uncertainty” (Milliken’ (1990) reported in Maitlis and Christianson, 2014). In addition, Lönnqvist and Pirttimäki (2006) outlined some of the main uses of BI performance measurement tools within organisations. According to them, the main uses of these tools are (1) translating organisational strategies into tangible objectives; (2) communicating these objectives to staff and; (3) monitoring progress toward achieving the objectives. VanDiver et al. (2009) also showed that customer behaviour patterns can be monitored via performance indicators. Table 4 summarises different concepts and their examples with regard to cue extraction in BI literature.

2.3.4 Plausibility

Sensemaking relies on plausibility rather than accuracy of observations and predictions, and occasionally the priority of plausibility over truth is also motivated by a trade-off between the cost of information-seeking and accuracy while searching for, extracting and reusing relevant information (Pirolli and Card, 2005) (see Section 2.1.2). In BI systems, availability of vast volumes of past data can be used not only for the creation of reports summarising historical events, but more

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importantly for prediction of future situations and events useful in considering alternative business scenarios, understanding existing and potential risks, as well as assessing the outlook of the organisation's future. In all such cases, accuracy of prediction is measured in terms of the system's ability to identify and evaluate many possible outcomes (Fayyad et al., 2008). A combination of mathematical models and machine-learning techniques for exploratory, predictive and optimisation purposes, often referred to as "advanced analytics", along with the access to good quality data, could assist managers to better evaluate their decision options, and thus become more effective decision-makers (Wixom and Watson, 2010).

BI systems provide plausible descriptions of different business scenarios and provide various outcomes for understanding organisational risks. What-if analysis, as a component of BI systems, can be used for modelling different business scenarios (Azvine et al., 2013); for example for operational risk management in enterprises, or forecasting supply and demand in supply chain management (Smietana, 2010).

BI systems rely on analytical investigation of the existing data using various machine learning or analytic techniques. These outputs assist BI end users in making plausible decisions that rely on predictive models. Machine learning and statistics methods and techniques can be employed to create a model which assists decision makers in making plausible decisions in different application domains. For example, they are widely used in health-care sectors for predicting medical transcriptions (Olinsky and Schumacher, 2010), or for predicting potential students enrolments or students' performance (Amburgey and Yi, 2011) in the field of

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higher education. In addition, the concept of fuzziness plays a role in BI systems for plausible decision-making. Applications of fuzzy technology in BI can be used for fraud detection in various sectors including insurance, air freight and financial services (Meyer and Zimmerman, 2011). Table 5 summarises the types of plausible modelling.

Table 5: Plausible aspects of BI in the literature

BI aspects	Authors
Fuzzy technology	Meyer and Zimmermann, 2011; Olinsky and Schumacher, 2010; Smietana, 2010
Prediction	Olinsky and Schumacher, 2010; Amburgey and Yi, 2011
What-if scenario	Smietana, 2010; Azvine et al., 2007
Risk	Azvine et al., 2007

2.3.5 Ongoing

Sensemaking is an ongoing process in which individuals shape and react to the environments they face. In this line, real-time BI provides decision-makers with ongoing data and analytic support that offers continuing access to changes in the business environment. In many industries, such as communications, manufacturing, aviation and defence, the effectiveness of decisions hinges on access to real-time data and analytics. In fact, real-time processing plays a critical role in BI systems, especially for operational and process-centric applications (Azvine et al., 2013; Negash and Gray, 2008b; Smietana, 2010; Wixom and Watson, 2010). For strategic business objectives, data needs to have a long life-span and eventually turn into historical data whereas, for operational objectives, data needs to be live, and updated and analysed on the fly (Strenger, 2008).

BI technologies can provide end users with ongoing access to business changes via continuous real-time reporting. The integration of BI services with

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business processes can enhance process-centric aspects of BI systems (Marjanovic, 2010) required for ongoing use of BI at operational level (Elbashir and Williams, 2007). However, as Golfarelli et al. (2004) noted, BI systems that are business-process driven require a unique design that is able to support management of not only data and analytics, but also of business processes themselves. Furthermore, BI users can also be treated as the part of an ongoing process (Foody, 2009), which may call for the user-centric architecture of BI, to allow cyclical and sequential process of exchanging data between users and BI systems. Cyclical BI processes are also discussed by Rouibah and Ould-ali (2002), who described iterative stages of business cue identification, their analysis, and turning them into actionable information for strategic decision-making.

The use of BI for extracting real-time data is wildly adopted in various domains including supply chain operations in healthcare (Smietana, 2010), coordination in the airline industry (Wixom and Watson, 2010), risk management in banking (Azvine et al., 2013) and manufacturing of digital products (Negash and Gray, 2008b). Using ad-hoc features of BI tools, end users can use query languages for pulling out their required data from data warehouses (Negash and Gray, 2008b). Ad-hoc queries are of crucial importance in BI systems especially in process-centric BI systems. Table 6 summarises the ongoing aspects of BI in the literature.

Table 6: Ongoing aspects of BI in the literature

BI aspects	Authors
Continuous reporting	Marjanovic, 2010; Golfarelli et al., 2004; Foody, 2009;
Ad hoc and issue-based reporting	Negash and Paul, 2008; Smietana, 2010
Iterative reports	Foody, 2009; Rouibah and Ould-ali, 2002; Elbashir and William, 2007
Evolution in BI reporting	Foody, 2009; Hallikainen et al., 2012
Real-time reports	Smietana, 2010; Azvine et al., 2007; Negash and Gray, 2008

2.3.6 Identity creation

Sensemaking is grounded in identity construction, which means that sensemaking depends on how sensemakers describe and perceive themselves (see Section 2.1). Weick (1995) claimed that enactment is central in the process of identity creation and identified two distinct perspectives on this process, namely that taken by an individual and that resulting from a concerted effort of the community of individuals in an organisation. There is very little direct insight reported on how BI and its analytic capabilities could assist sensemakers in defining and understanding their own role in the organisation (Namvar, 2015; Namvar et al., 2016; Namvar and Cybulski, 2014). In fact, BI as a technology is unable to create an identity for BI users and organisations. However, the necessity of creating BI identity for fact-based decision-making is emphasized in the literature. In the following, various aspects of individual and organisational identity required for using BI will be discussed from the point of view of various authors.

The identity of BI users could be discussed in terms of an individual BI user, who adopts an individual perspective, or a group of BI users with holistic or unified perspectives that represent an organisation. Skills, experience, personality and

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knowledge of BI user can represent their identity while using BI systems (Hasan and Hyland, 2001; Negash and Gray, 2008b; Nemati et al., 2010). Interestingly, Coghlan et al. (2010) identified several individual skills and abilities from the perspective of employers, including computing skill, analytical skill, business knowledge, and an ability to translate business needs and strategy into BI problems. The identity of individuals could also be portrayed through their management style of either trusting data while making data-driven decisions or not trusting available data and relying on their intuition and gut feeling in decision-making (MacKrell and van den Boogaard, 2012; Stoodley, 2012). As usually the final decision on using BI reports will be made by BI decision-makers (Marjanovic, 2010), knowledge and cognitive skills such as reasoning are particularly important and required. Therefore, the knowledge of individuals also influences interaction with the BI system and subsequently affects knowledge creation (Glancy and Yadav, 2011). Steiger (2010) discussed improving the quality of decision-making in relation to individuals' knowledge creation, in which their mental models are challenged, modified and eventually new experiences or knowledge could be accumulated.

Watson (2007) discussed BI users' resistance towards BI due to unwillingness to give up existing tools or to learn BI. Such resistance could be associated with the mental model discussed by Steiger (2010), where an individual's mental model was not ready for modification and knowledge creation.

On the other hand, the BI identity of organisations involves a broader context that encapsulates aspects of business strategy, scope, culture, openness to technological change, structure and willingness to share knowledge and

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governance. In fact, competitive advantage could be achieved through ceasing of opportunities and aligning of business strategies with business processes (Coghlan et al., 2010; Davenport, 2010; Hallikainen et al., 2012; Watson and Wixom, 2007; Williams and Williams, 2003).

It is important for organisations to outline the scope of the BI problems that they encounter. For instance, Glancy and Yadav (2011) discussed the scope of BI in terms of issues that are external to the organisations (e.g. the global market, competitors, general public, government regulations and other global issues) and issues that are focused internally in organisations (e.g. customer feedback, business performance, organisational risks and other organisational issues). The identified BI scope by organisations could have some impact on the organisational culture, which is another example for portraying group identity and the study of relationships between BI systems and organisations, as discussed by Davenport (2006), Stoodley (2012), Watson and Wixom (2007) and Wixom and Watson (2010). Organisational culture is one of the critical factors in guaranteeing the successful implementation of BI in organisations. For instance, factors such as the beliefs of senior management and the users' motivations to use information and analytics contribute to shaping the organisational culture toward the adoption of BI. In fact, for the adoption of BI, LaValle et al. (2011) outlined three stages of BI (or analytics) adoption, which were derived from an organisation's capabilities for the three different purposes; namely, justifying actions, guiding actions and prescribing actions for organisations. From the view of organisational structure, various functional units or departments will have different levels of involvement with BI. For example, the variety of BI users studied by Nemati et al. (2010) exhibited a

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spectrum of involvements in BI depending on their roles in the organisational structure.

Other aspects of group identity include how data captured by BI is governed and how data and created knowledge are shared in an organisation across different levels. Respectively, Wixom and Watson (2010) provided an example of effective BI governance that shows a dynamic and multi-level structure, and Imhoff and White (2010) provided the stages involved in collaboration in a BI environment.

Although various aspects of BI identity was discussed in above, no significant work was found in the literature of BI that indicate how this identity could be created and how it is related to other aspects of organisational sensemaking.

2.3.7 Enactment

Sensemaking is about enactment. “Feature of sensemaking concerns the action that people take to make sense of a situation which, in turn, enacts the environment that they seek to understand” (Maitlis and Christianson, 2014, p. 67). Sensemakers often construct and influence part of the environment they face, which either empowers them or constrains their actions (see Section 2.1). In turn, the environment shapes the identity of sensemakers and determines their interpretation of situations. By acting on their environment, people shape their organisations by bringing into existence a variety of organisational structures and events, which in turn continuously alter their own identity and their understanding of the changing environment. BI systems have a very limited repertoire of facilities capable of supporting individuals to directly change their business environment (Namvar, 2015; Namvar et al., 2016; Namvar and Cybulski, 2014). Indeed, BI as a technology

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does not support individuals in enacting on BI environment. However, various aspects of enactment are discussed in the BI literature, which I turn to next.

Enactment in the context of BI is about the interaction of BI end users with BI tools and reports and applying the results to business processes. It consists of concepts such as “actor”, “subject”, “process” and “instrument”. Briefly, the actor in this context refers to the requirement or need identified for a change (which is the subject) in business processes through instruments such as reporting or visualisation. The identification of requirements or need should include understanding of business problems and opportunities, and essentially figure out the objectives and resources required for the change (Elbashir and Williams, 2007; Foody, 2009). The change in business scenarios affects the business processes and need to be reflected through the stages of business processes. Dynamic business processes are demanding and challenging, especially as organisations need to ensure agility, constantly sense for opportunity and track changes in order to meet business requirements or government regulations (Hallikainen et al., 2012; Watson and Wixom, 2007).

Based on the concept of self-service reporting, more organisations are pushing BI users (e.g. executives) to interact with BI reports by taking initiative and generating their own reports (Foody, 2009; Stoodley, 2012; Watson, 2008). Thus, more personalised reports could be generated at a level that is user-relevant, where users are able to view and explore data by themselves, which can result in shortening the required time for turning BI outcomes into actions (Hallikainen et al., 2012; Negash and Gray, 2008b; Smietana, 2010; Watson, 2008).

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While several aspects of enactment on BI environment was discussed in above, the literature of BI is silent in explaining the role of BI in empowering the enactment capabilities of end users. In fact, similar to identity creation, the role of enactment is not clarified for using BI systems. More importantly, the relationship between enacting on BI environment and BI identity creation with other properties of sensemaking is not clarified in the literature of BI.

2.4 Conceptual framework

The critical analysis of the literature done in Section 2.3 showed that BI is able to support specific sensemaking properties. It explained which properties of sensemaking are not supported by BI directly. As can be observed from the discussion thus far, many features of modern BI and the common properties of organisational sensemaking significantly overlap, intersect and interweave.

In conclusion, we can see that many features of contemporary BI and the common properties of organizational sensemaking significantly overlap, intersect, and interweave. As Figure 10 shows, five sensemaking properties (retrospection, plausibility, cue extraction, ongoing processing, and social factors) can be directly mapped into (and be supported by) BI components and their features.

This figure shows that BI tools can assist in providing a retrospective view by collecting data from the organisational environment and processing this data. Predictive analytics, as a component of BI, can assist decision makers in making plausible decisions. BI tools provide decision makers with various types of cues from the environment including alarms, patterns and KPIs. Real-time BI facilitates ongoing access to various types of reports that monitor changes in the business

environment. Also, modern BI tools enhance collaboration between decision makers by providing options for sharing the reports and commenting on them.

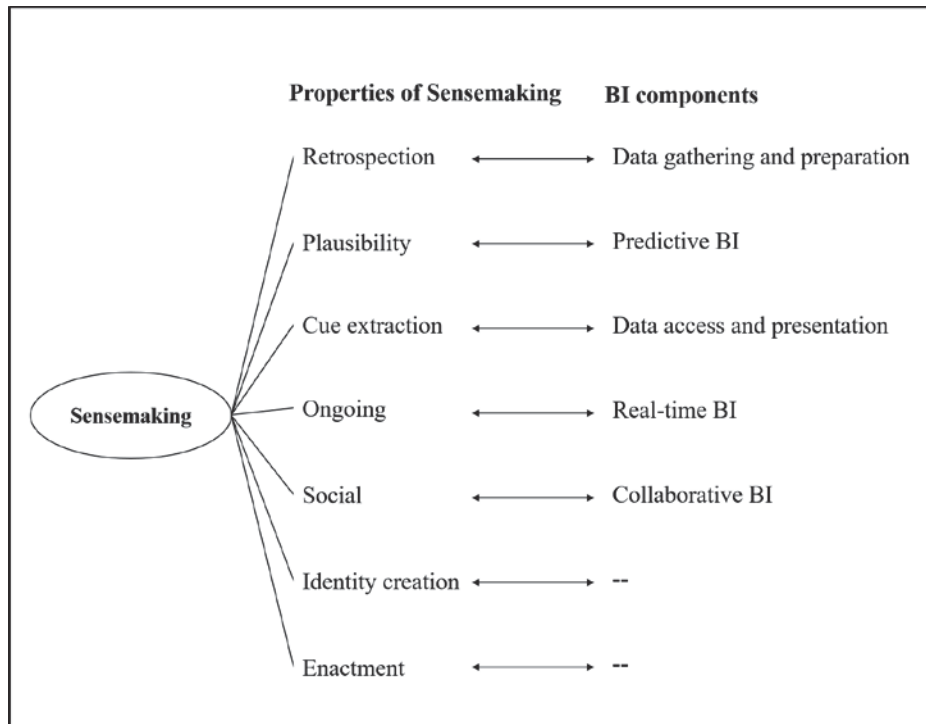


Figure 10: Conceptual framework for this study

Although various aspects of individual identity, such as skills and experience, and various aspects of organisational identity, such as structure and strategy, are mentioned in the BI literature, there is no research that shows how BI can improve these identities. Also, the concept of enactment is not defined clearly in the BI literature and there is not enough research that shows how enactment could happen during the development of BI and its use in organisations. In fact, the extant BI literature provides no obvious answers to the question of possible relationships between BI, enactment, and identity creation (see the dashed lines in Figure 10). In search for answers to how these properties can be supported by using BI in the process of organisational sensemaking, this study turns to BI developers, analysts,

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consultants, and users, who reflected on their experience in using BI tools to make sense of their organizations.

2.5 Summary

In this chapter, the literature of sensemaking and BI were reviewed. First, different models and theories of sensemaking were presented. It was explained why Weick's model of sensemaking subsumes the characteristics of other models of sensemaking and consequently is chosen as the theoretical framework of this study (see Section 2.1.2). Then, the literature of BI was presented in two sections; first, the notion of BI was explained from the point of view of various authors (see Section 2.2.1). Then the organisational needs for successful BI implementation were discussed in Section 2.2.3.

The review of literature provided in this thesis assisted in clarifying the purpose of study and research question, limitations and delimitation, which is needed prior to data collection and analysis in a qualitative inquiry (Creswell, 1998, pp. 61–63). It also provided theoretical perspectives, existing thoughts for framing the research question and a critique of related empirical research on BI and sensemaking (Marshall and Rossman, 1999, p. 58).

3 Research approach and design

This chapter discusses the adopted research method for this study. It explains the approach for data collection and clarifies the interpretation of the collected data and the philosophical stance supporting the data analysis. Every methodological step, from data collection to data analysis, will be explored, analysed and discussed with regard to the previously stated research question (see Section 1.2):

Research question: How can BI improve the process of organisational sensemaking necessary for making decisions?

Before any further analysis is taken, it is important to note that the Chapter 2 identified a significant gap in the link between BI and organisational sensemaking (in the area of BI identity creation and enactment). Consequently, answers to the above research question will be found not in the published literature but rather in practice, which has been accumulated in years-long experience of BI users and developers, and which can be glimpsed in the instances of BI deployment and operation. Capturing, exploring and analysing the experience of BI practitioners seems the most promising source of answers to the above research question.

“The research approach adopted could vary with different types of theory in IS” (Gregor, 2006, p. 612), and in the process of determining the research approach suitable for this question and the above qualification, the theoretical concepts and fundamental assumptions should be critically examined (Preston, 1991). To this end, Crotty (1998) identified four main aspects of any research project that need to be considered, justified and clarified: namely, its underlying epistemology, theoretical perspective, methodology and the actual research methods. As the following sections will explain, this thesis adopted a constructivist and

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interpretivist approach, where qualitative data could be collected in a series of long interviews, and subsequently analysed and interpreted using hermeneutic phenomenological methods, to induce a framework for BI-based sensemaking (see Figure 11).

The theoretical and methodological choices will be made by comparing and contrasting several alternative research approaches, discussing their advantages and disadvantages, leading to a research design that was eventually adopted for this project. At the end of the chapter, the ethical consideration of this study are briefly presented.

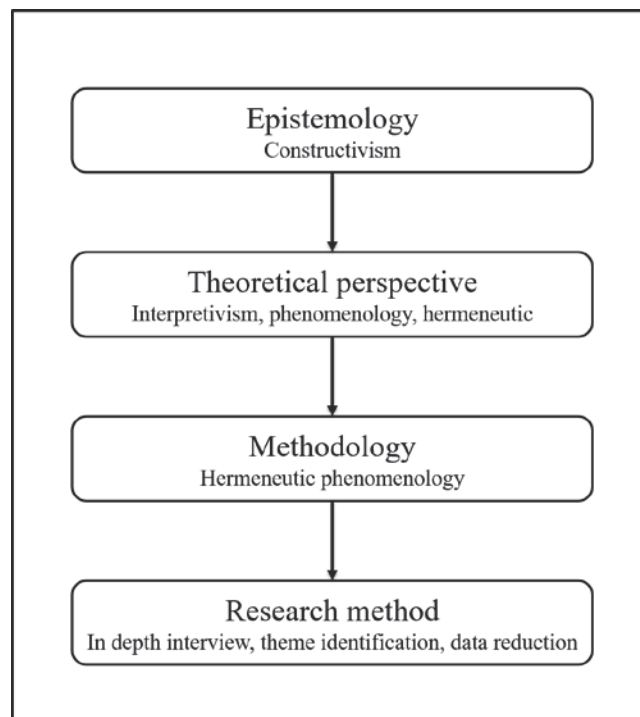


Figure 11: Methodological foundation of this research

3.1 Research approach

Epistemology is defined as “the theory of knowledge embedded in the theoretical perspective and thereby in the methodology” (Crotty, 1998, p. 8). It

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deals with the inherent nature, the conceptual basis and the scope of knowledge, as well as the human empowerment of having knowledge (Hamlyn, 1995). Constructivism is the epistemology that qualitative researchers often adopt (Crotty, 1998, p. 9), especially when the investigated phenomena are to be understood in their rich social context, often unexplored and full of surprises. The constructivist paradigm assumes that "... realities exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them" (Guba, 1990, p. 27). Given that this research aims to examine and understand previously unexplored experiences and views of various BI users, such as business executives, decision-makers and BI developers in their rich techno-organisational context (across a variety of Australian industry sectors), a constructivist approach was deemed to provide the most appropriate epistemological foundation.

Theoretical perspective defines the philosophical foundation underpinning the methodology, provides a context for the research process and grounds the logic and criteria applied in the study (Crotty, 1998, p. 8). A commonly adopted scientific method of investigation adopts a positivist research approach, which is linked to objectivist epistemology that recommends a detached observation and objective explanation of the investigated phenomena (Crotty, 1998, p. 9). The focus of such a study is commonly confirming or testing assertions, conceptualisations or theories related to some prior understanding of the researched topic. The positivist work normally demands full control of the research process, and thus it is less suited those investigations where situations are not well understood (and thus controls would be difficult to define) or socially constructed (where the observed phenomena are dynamic and outside the researcher's control). The positivist

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perspective is not applicable in the context of this thesis as there exists very little prior knowledge of techno-organisational processes of sensemaking, especially in the context of BI. In contrast with positivism (Walsham, 1995, p. 376), interpretivism aims at understanding complex phenomena, which are culturally derived and historically situated (Crotty, 1998, p. 8). Lee (1991), however, suggested that “interpretive findings can later be subjected to positivist testing”. As this research aims to understand the experience of decision-makers in rich socio-organisational context and assumes that knowledge of BI-based sensemaking is a social construction by human actors (Walsham, 1995), it clearly suited the interpretivist research approach.

The emphasis of the previous research in BI is primarily on the effectiveness of business decision-making using large data sets rather than focusing on understanding the organisation and its problems, which could ultimately assist decision-making processes and eventually lead to higher quality decisions (with or without the use of technology). There is very little previous work concerning how BI could help decision-makers in understanding their organisation. Considering the vacuum of prior understanding of the research domain it is suggested that exploratory research should be used in this study. This approach is particularly advantageous in situations where research aspects or variables cannot be easily identified at the very beginning of the study and there are few theories available to explain the emerging insights (Creswell, 1994).

3.1.1 Hermeneutic phenomenology

This research looks at the opportunities presented by BI to improve the process of organisational sensemaking necessary for making quality decisions. With the focus on decision-makers' practice and their lived experience in using BI in organisational settings, which needed to be untangled from the confounding web of socio-technical context and personal opinions, this study chose hermeneutic phenomenology (Van Manen, 1998) as an overarching theoretical perspective and the method of inquiry.

Phenomenology describes the methods on inquiry where the "phenomena" can be investigated as they are experienced and reflected upon to seek reinterpretation and renewal of meaning (Husserl, 1931). In general, the phenomenological process allows the researcher to study highly subjective and complex personal accounts of events and circumstances with a view to gain awareness, understanding and knowledge of the investigated phenomena (Moustakas, 1994, p. 12). In this research the interaction with, and adoption and use of, BI tools for organisational sensemaking were the phenomena of interest, imparted with meaning and interconnected with social and business structures that form the fabric of organisational decision-makers. The approach taken in this study is to isolate the meanings and experiences that would possibly be shared within the community of BI users (consultants and decision-makers) and developers (in-house analysts and BI vendors). Study participants need to be selected from a range of very different organisations, and yet it is hoped they would be relying on a set of common practices and would be using comparable technology within their work portfolios.

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The experience identified in the process will be captured in the narrative form, which is “presented as a framework for understanding subject and interview data in qualitative research” (Sandelowski, 1991, p. 161). It represents the researcher’s perception of the study participants’ stories encapsulating, views and opinions, descriptions of situations encountered, accounts of problems resolved, recommendations given or received, possibly existing documents, communications and the statements of observation. Those experiences are likely to be reported in two main categories – the first relating to the analytic principles encompassed by the existing BI models for gaining organisational insights; and the second pertaining to the business decision-making processes that are constrained and enacted by social and organisational structures (Moreno Jr, 1999). Since the accounts of BI stakeholders’ experience will be in the form of narratives or descriptions of observed situations, the most appropriate representation is in the form of text, and practitioners’ experience could be identified in interviews. Myers suggested that interpretation of text collected in the course of case studies and interviews is an effective method of studying information systems, which commonly span technical, social and political dimensions of organisations and their people (Myers, 2008).

There are several phenomenological traditions that are potentially applicable to this research, for example transcendental, existential and hermeneutical (Van Manen, 1998). The tradition that is selected to guide this research is hermeneutic phenomenology, which was first proposed by Gadamer (1966, see 2008) and reinterpreted by Ricoeur (1969, see 2005), practiced by Van Kaam (1966), and refined, formulated and publicised as a research methodology by Moustakas (1994). Hermeneutics, the theory of interpretation, which was originally conceived

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to support in-depth analysis of historical texts, provides a methodical analytic framework for understanding subjective views and opinions, in spite of the enquirer's distance from the source of text (Lukaitis, 2010). This distance can be a combination of the following barriers:

- The time since the original text was written.
- Culture from the subject matter where the original text was created.
- Intention of the author that may mislead, omit or twist events and facts.
- Language of the text may no longer be in day-to-day use.

Gadamer (1966, see 2008) asserted that understanding of complex and unexplored phenomena can only be possible through a cyclical dialectic process that is commonly referred to as the “hermeneutic circle” – an ongoing interpretive oscillation between accumulated understanding and new insights, in their rich socio-historical context. By applying the cycles of hermeneutic analysis to the phenomena of interest, which are often described with text or some text analogue (such as drawing, music or film), the researcher can understand invisible and implicit meanings buried in the richness of told and retold narrative (Heidegger, 1962). By adopting hermeneutic analysis to decision-makers' accounts of using BI in sensemaking, it is possible to explore these experiences from a variety of personal, organisational and social perspectives, reconciling vastly different views and opinions – what Merleau-Ponty (2004) referred to as arriving at the essence of the investigated phenomena to identify the common core of shared experiences.

In summary, text is a suitable representation for the research question of this study (see Section 1.3). The content which is represented by text can also be rich, complex and possibly unfamiliar to the researcher. It thus should be analysed in

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depth, considering the links between the social system, and technological system (Gregor, 2006; Gregor and Jones, 2007) and the personal distance of researcher from the reported events, which are outlined above, and even the bias. Also, as there are multiple information sources, the analysis may need to be incremental, following a typical hermeneutic circle, where understanding at a specific point influences the next cycle. Therefore, I will need to frequently return to the interview transcripts and with each new reading, I will be able to revise my understanding and derive a new interpretation

Alternative approaches: Creswell (1994, p. 69) articulated five traditions in qualitative research: namely, biography, ethnography, phenomenology, case study and grounded theory. A biography approach can't be undertaken, as this study does not aim at exploring the lives of individuals. An ethnographic approach is less suitable for this research as sensemaking is a mental activity, which cannot be easily observed without personal reflection and intense discussion with the sensemaker. As the BI stakeholders mainly go about their day-to-day business, it may not be appropriate to spend extensive amounts of time in the field with them. Also, considering observations as short snapshots of practitioners' work, it may not be possible to observe any significant cases that are worth further analysis. Grounded theory may well be used to generate new techno-organisational theory of BI, however, sensemaking already provides a complete theoretical framework that could be used as a lens for gaining insights emerging from this investigation.

A case study method is another possible alternative to phenomenology for this research. The unit of analysis of case studies is a well-defined bounded system, such as an organisation, where several sources of information including interviews, documents, charts or figures could provide a cohesive view of the situation (Stake,

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2000). The insights about decision-makers and the use of BI for sensemaking can be inferred from organisational documents, communications and charts. Case studies can indeed be used to thoroughly study sensemaking across a specific organisation; it could assist in determining organisational culture, management practices and attitudes of BI end users towards BI technology – all to be substantiated with BI stakeholders' lived experience (Creswell, 1994). However, as this study aims to identify experience that is shared between many practitioners across several different organisations, and the unit of study is an individual sensemaker. Therefore, as case study could restrict the investigation to the a bounded system such as organisation or project, it deemed to be less relevant than a phenomenological investigation of experience gained by individuals across several different organisations, which will offer a better approach to exploring how BI end users make sense of BI environment in various contexts. Consequently, hermeneutic phenomenology will be employed, rather than a case study approach.

Phenomenology focuses on the investigation of shared understanding of one or more BI stakeholders through their lived experience of decision-making and sensemaking. As the aim of this research is to focus on gaining insights into the decision-makers' lived experiences using BI tools with a view to gain understanding of their organisation, clearly it is a more direct method of answering the research question posed in this thesis. Phenomenology can effectively deal with different aspects of organisational complexity in using BI for sensemaking; that is, structure and processes, interorganisational aspects of business, communication and reporting structures, the role of social groups in developing organisational understanding, the roles played by various individuals in developing business insights, any potential conflicts in sharing BI technology and the BI end users'

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personal views and individual perceptions. Thus, a phenomenological approach along with the hermeneutic analysis of the collected data is employed to effectively understand the phenomenon under study.

3.2 Research method and design

The research method and design of this study will be discussed in this section. Research method is about the techniques or procedures used to collect and analyse data related to the research question (which may involve the hypothesis in quantitative research) (Crotty, 1998, p. 6). This research focuses on investigating the process of understanding organisational sensemaking and the interaction of individual decision-makers with BI tools. It aims at constructing a comprehensive picture of sensemaking when assisted with BI and is shaped with the views of BI stakeholders in their workplaces (Creswell, 1994). This research will adopt a qualitative research approach to data analysis of interactions of decision-makers with BI, their relationships and communication with each other, as well as their motivation for using BI in their decision-making (Taylor and Bogdan, 1998).

A series of methods and procedures are recommended by Moustakas to be carried out by the researcher to conduct an organised and systematic (hermeneutic) phenomenological investigation. He identified seven distinct steps, starting from understanding the research problem and question articulation through to data collection and analysis (Moustakas, 1994, p. 103). These steps, however, could be adapted by researchers to guide the process of the investigation into the study phenomenon (Moustakas, 1994, p. 104).

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As described in Section 3.1.1, hermeneutic phenomenology research occurs in a cyclical process and a new horizon of understanding is achieved in each step (Gadamer, 1976; Klein and Myers, 1999). This approach indicates a knowledge creation cycle in each step of a research, which includes literature review, interviews and data analysis (e.g. Linden, 2011). In this research, Moustakas' approach (1994) will be customised to design three phases along with four loops to conduct a phenomenological research for the ongoing process of refinement until the essence of the experience is reached (Linden, 2011). These phases are theoretical framing, data collection, and phenomenological reduction and framework development (see Figure 12), to which this thesis will turn next.

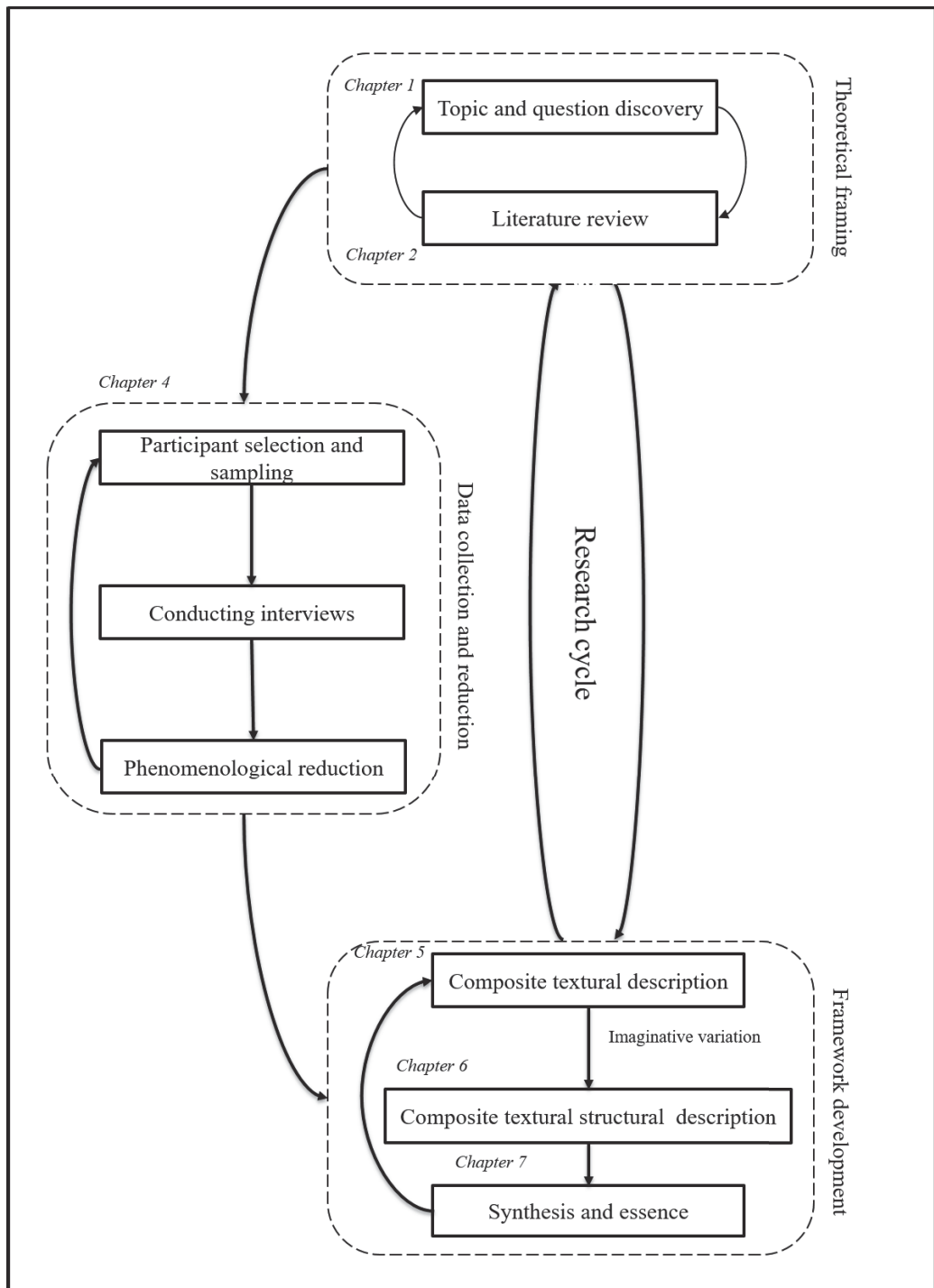


Figure 12: Research method

3.2.1 Theoretical framing

In preparing a phenomenological investigation, the first challenge is to formulate a topic and question that have both personal significance and social meaning (Moustakas, 1994, p. 104). In positivist research, a considerable amount of time and effort should be spent on the early stages to develop the research question and conduct the research, while in interpretivist research this phase requires less time and demand. To discover the topic and question, both professional and research literature should be comprehensively reviewed (Moustakas, 1994, p. 104), as it is already done in Chapter 2.

The phase of theoretical framing aims at the formulation of a research question and improvement of existing sensemaking theories in the context of BI to propose a preliminary theoretical framework for BI-based sensemaking. Weick's sensemaking framework was chosen as the theoretical framework of this study (see Section 2.1.2), and the research question was articulated based on that framework. A set of interview questions for data collection will subsequently be derived from the primary research question and its surrounding research topic.

3.2.2 Data collection and phenomenological reduction

A cyclical process will occur for data collection and its understanding. Figure 13 illustrates the hermeneutic circle that uses feedback from each interview to modify and improve data collection, in which sufficient number of participants with various work experiences will be interviewed to achieve theoretical saturation (A.

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L. Strauss and Corbin, 1990). The following section explains the elements of this figure.

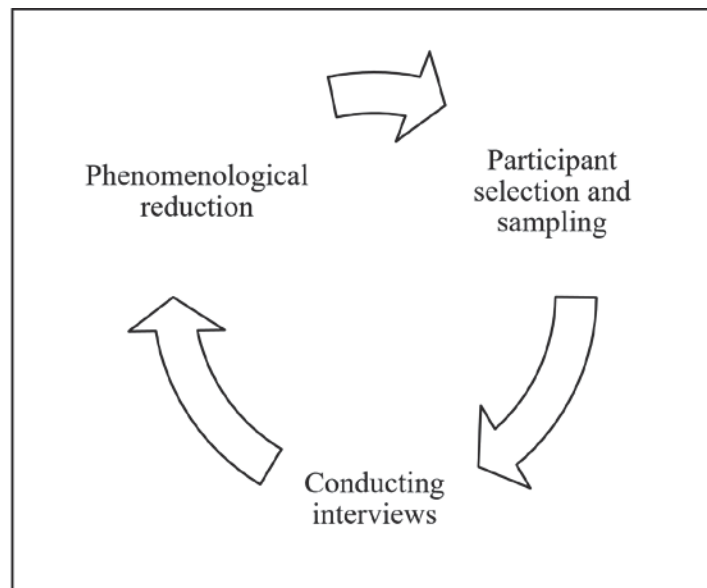


Figure 13: Data collection and phenomenological reduction

Participant selection and sampling

This study adopts purposeful sampling for selecting study participants who can “purposefully inform an understanding of the research problem and central phenomenon in the study” (Creswell, 1994, p. 126). It follows four characteristics of purposeful sampling proposed by Lincoln and Guba (1985). First, the collected data will lead into making proper decisions for sample size and selection. Second, the selection of subsequent study participants should only occur when the previous interviews are recorded and analysed. Third, interview questions should be continuously adjusted as the insights from the previous interviews may provide new areas of focus. Finally, data collection should be finalised when the researcher reaches the point where no more information is being obtained. Thus, the process of data collection will continue until no more new insights can be obtained and saturation occurs.

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The study participants will be selected based on their role and experience in using BI in their everyday practice. As the interviews aim to discover how BI is used for understanding the business environment and decision-making, study participants had to be familiar with BI or use one of BI tools in their daily decision-making. Internal and external experts who have engaged in BI system development will be employed to develop first-hand experience of both the benefits of well-designed BI and the difficulties that arise when BI systems are not a good fit for a particular context in which they are being used (Creswell, 1994). Furthermore, as the research does not focus on any specific sector and the lived experience of study participants were of interest (see Section 1.4), the study participants will be chosen from variety of sectors. As the interaction with BI tools can vary based on organisational requirements, study participants will be chosen with different backgrounds and roles within their organisations (Moreno Jr, 1999); namely, consultant, developer, analyst and user.

Conducting interviews

As most of methodologies confirm the critical importance of collecting voluntary and honest responses from willing research participants (Burns, 1997) and as it was implied by the ethics of this study, the first criterion for study participant selection is their unprompted acceptance for participating in the data collection process. Before conducting interviews, study participants will be provided with instruction on the nature and purpose of the study, and an agreement, which includes a consent form. Their confidentiality will be assured, and the responsibilities of myself and other research participants consistent with ethical principles of research will be described (Moustakas, 1994). Also, they will be

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provided with a second form that allows them to revoke their participation at any time during the research before the publication of results (see Appendix 2: Plain language statement and consent form).

This research will use semi-structured interviews for data collection, which means the interviews are not restricted by a rigid set of questions. However, although open-ended questions will be designed for the interviews, they will be focused on the research questions. The flexibility of semi-structured interviews allows new questions to be asked based on what study participants say (Lindlof and Taylor, 2002). In this study thus a set of primary questions will be developed about decision-making and the way BI is used for understanding business environments before decisions are made. Using the term “sensemaking” in interview questions will be avoided as study participants may not be familiar with this terminology. Instead a set of questions will be designed to refer to the properties of sensemaking; for example, “how BI is used for creating plausible outcomes”.

Phenomenological reduction

Although many scholars (e.g. Marshall and Rossman, 1999) noted that the process of qualitative data analysis is not linear, there are some guidelines for this analysis. In line with Van Kaam (Van Kaam, 1959), Moustakas (1994, p. 97) suggested that listing, grouping, elimination, reduction, clustering and textural description can be applied after each interview as part of phenomenological reduction analysis (Moustakas, 1994). Hycner (1985) also proposed another approach, similar to Moustakas', which includes five steps: namely, bracketing and phenomenological reduction, describing units of meaning, forming themes by clustering units of meaning, summarising interviews and, finally, extracting themes

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from all the interviews and providing a composite summary. The goal of these approaches is to facilitate the process of understanding a large amount of text by grouping codes and bringing meaning to the data (Dickson, 2015). As this study adopts Moustakas' (1994, p. 97) approach to discover the fundamental themes required for the rest of the study, the details of each step articulated by him, are presented in the following.

Listing and preliminary grouping: To achieve a comprehensive view of the transcribed data and total sense of description, Giorgi and Giorgi (2003) recommend reading through the whole transcript to achieve an “overall sense of the description”. To complete the listing and preliminary grouping process, Van Manen (1990) highlighted the necessity for reading statements from study participants' transcripts several times by the researcher and sifting through those parts of the text that are relevant to the study phenomena.

In this stage, first the focus of research will be put in brackets and everything else will be set aside, therefore the entire research process will be rooted solely on the question and topic (Moustakas, 1994, p. 97). Then, a combination of different coding will be used in this step to conceptualise and categorise the statements of each interview. Strauss and Corbin defined this concept as a labelled phenomenon to yield an abstract representation of an interaction, action, event or object. The purpose of conceptualisation is to enable the research to group similar events and objects under common headings or classifications (A. Strauss and Corbin, 1990, p. 103).

The discovery of concepts is the focus of “open coding”. Strauss and Corbin noted that to uncover and name concepts researchers should “open up the text and

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expose the thoughts, ideas and meaning” included therein (A. Strauss and Corbin, 1990, p. 102). During open coding, thus, data will be broken into discrete parts, and it will be examined and compared to identify similarities and differences. In this study, the concepts that are be uncovered after open coding are called “preliminary codes”.

After open coding, axial coding will be applied to begin “the process of reassembling data that were fractured during open coding” (A. Strauss and Corbin, 1990, p. 124). In axial coding, categories will be related to their subcategories to provide a precise and comprehensive explanations about the phenomena under study. In this study, the output of axial coding is called “final codes”, which combine several preliminary codes that share similar meaning about the using BI for sensemaking.

Reduction and elimination: As a researcher becomes part of the study, and must deliver their own perspectives to account for assumptions, reduction of data into codes and elimination of redundant statements using shared codes is needed. At this stage, a textural meaning and invariant constitute of the phenomenon under the study will be determined (Moustakas, 1994, p. 120). Moustakas suggested that for determining invariant constituents, each statement must include a moment of the experience that is a necessary and adequate constituent for understanding it. Also, it should be possible to abstract and label the statement (Moustakas, 1994, p. 121).

Moustakas also noted that every statement should initially be treated as having equal value (Moustakas, 1994, p. 97). Then, repetitive, overlapping and

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vague statements should be eliminated. The horizons that remain after this stage are invariant constituent of the experience (Moustakas, 1994, p. 121).

Clustering codes into themes: In this stage, the final codes from previous stages will be used to shape themes. Selective coding will be applied to integrate final codes (A. Strauss and Corbin, 1990, p. 143) that are identified during the process of listing and preliminary grouping, and shape larger theoretical themes. The following general criteria (A. Strauss and Corbin, 1990, p. 146) will be followed to choose the themes, or central categories:

- Themes must be central and all final codes can be related to it.
- Themes must appear frequently in the data.
- The name or phrase used for describing themes should be adequately abstract to make it possible to use them for research in other substantive domains.

Individual textural description: The purpose of preparing narratives is to clarify the meaning extracted during the interviews by presenting verbatim examples from the transcribed interviews (Moustakas, 1994, p. 121). This description will be constructed from the themes and delimited horizons of each study participant's experience (Moustakas, 1994, p. 133). The textural description of each individual interview will be used in later stages of the data analysis.

3.2.3 Framework development

In Moustakas' (1994) approach to hermeneutic phenomenology, after the themes are identified and textural description of each study participant is prepared, three main steps should be followed: (1) composite textural description; (2)

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composite textural-structural description and; (3) synthesis of finding. During this process it is needed to use epoché by declaring and articulating my biases and prejudices. Although removing my own prejudices completely is impossible (Gadamer, 1976), they can be reduced by statement development about my personal biases and self-reflection related to them at different phases, namely data collection, and data analysis.

Composite textural description: Individual textural descriptions illustrate the experiences of specific study participants in detail. While some codes and themes will appear in each individual textural description, others will present only in the analysis of the experiences of other interviewees. As each participant focused on just some parts of this phenomenon, just a few themes resulted from each interview, and none of study participants covered all the themes. The composite textural description brought together all different themes related to using BI for understanding an organisation.

In this stage, therefore, all individual textural descriptions resulting after phenomenological reduction (see “individual textural description” in Section 3.2.2) will be integrated, and identified themes (see “clustering codes into themes” in Section 3.2.2) be used to construct a composite textural description. Composite textural description aims at looking for similarities and differences between study participants’ experiences of BI use for sensemaking. The composite textural description will guide the way for the imaginative variation presented in the next section.

Composite textural-structural description: Following phenomenological reduction, the next step is imaginative variation. Imaginative variation seeks

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possible meaning through “the utilisation of imagination, varying the frames of reference, employing polarities and reversals, and approaching the phenomena from different perspectives, positions, roles or functions” (Moustakas, 1994, p. 97). It determines the structure of the phenomena and its meaning by uncovering the essence and focusing on pure possibilities.

Moustakas (1994, p. 98) noted that “variation is targeted toward meanings and depends on intuition as a way of integrating structures into essence”. He further added that in imaginative variation, “the world disappears, existence no longer is central, anything whatever becomes possible”. To this aim, researchers should know that there is no single inroad to truth, and many emerging possibilities are intimately connected with the essence of the study phenomena. This research will use the guidelines suggested by Moustakas (1994, p. 98) for imaginative variation:

- The possible structural meanings that underline the textural meanings should be varied systematically.
- The underlying themes or contexts that are important for the emergence of the phenomena should be recognised.
- The universal structures that arise from participants’ feeling and thoughts with reference to the phenomena should be considered.
- Exemplifications that vividly show the invariant themes and simplify the development of a structural description of phenomena should be provided.

At the end, imaginative variation will provide a composite textural-structural description of the investigated phenomenon. This description will be presented in Chapter 6.

Synthesis of meaning and essence: The synthesis of meanings and essences is the final step in the phenomenological study, and is about the “intuitive integration” of the composite structural descriptions to develop a synthesis of the meanings of the phenomenon or experience (Moustakas, 1994, p. 100). Essence means “the condition or quality without which a thing would not be what it is” (Husserl, 1931, p. 43 in Moustakas, 1994, p. 100).

Moustakas noted that the essence of any experience or study can never be totally exhausted, and the fundamental synthesis represents the essence at a particular place and time from the vantage point of a researcher, achieved after imaginative variation (Moustakas, 1994, p. 100). In this study, after the textural-structural description, the synthesis and essence of meaning will be presented in Chapter 7 to form a framework for BI-based sensemaking. In this framework, possible meanings through the utilisation of imagination by taking into account all possible valid interpretations of BI-based sensemaking will be selected. Then, the concepts derived from such invariant experience with the ideas reported in prior research will be contrasted to explain the shared phenomena from the perspective of Weick’s model of sensemaking (1995).

3.3 Evaluation

This study will be structured within a constructivist–interpretive paradigm and will investigate the meanings and personal experience of individuals. The findings, therefore, does not denote objective reality but the opinions, beliefs and perceptions of study participants (Crotty, 1998). Consequently, the evaluation of this research will depend on research design, used instruments, and employed

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analysis and interpretation. There are constructs of validity or trustworthiness that must be demonstrated for undertaking quantitative research. To ensure their validity and reliability in interpretivist investigations, Lincoln and Guba (1985) suggested evaluating credibility, transferability, dependability and confirmability. The following sections demonstrates an understanding of the above criteria, and illustrates how this study ensures that these issues are considered through the adoption of phenomenological inquiry methods. Then, it will be discussed how the point of theoretical saturation of this research will be achieved.

Credibility is the ability of researcher to know “where the data in a given study comes from, how it was collected and how it was used” (Shank, 2006, p. 114). Here the researcher arrives at questions such as “Do the findings of research make sense?”; “Are they credible to the study participants and readers?”; and “Is there any “authentic portrait” of what the study is looking at?” (Miles and Huberman, 1984, p. 278). Miles and Huberman (1984, p. 289) also noted that credibility is the process of checking, questioning and theorising, and is not a strategy for developing rule-based correspondence between findings and the real world. The main point is to formulate the communication between research and study participants in a way that describes the phenomenon under study. In this research, after transcripts are produced, the study participants will verify them to ensure the transcripts are a correct representation of what they said. Also, after the transcription of long interview experiences into text files, the verbatim transcript of experience will be applied when analysing the data (see Chapter 4) and direct quotes will be cited from study participants (see Chapters 5 and 6).

Confirmability relates to the formation of consistent research practices to ensure that different researchers could confirm the findings of the research,

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employing the same data capture instrumentation in the same context (Creswell, 1994, p. 246). In short, the underlying question here is “Do the conclusions depend on the subjects and conditions of the inequity rather than enquirer?” (Miles and Huberman, 1984, p. 278). Miles and Huberman further (1984, p. 289) noted that the basic issues here are relative neutrality, reasonable freedom from acknowledged bias – at minimum – and explicitness about the inevitable biases that exist. Also, to assess conformability, Shank suggested (2006, p. 115) demonstrating how data will be analysed, codes will be extracted and themes will be identified. The details of interview questions (see Section 4.2) and direct thematic analysis (see Section 4.3 and Chapter 5) will be provided in order to reinforce the confirmability of this study.

Transferability discusses to what extent the result could be applied to another context for a similar result. In fact, it is “an empirical process for checking the degree of similarity between sending and receiving contexts” (Guba and Lincoln, 1989, p. 241). Lincoln and Guba (1985) clarify that providing a transferable study to other context is not the responsibility of constructivist researchers. Instead, a “thick” description of the research, that describes in details the participants or setting under study, should be provided to readers (Creswell, 1994, p. 252); thus, it is the reader who will judge when and how they can transfer the study to other contexts. Creswell (Creswell, 1994, p. 252) noted that “thick description” means that the researcher provides details when “describing a case or when writing about a theme”. Such extensive descriptions of the identified themes will be evidenced throughout the textural-structural descriptions in Chapter 4 and 5 to assist in assuring the transferability of this research by readers. Additional

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information about the profile of study participants and identified themes are provided in Appendices 3 and 4.

Dependability relates to “the stability of the data over time” (Lincoln and Guba, 1985, p. 242). In a constructivist investigation, the research should show that the rigorous process of research is documented, logical and traceable (Schwandt et al., 2007). Dependability will be achieved at the point where “the argument is complete, allowing the reader to follow and understand it without unexplained leaps from argument to conclusion” (Williamson et al., 2003, p. 131). In this study, firstly, by remaining intact through the strict adherence to the phenomenological steps proposed by Moustakas (1994, p. 85), the likelihood of dependability will be augmented (see Section 3.2). Secondly, as proposed by Creswell (1994, p. 251) through statements about the researcher’s positions, “the selection of informants, the biases and values of the researcher” (see Section 4.2 and 4.3), the dependability of this study will be enhanced.

In addition, some other strategies recommended by Creswell (Creswell, 1994, p. 251) will be employed to ensure the quality of this study; namely, triangulation and negative case analysis. In triangulation, to provide corroborating evidence, researchers use various sources, methods, investigators and theories (Lincoln and Guba, 1985). In this study, thus, information from different interviews will be corroborated to shed light on identified themes (see Chapter 5). In negative case analysis, the researcher provides negative and disconfirming evidence (Lincoln and Guba, 1985), as not all evidence will fit the pattern of code or theme (Creswell, 1994, p. 251). Here, to provide a realistic assessment of the phenomena under the study, positive and negative evidence will be used to describe the use of BI for sensemaking (see Chapter 6 and Table 11).

Theoretical saturation examines whether the saturation of knowledge and themes has occurred to the point of completeness. In fact, completeness of understanding or theoretical saturation is reached when the addition of new data does not change the developed horizon of understanding. It relates to the continual sampling of data until such point where:

- No new data seems to emerge (Eisenhardt, 1989; Fernández, 2004);
- No new themes or categories emerge from newly acquired data (Whittemore et al., 2001);
- Relationships between categories are well established (Glaser and Strauss, 1967, pp. 61–62).

In this study, completeness or theoretical saturation will have been reached when newly acquired data or knowledge simply repeats what has already been known and understood about BI-based sensemaking or when newly acquired data or knowledge does not modify or conflict with the understanding of developed themes.

3.4 Ethics

As a requirement for conducting a human research at Deakin University, ethics approval will be obtained from the Deakin University Human Research Ethics Committee. Also, study participants will be provided with consent forms and were asked about their approval before data collection and analysis.

Before the interviews, a plain language statement will be presented to each study participant (see Appendix 2). In the plain language statement, the purpose of research will be clarified and it will be explained that participants could ask to

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withdraw from further participation before the publication of results. Complex jargon or acronyms will be avoided in the developed plain language statement and consent forms, and they will be written in simple English. Thus, participants will be informed of their rights and participation requirements before data collection.

Also, after conducting each interview and its transcription, the text file will be sent to study participants and they will be asked to review the interview and make any changes to the file or delete any part of the interview that they do not want published. Also, a pseudonym will be allocated to each participant and their organisation. The participants will be identified with pseudonyms in every publication and analysis (see Table 7). Their pseudonyms will be selected to maintain their gender implication, and employers will be anonymised without hiding their broad industry grouping.

3.5 Summary

This chapter emphasised that the insights on the best use of BI are likely to rest with BI practitioners actively involved in day-to-day business decision-making. Considering little prior work in this area, an empirical exploratory study was therefore suggested in this domain to gather and investigate experiences. Consequently, it was explained that the interpretivist perspective, which is a social research method to deal with the research problem and guide our analysis of the collected data, was explained.

Then, this chapter clarified that with a focus on decision-makers' lived experience and practice, which need to be untangled from the confounding web of socio-technical context and personal opinions, hermeneutic phenomenology was

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chosen as an overarching theoretical perspective and the method of inquiry. Finally, the steps of this research method were described.

The next chapter will address how data is collected and phenomenological reduction is applied. It will explain the common codes and thematic analysis. Chapter 5 presents the composite textural description by elaboration on the identified themes from the point of view of various study participants. Chapter 6 uses imaginative variation to present the composite textural-structural description of this study. It will discuss the properties of sensemaking using the identified themes. Finally, Chapter 7 provides the synthesis and essence of meaning. It illustrates the framework for BI-based sensemaking.

4 Data collection and phenomenological reduction

This chapter describes the hermeneutic study, undertaken to understand study participants' experiences, views and opinions. The first part of this chapter deals with data collection. The second part discusses how phenomenological reduction will be applied to the collected data, and explains the codes and themes that will be derived from data to represent issues important to study participants. In each phase of data analysis, the process of epoché (see Section 3.2.3) will be conducted and its results will be presented to highlight my biases and prejudgments, which will be dealt with in the process.

As prejudice or bias and prior knowledge are the initial drivers for researchers in understanding the phenomenon (Myers, 2008), before data collection, I aimed at identifying my personal biases and prejudgments. As many philosophers and researchers (e.g. Gadamer, 1976, p. 125) claim that those biases cannot be set aside, excluded, or eliminated, I tried to understand them and take them into consideration when engaging with the data. I initiated data collection by explicitly describing my prior experience with BI in the following self-reflection:

One of the major influences which motivated the current study is my past experience with data mining tools and my experience of working with analytical tools. Also, having done some research and publications in knowledge management area, I was mainly concerned with the relationship between data, knowledge management and sensemaking (discussed in Hasan and Gould, 2001). Before the study, I hold the view that knowledge

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management theories and models can be used to fill the gap between sensemaking and BI. In my opinion, sensemaking and BI are both about the knowledge creation part of knowledge management. However, sensemaking deals with creating tacit knowledge, while BI creates explicit knowledge. BI, also, assists in storage and retrieval part of knowledge management cycle. I am, therefore, of the opinion that a BI-driven sensemaking can be used to convert explicit knowledge to tacit knowledge.

Throughout the subsequent research, I, therefore, had to be acutely aware of my own understanding of data mining, analytical tools and knowledge management. I had to ensure that those views did not interfere with the process of data analysis.

4.1 Participant selection and sampling

According to Weick and colleagues (2005, p. 410) “organisational sensemaking is first and foremost about the question: How does something come to be an event for organisational members?” As also explained in Section 3.2.2, the unit of analysis in this study is individuals who use BI tools in their daily decisions. Hence, interviews were conducted with study participants from separate organisations to identify their personal experience in using BI, making decisions and making sense of their organisations (see “participant selection and sampling” in Section 3.2.2). Other sources of data such as documents or log data were not used since the lived experience of the study participants was only of interest as a requirement of phenomenological study (see Section 3.1.1). Most of the interviews

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were one-on-one, however in some cases (on study participants' requests) interviews were conducted in small groups.

Following criteria discussed in Section 3.2.2, purposeful sampling was used to select study participants. Collection of data continued until saturation on the aspects of participants' experience that were the focus of this study was achieved. Saturation occurred after 23 interviews with 27 participants. All the participants and their companies were given pseudonyms to assure their confidentiality. As the consciousness of various participants is historically influenced (Gadamer, 2008), the following summary presents their brief profiles to provide an insight into their diverse backgrounds and potentially their experiences (Dickson, 2015). Appendix 3 elaborates more on their work and everyday duties.

The study participants included primary organisational users of BI technology (see "participant selection and sampling" in Section 3.2.2), such as consultants (12), users (6), developers (5) and analysts (5), who were all relying on the use of BI in their work portfolios. As the focus of the study was on both individual and organisational sensemaking (see Section 1.2), the study participants were chosen mainly from large enterprises (including multinationals), each with over 1000 employees, where rich organisational settings could support the creation and evolution of BI-based sensemaking for individuals and their groups. Only five organisations were small BI consulting companies of fewer than 100 employees. The chosen companies were from a variety of different industries, including IT, finance and banking, government, healthcare, education and retail (see Table 7). The choice of wide range of participants from different industries including IT, finance, banking, government, healthcare, education and retail in various size,

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small, medium and large, assisted in enhancing the transferability of this research (see transferability in Section 3.3).

Table 7: The characteristics of study participants

Pseudonym	Position	Industry	Company size
Hill	Managing Director	IT	Fewer than 20
Shaun	Executive Director	IT	Fewer than 100
Jane	Senior Consultant	IT	Fewer than 20
Scott	General Manager, Development	IT	More than 1000
Shane	Technology Strategist	IT	More than 1000
Daniel	Data Analyst	IT	Fewer than 100
Myla	Data Analyst	IT	Fewer than 100
Nathan	Director, Sales and Marketing	IT	Fewer than 100
Robert	Channel Technical Manager	IT	More than 1000
Roy	Software Sales Manager	IT	More than 1000
Alfred	Director, Data Integration and Management	IT	Fewer than 100
Chandler	Director, Financial Governance and Planning	IT	Fewer than 100
Ross	Founder, Data Visualisation Company	IT	Fewer than 100
Madison	Director, Enterprise Intelligence	Finance	More than 1000
Dale	Data Analyst, Enterprise Intelligence	Finance	More than 1000
Matt	Manager, Business Intelligence	Education	More than 1000
Jordan	Senior Data Analyst	Education	More than 1000
Rachel	Director, Research and Analytics	Government	More than 1000
Sahil	Manager, IT Strategy and Architecture	Government	More than 1000
Clark	Director, Operations	Government	More than 1000
Jeffrey	National Manager, Financial Reporting and Analysis	Government	More than 1000
Glenn	Manager, Data Analysis	Healthcare	More than 1000
Arnaldo	Business Intelligence Developer	Healthcare	More than 1000
Ruofan	Senior Business Analyst, Data Infrastructure	Banking	More than 1000
Ian	Operations Manager, Diagnostic Imaging	Healthcare	More than 1000
Andrew	Manager, Diagnostic Imaging	Healthcare	More than 1000
Emily	Senior Delivery Analyst	Retail	More than 1000

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The most common tools used by study participants were Microsoft SQL Server, IBM Cognos and TM1. Depending on the company and the level of analytical skill, other tools were used from vendors such as SAS, Microsoft (e.g. Excel with BI add-ins), IBM (e.g. SPPS and SPSS Modeller), R, Tableau, Omniscope and Procuretrak, Oracle, Lavastorm, Allesco, MapInfo, Siebel, Manugistics, Maximo and Unica.

4.2 Conducting interviews

The study participants were mainly contacted by email to arrange the interview at a time and location suitable for them. The setup of interview varied based on the study participants' request in a way that they felt secure to fully express themselves. Most of the interviews lasted about one hour and were conducted at their workplaces to make it easy and convenient for them to participate. However, two interviews were organised in a meeting room at Deakin University.

The majority of interview questions were open-ended and were tailored based on the role of the study participants and the type of their company. Since the majority of the study participants were not familiar with sensemaking theory, questions focused on familiar notions related to individual properties of sensemaking (see "conducting interviews" in Section 3.2.2). For example, they were asked to explain how they extract insights, how they use predictive models, or what are the sources of data in their BI systems, which is related to cue extraction, plausibility and retrospection in sensemaking, respectively.

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Also, as sensemaking is ongoing process of dealing with ambiguities, and decision-makers or sensemaker move through this journey by making decisions and taking actions (Weick, 1995), study participants were motivated to explain their daily interaction with BI system, their actions on BI reports and decisions which are made during this process. They, therefore, were invited to provide examples of using BI for decision-making and for using BI reports in the process of gaining insights into the organisation and its challenges. The following semi-structured questionnaire was used during the interviews as a guide to free-flowing discussion rather than as a strict series of prompts and answers. The interview was preceded with an informal introduction of all participating parties (including interviewers, interviewees and some support personnel).

- Describe your role in the organisation.
- Describe your clients and their organisation.
- Describe the BI technology used in your business and the ways its various components are used by different departments and BI users.
- Describe how you use BI in your day-to-day practice.
- How frequently do you rely on BI to support your day-to-day problem-solving?
- Do you see yourself heavily dependent on BI?
- How do you perceive the importance of BI in your organisation?

Then, study participants were asked to provide examples of complex business situations that required large amounts of business data, complex data analytics and visualisation, and which were needed to understand the situation and prescribe an action plan. They were also asked to explain these cases by discussing the use of

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BI tools. A set of questions was designed to investigate how BI could be used to assist understanding of business setting and operation. With a focus on sensemaking properties, study participants were asked to explain how they use BI for understanding their business environment as well as decision-making in complex and ambiguous situations:

- In what circumstances do you or other decision-makers typically face this situations?
- What kind of data is commonly involved in this process?
- How can BI help managers in understanding confusing or complex situations?
- What analytic tools do you find most useful in this process? How did they help?
- Explain how BI could assist in making executive decisions.
- Explain how BI could assist in developing action plans.
- Explain the role for what-if analysis in decision-making.
- Explain how BI could assist in strategy planning.
- From your perspective, how well (to what extent) do BI analytics actually support executives in understanding business operation?

Subsequently, a series of questions was used to explore the use of visualisation for understanding the organisation. This series of questions aimed at identifying data visualisation aspects that may be of use for understanding the business environment:

- What BI visualisation do you prefer (or not) and why?
- How are executives using visualisation tools?

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- How could data visualisation help in dealing with information overload?
- Is personalisation of visuals important for decision-makers? Why?
- If so, can existing systems support ongoing changes to the personalised analytics?
- To what extent do you rely on interactivity with visualised data?
- From your perspective, how well (to what extent) does BI visualisation actually support executives in understanding the business environment?
- Do you see any preferences among executives in terms of insight presentation? What type of presentation is typically preferred and why?

Then, as not only success stories of BI use can be used to explore requirements of BI-based sensemaking, study participants were also invited to share any stories of failures, which involved the use BI or the failures of not using BI within their organisations. They were asked to describe how and why this happened:

- How do you overcome the problem when executives are not convinced with the results?
- Could you share your experience when you are dealing with executives that are sceptical about using BI or when they prefer relying on their intuition and experience only?

As collaboration between BI stakeholders is highlighted in the literature of BI and sensemaking, study participants were asked to explain how they and other BI stakeholders collaborate on decision-support systems and how BI can facilitate this process:

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- What sort of decisions involve all parties during the process?
- What sort of decisions do you need to be in charge of by yourself throughout this process?
- What sort of decisions can you not make by yourself but need to involve others during this process?
- What sort of decisions should be made together?

Finally, a set of questions was asked to evaluate the result of this collaboration in assisting BI end users in understanding their business.

- What aspects of BI do you think need to improve in the near future?
- What are the challenges/problems for you in using BI for understanding the organisation?
- What kinds of technologies would you like to be available in future BI tools?
- What do you think BI would be able to do and what is BI not able to do in future?

Apart from the interview with Sahil, which was conducted by my principal PhD supervisor, my supervisors and I engaged in all other interviews. As free discussion with the study participants was adopted, the interviewers used a questionnaire template and checklist to ensure that all important aspects were covered and captured as per schedule. It should also be noted that in many cases, study participants had a clear preference as to the focus of their interview and were allowed to elaborate on the issues of interest to them or add new aspects that were not planned or anticipated. Interviewing the last study participants did not add any new insights to the issues of BI-based sensemaking, nor did they suggest additional

issues of concern that have not been discovered earlier. Since saturation has been achieved at this stage (see theoretical saturation in Section 3.3), there was no need to conduct more interviews.

4.3 Phenomenological reduction

During the cyclical process of data collection (see sections 4.1 and 4.2) transcripts were prepared and immediately subjected to the hermeneutic phenomenological analysis. It is important to note that epoché was practiced throughout this process, and the following self-reflection guided the analytic activities.

During the extensive review of the literature, my understanding improved in the subject of BI and sensemaking. I, also, taught several units of a Master of Business Analytics course at Deakin University. This provided me with a great opportunity to engage in different lectures and meet industry lecturers who had invaluable experience in the BI field. This changed my previous understanding of BI, which was mainly about predictive analytics. I realised that, the applications of BI are, predominantly, limited to the reporting. The importance of information presentation was also highlighted during many workshops that I attended. Interviews revealed many unexpected insights into the research domain. In particular, interviews with people who had different roles in their organisations, data analysts, consultants, developers and end users of BI encouraged me to revisit my presuppositions and acknowledge the importance of communications between different BI stakeholders.

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As it can be seen in the above epoché statement, my understanding about BI was improved during my academic work and literature (see my epoché statement at the start of this chapter). During this step, I was mainly concerned about the role of BI reporting, predictive analytics and data visualisation in organisational sensemaking. The next sections present the details of listing and preliminary grouping, reduction and elimination and clustering codes into themes. This is followed by individual textural descriptions of three study participants.

4.3.1 Listing and preliminary grouping

By reading the interview transcripts, concepts related to using BI in organisations were uncovered and dubbed with preliminary codes to represent them. These codes include the concepts related to using BI within organisations for better decision-making and for understanding business environments. Following the guidelines presented in Section 3.2.2 (see “listing and preliminary grouping”) open coding using the following steps was used to uncover the preliminary codes.

- Transcripts were prepared and split into questions and paragraphs.
- All the paragraphs were numbered in a spreadsheet.
- Some preliminary codes based on the literature review of BI and sensemaking were identified.
- Each text fragment was assigned with a preliminary code based on its contents. During this step, sometimes new codes were added, and sometimes the text was split into smaller fragments if it covered multiple issues.

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For this to take place, the text had to read and re-read several times, and codes and the understanding of what the text was about had to be modified. It was necessary to go through the previously coded text and add new codes that emerged, and to change the interpretation of those fragments. In total, 56 preliminary codes were uncovered, listed below:

BI evolution	Notifications
Iteration in report generation	Alerts
User's feedback	Ad hoc queries
Repetition in report generation	BI ubiquity
Shared understanding	Metrics
Problem identification	KPIs
Business gaps	Scorecards
Business needs	Insights
User's expectation	Patterns
Collaboration	Trends
Commenting on reports	Starred reports
Editing reports	Ease of use
Report circulation	User's capability
BI budgeting	Knowledge
Copying BI solutions	Experience
BI adoption	Engagement
Company's history	User's scepticism
External data	User's resistance
Business rules	Report validation
Business change	Justifying decisions
Business process	Options in reports
Data sources	Uncertainty
Report automation	Accuracy of reports
Live data	Confidence level of reports
On-time reports	Risk of decisions
Age of report	Prediction

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Storytelling	Details of reports
Information overload	Personalisation

The preliminary codes were subsequently reviewed and those with similar meaning in the relevant context were combined to shape final codes. As explained in Section 3.2.2 (see “listing and preliminary coding”), axial coding was applied to relate categories to their subcategories and reassemble preliminary codes that were fractured during open coding (A. Strauss and Corbin, 1990, p. 124). Specific adjustments to the preliminary codes are presented in Figure 14.

Iteration, repetition and user feedback are categorised under BI evolution. A final code named “problem identification” was used to categorise existing “business gaps”, “business needs” and “user’s expectations”. “BI user collaboration” represents “commenting on reports” by end BI users, “editing reports” and “report circulation”. One of the main functions of BI is providing decision-makers with insights about their business environment. Thus, a common code named “insights” was used to denote “patterns”, “trends”, “starred reports”, “KPIs”, “metrics” and “scorecards”. “Accuracy of reports”, “confidence level in reports”, “risk of decisions” and “prediction” are replaced with “uncertainty”. “Alerts”, “live data” and “notifications” are replaced with “automated reports”. Also, “age of report” is substituted with “on-time reports”.

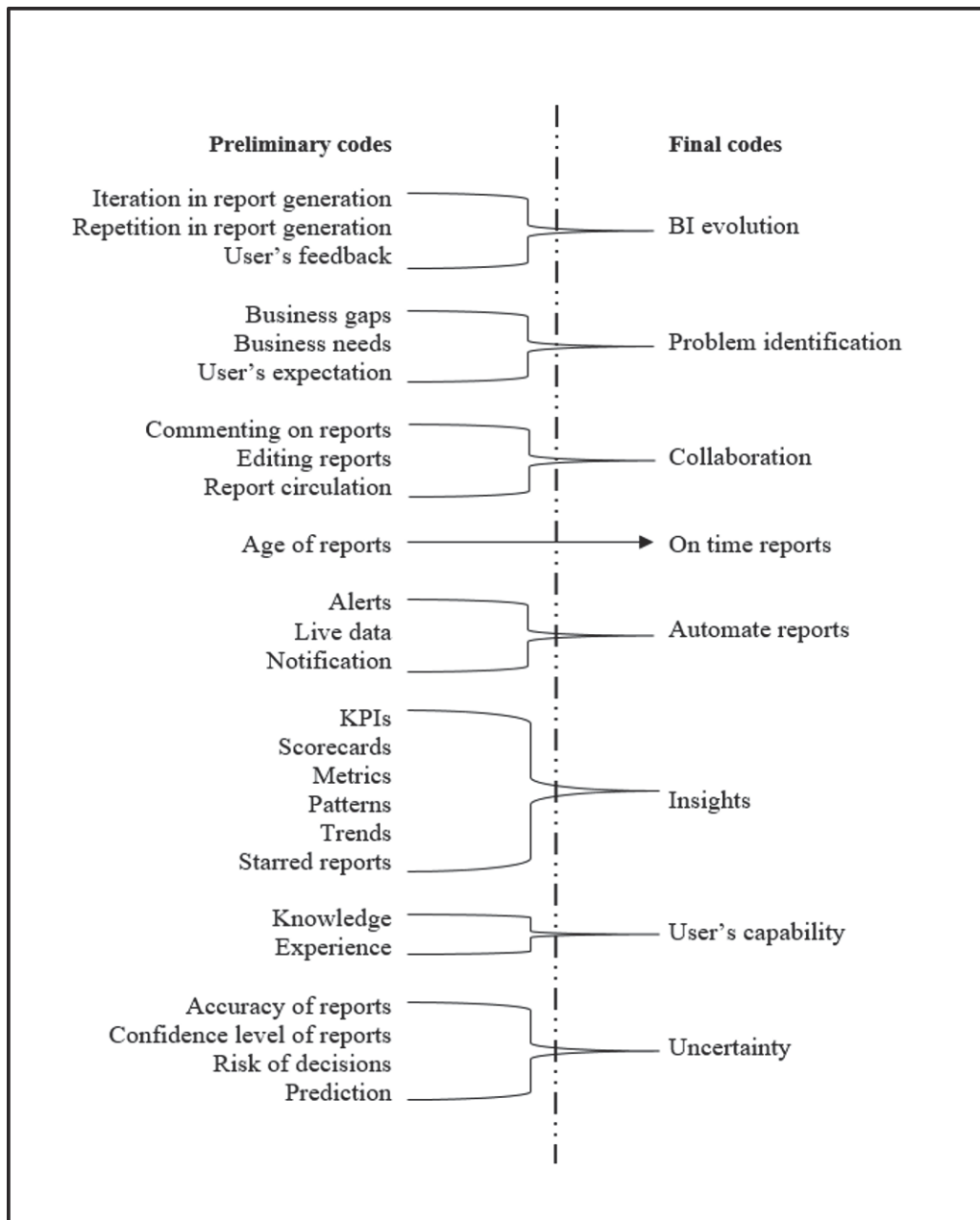


Figure 14: Grouping preliminary codes

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After axial coding, 31 common codes resulted, which represented various aspects of BI that had some significance to BI stakeholders for sensemaking within organisations.

BI evolution	Ubiquitous reports
Shared understanding	Insights
Problem identification	Details of reports
Collaboration	Storytelling
Business change	Personalisation
Business process	Information overload
Data source	Justifying decisions
Company's history	Options in reports
External data	Uncertainty
Business rules	User's scepticism
BI budgeting	User's resistance
Copying BI solutions	Report validation
BI adoption	Ease of use
On-time reports	User's capability
Automated reports	Engagement
Ad hoc queries	

It should be noted that each final code was mentioned by one or several study participants. While some of them, such as “collaboration”, were mentioned by several study participants, others such as “options in reports” were just highlighted by a few. Table 8 illustrates the final common codes and the study participants who talked about them. The highlighted items in this figure show that a quote for that specific relationship is presented in the next chapters.

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Table 8: Summary of common codes

	Hill	Shawn	Emily	Jane	Madison	Date	Matt	Jordan	Shane	Scott	Daniel	Myyla	Rachel	Nathan	Sahil	Alfred	Chandler	Ross	Glenn	Arnaldo	Clark	Ruofan	Robert	Roy	Ian	Andrew	Jeffrey
BI evolution			x		x	x					x			x		x				x	x				x	x	x
Shared understanding	x									x	x					x						x					
Problem identification		x	x		x	x					x			x		x						x	x			x	x
Collaboration		x				x		x	x	x			x		x				x	x		x					x
Business change	x						x							x						x			x	x			x
Business process	x									x				x									x		x		x
Data source														x													x
Company's history	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
External data	x	x	x						x		x																x
Business rules				x				x	x		x						x					x	x				x
BI budgeting	x	x	x											x		x						x		x			
Copying BI solutions	x																					x		x			
BI adoption	x													x		x				x		x	x			x	
On-time reports	x	x	x		x											x							x				
Automated reports			x		x											x				x				x			
Ad hoc queries			x		x	x	x						x	x							x						x
Ubiquitous reports									x							x			x	x					x		
Insights			x		x	x	x	x						x	x									x			
Details of reports		x		x					x					x	x					x							
Storytelling				x	x				x				x						x								
Personalisation														x													x
Information overload		x	x	x			x							x	x												
Justifying decisions																	x			x							x
Options in reports															x					x							x
Uncertainty		x	x					x	x					x		x			x			x	x		x	x	
User's scepticism					x		x				x			x												x	x
User's resistance					x		x				x			x		x			x					x			
Report validation											x			x	x					x					x	x	x
Ease of use																						x					
User's capabilities		x					x		x		x									x	x			x		x	
Engagement											x			x								x					

4.3.2 Reduction and elimination

The purpose of this reduction and elimination is to arrive at textural meaning and invariant constitute of the phenomenon under the study (see “reduction and elimination” in Section 3.2.2). To this aim, with reflection on each transcript, statements that were vague, repetitive or overlapping were eliminated.

Subsequently, using Excel, I grouped statements with the same code so that study participants’ views on specific issues could be fully presented and easily referred to. For example, Clark in statement 28 talked about iteration, evolution, feedback and negotiation. In statement 41, he talked about integration, business rules, conversation and scope. Both statements related to communication, and were consequently grouped together. Therefore, all the common codes that emerged in the study participants’ experiences were extracted. Consequently, I achieved the horizon of understanding for each study participant.

4.3.3 Clustering codes into themes

After uncovering the preliminary codes and grouping them to shape final codes, and eliminating the overlapping, repetitive and vague statements, final codes were clustered into themes (see Table 9).

During this process the guidelines of Strauss and Corbin (A. Strauss and Corbin, 1990, p. 146) were used to shape the themes (see “listing and preliminary grouping” and “clustering themes into themes” in Section 3.2.2). The following explains the nature of thematic clusters and the process of their creation.

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Table 9: Identified themes and their common codes

Themes	Final codes
Scope definition	BI evolution, Shared understanding, Problem identification, Collaboration
Process alignment	Business change, Business process, Data source
Integrity	Company's history, External data, Business rules
BI customisation	BI budgeting, Copying solutions, BI adoption
Turn into action	On-time reports, Automated reports, Ad hoc queries, Ubiquitous reports, Insights
Data presentation	Details of reports, Storytelling, Personalisation , Information overload
Intuition	Justifying decisions, Options in reports, Uncertainty
Trust in data	User's scepticism, User's resistance, Report validation
Exploration	Ease of use, User's capabilities, Engagement

Several study participants noted that for addressing business problems with BI, first, a shared understanding between different BI stakeholders should be developed. To this aim, various BI stakeholders should collaborate to employ an evolutionary approach and identify the scope of BI within their organisations. Thus, a theme named “scope definition” was created, which includes “collaboration between various BI stakeholders”, “BI evolution”, “shared understanding of BI” and “problem identification”. The study participants spoke about three common codes that are closely related to the business processes. They highlighted the importance of modifying business processes to achieve a high-quality data source. Therefore, “business change”, “business process” and “data sources” were combined to create a “process alignment” theme.

BI systems are designed to provide a clear view of the business environment. To this aim, different sources of data should be integrated. More importantly, data rules should be in the same line with business rules. A theme named “integrity” was developed, which is a combination of “business rule”, “external data” and “company's history”. Several study participants spoke about the required

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characteristics of BI and its reports for assisting decision-makers in taking actions. “Insights”, “automated reports”, “ad hoc queries” “on-time reports” and “ubiquities reports” are the common codes that can potentially facilitate taking action with BI systems. Thus, they are clustered into the “turn into action” theme.

The study participants understood the importance of customising BI based on the organisation’s culture and strategies. A theme named “BI customisation”, thus, was formed to address “BI adoption”, “budgeting” and “copying BI solutions”. Even though adoption and providing enough budget are the common codes directly related to customisation, copying BI solutions contradicts BI customisation. Indeed, some study participants cautioned on the risk of copying BI solutions without considering the requirements for adoption. While the developed themes to this point were about organisational requirements for using BI, the remaining themes are mainly about individual needs and characteristics for the use of BI. These themes are “data presentation”, “intuition”, “trust in data” and “exploration”.

“Data presentation” is composed of “details of reports”, “storytelling”, “information overload” and “personalisation”. The study participants understood that decision-making is associated with risks and inexact situations. Even fact-based decision-making can be influenced by the fuzziness of outcomes. They noted that in some situations intuitive decision-makers look for evidence in BI reports to justify what they already have in mind. They are also happy to accept BI reports, which merely imply plausible outcomes and identify inexact options. For example, the statistical power of predictive models can be provided, therefore, decision-makers will know that the model can work with a definite level of uncertainty. These reports give them the opportunity to apply their own judgment while making

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a final decision. The theme “intuition”, therefore, consists of “justifying decisions”, “options in reports” and “uncertainty”.

The “trust in data” theme describes how BI reports can motivate decision-makers to rely on the reports and use them. It is composed of “report validation”, “user’s scepticism” and “user’s resistance”. Finally, several study participants elaborated on the role of BI users’ analytical skills for using BI reports. The “exploration” theme, thus, was developed to address “engagement”, “ease of use” and “user’s capabilities”. In the following sections, individual textural description for three study participants is presented to describe the developed themes.

4.3.4 Individual textural description

The purpose of preparing a narrative from an interview transcript is to clarify what understanding was derived from the interview, and to help recognise and identify relevant qualities of experience reported to the interviewer (Moustakas, 1994, p. 133). As explained in Section 3.2.2 (see “individual textural description”), in hermeneutic phenomenology such narrative forms are called “textural descriptions” and are used in later stages of data analysis (Creswell, 1994). To improve generality and transferability (see Section 3.3) of the results, in preparation of individual-textural descriptions, I tried to focus on the parts of interview which were general across wide range of industries and companies in various sizes. Therefore, I avoided considering points of views of study participants when it was specialised to their company size or their industry.

For the sake of brevity, in this thesis, only three individual textural descriptions are included in their entirety, based on interviews with Clark, Shaun

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and Hill (see Table 7). The analysis of the remaining interviews can be found in Chapter 5 and the Appendix 4. The selection of these participant interviews covered all identified themes (see Table 9 and Figure 15). Moreover, as these three participants elaborated on some common themes differently, their textural description provided insights for the imaginative variation presented in Chapter 6. Other individual textural descriptions of the remaining study participants are available on request. Note that in the ensuing discussion, references to study participants' views and opinions have been enclosed in square brackets, identifying the study participant's pseudonym and the paragraph in the interview transcript. Furthermore, in some included quotes of the study participants' statements, the names of their clients are replaced with "client" to ensure confidentiality.

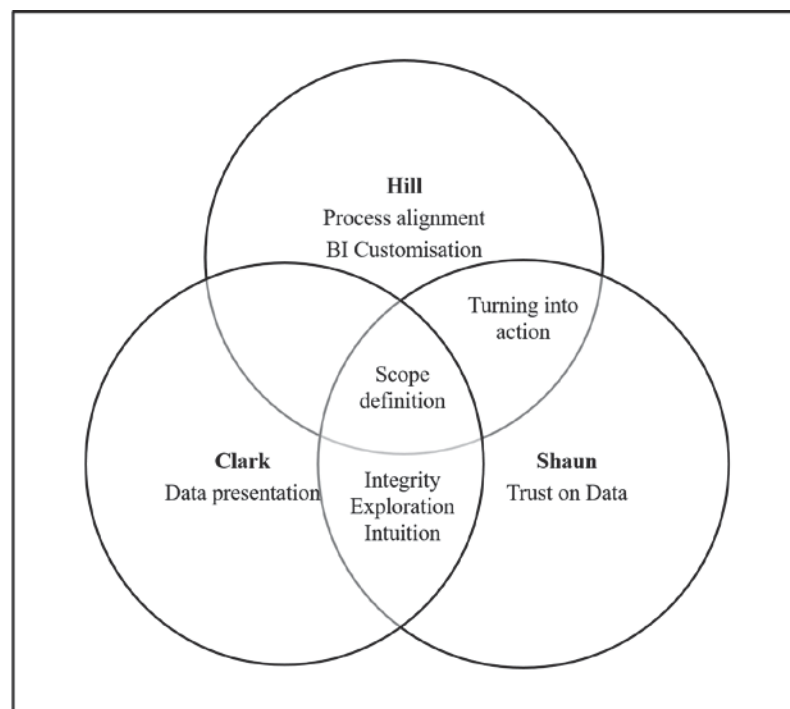


Figure 15: Themes in selected individual textural descriptions

4.3.5 Textural description of interview with Clark

Clark is a Director of Operations in the government sector. During about two, Clark has been working on a project that is focused on reviewing the design of a BI solution for his organisation. Prior to that, for the several years, he has been a Director of Risk and Intelligence in a number of business areas. In those roles, he has had experiences of using large data warehouses for data analysis and delivering decisions with BI tools. He has been dealing with an Australian large and a large warehouse since early 1995. In his career, he has progressed from doing quantitative and technical work into qualitative work and translating the data into the business to create intelligent reports. He has experiences in interpreting BI reports and developing practical solutions that integrate BI outputs and everyday business decisions. In his role, he is more concerned about enabling people to understand BI and interact with self-service BI tools. He attempts to use the functionality that his organisation owns to turn business information into beneficial reports that assist in making decisions from the strategic level to tactical level.

In Clark's recent project, his organisation aimed at using analytics to detect defrauds. His previous job also was about building a system that assists in detecting defrauds and dealing with that. He accomplished the project by developing sophisticated data mining models that used prior information to understand the business environment. In the developed model, not only a great amount of quantitative input from the data warehouse, but also the qualitative inputs from the experts were used, which assisted in identifying areas of highest risk and priority for the organisation, and led them into building their annual plans.

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The data warehouse in his company was initiated in 1994. The data is transferred from the transactional systems to the warehouse daily, and forms the foundation for their analytical solutions. These solutions are initiated through Cognos cubes or special purpose applications, which use the underlying specialised data designs from the warehouse. After several years, the capability of his company has significantly increased in terms of using analytics, as they have refined their approach to utilising BI reports and applications, which were previously limited to ad hoc analysis.

Clark elaborated on the complexities of dealing with data in his company. Their initial plan was developing an application that manages the issues related to their client's behaviour. For the first few years, they mainly tried to understand the data. The complexities of their data resulted in a huge amount of work for its preparation.

Big organisations like Coles or Woolworths have very large data stores, but the complexity is quite low, and so it's quite easy for them to work out, you know develop models for understanding how things are performing, etc. The data in SLT [his organisation] is quite complex so it is very different problem than those simpler data problems. So it took us quite some time, but we are now at the stage where there is integration between our transactional systems and our knowledge decision-support type systems. So what happens is that the returns come in, into our transactional systems, and then push straight into here, and we run our models and we then push information back etc. [Clark, ID6].

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Clark provided links to their programs and explained that his team is planning to bring together the picture of their focus by integrating “quantitative and qualitative intelligence”. Clark noted that the quantitative side of this integration is driven directly by his company’s BI environment.

Business intelligence is an integral component in developing that understanding [of the business environment], of where the risk lies, setting a strategy and delivering on that strategy through the business. It happens in a variety of different ways. I should say ‘though, it’s important to understand that it’s not just business intelligence systems that does it because you’ve got to take that qualitative aspect in. Because we’ve got lots of people out there touching the clients etc. they bring back a perspective and so it’s how you integrate those into the picture that really matters [Clark, ID19].

Clark added to his previous view by elaborating on different types of clients that his organisation faces, including individuals, micro-businesses, medium enterprises and large businesses. He explained that the role of qualitative data is more significant in dealing with large enterprises. In fact his organisation uses mixed methods, which employs both qualitative and quantitative data, to make decisions about large enterprises.

The further you go towards the large business, which is small markets, small and medium enterprises, the large businesses – I can’t remember exactly what the number is; a thousand or something – typically at that end there is a big use of data but the quantitative data is most probably only representing 25 per cent of the decisions. The rest of the decision is around other qualitative inputs that we get from media, we get from interviews with clients etc. that

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will draw us to that final conclusion about what we should do. Down at the other end of the individual market, where you've got 12 to 13 million clients lodging returns, basically we have to pretty much make the decision on the quantitative data because you can't make qualitative assessment on every single one of those. You can't do it. So we do – in the large market there is a very strong use of that qualitative inputs. And as I say, it's most probably 70 per cent of the decision that gets made in the end [Clark, ID33].

A number of common codes were extracted from Clark's interview, including scope definition, integrity, data presentation, intuition and exploration. In the following, each of them will be discussed with the reference to interview notes.

Scope definition: Clark understood that developing a BI system occurs over time and requires an evolutionary approach. After several years, there is still a gap between their enterprise reports and the reports that can be beneficial for users at the operational level. His aim of BI development is achieving reports that are integrated across all levels of the organisation and BI would be used as a part of the process of understanding business operations and strategy planning. In this line, he elaborated on the evolutionary nature of BI:

Development of these things [BI], to me, is always a little bit evolutionary. I know your normal project management is that you start off and you define your project, and you do your analysis, and you end up with a problem down here. But reality is, in this world [BI], it's very iterative and so what happened in that particular case was, up front we had a design conversation around how this might work within the business. Just how – if we can tell you which agents are the high risk ones, and we have conversations around what that

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might be before we started building the models, right? But we said, “How will this happen? How will you have a conversation? What will you be looking for? How will you then deal with it?” [Clark, ID28].

He gave his experience of developing BI within his organisation, where the feedback of BI end users should be constantly monitored to improve the reports.

We went through all that up front and then what we did is we produced this one page and we said, “How about if we delivered something like this?” We haven’t even worked out how to do it yet. But we said, “How about if we delivered something like this?” And they looked at it and said, “Oh, yes, that would work but we’d also need to know this” [Clark, ID28].

Clark further asserted that his company followed an iterative process to develop a model that can produce the required reports.

We worked out where to get the underlying data and then we went back again and they went, “Oh, yes, well that’s good but hey, I don’t think that works and I don’t think that works”, and we went through that process. And reality is that good BI works in that way. It is a constantly evolving thing. It’s not static, ever. Because if it is – my experience, and a lot of this is that models age quite quickly, particularly in environments where you’ve got feedback. So as soon as you start going out with something like this and you interact with clients, they talk to other clients and behaviour changes [Clark, ID28].

Clark noted that in his industry the business environment changes rapidly and after few months, developed models don’t work as well as before. Thus they need

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to employ an evolutionary approach that requires taking into account the change in efficiency factors within their organisation.

So what happened was, for instance with Refund Integrity, we started identifying an awful lot of problems but where was the resource that it had come from? So ultimately we had to work out ways of refining our identification techniques and helping put together processes that would make it much more efficient so that we could still do the work but we could do it with a lot less people. But that's the sort of stuff that happens over time, it is an evolving thing [Clark, ID28].

Integrity: Clark elaborated on integrating business rules and data rules for using BI within his company. Although a bright data scientist, who holds a PhD, creates the analytics models, they still need to be translated into business rules. Clark noted that after the reports are generated, it is vital to pass them to the decision-makers quickly to assist in their daily activities; however, the models should be reviewed and modified by business analysts to be converted to forms that are understandable for decision-makers. He then gave his experience of employing an integrated approach for deploying BI:

What we did with this particular project, we knew we had a problem, we knew we had to solve it. One side of it was this issue of, "How do I deal with – how do I do the analytics so I can identify them?" Another part was, "Well how to I integrate the systems?" But the other part was the business processes. And you had to try and make sure that those three things came together [Clark, ID7].

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In his company, in several situations the data analysts have not shown enough understanding of the business. Hence, Clark has continually perceived a gap between the people who produce the reports and the end users of those reports.

We have got some incredibly smart people in our analytics area in National office and I worked for about 15 months on our change program where we updated a lot of our core systems and my job was to try and develop a lot more of these analytical models that will improve our decision-making ability. What I found was that we had some people who were absolutely propeller-hats; they were smart cookies, but they'd turn out things and I'd go, "Yes, so how do I use that?" [Clark, ID11].

He highlighted the need for appropriate communication between data analysts and decision-makers. Clark asserted that this communication between different parties is vital as it facilitates sharing various ideas and different points of view. In his organisation, when there was enough financial support, a meeting would be held between different BI stakeholders. However, recently, they have videoconference facilities that assist in bringing people from different locations together to share presentations and reports. Moreover, they have a community of practice called "Analytics Net" in which they have short weekly sessions, between 30 minutes and one hour, when they discuss various topics, from technical to specific strategic issues. Clark further explained how this collaboration assists in modifying the analytical models.

The way it worked for us, there was a person and he was in the same office as me, but when we were first implementing it, each day we'd sit down. We'd sit down for half an hour. We'd go, "What's happening?" We'd look at the data

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and I'd say, "What do you think that means?" Yes, look, you keep the business people in the loop at all times. Now it's deployed it most probably – I'm not involved with it anymore but it most probably happens once every few weeks, or a month, or whatever, because it's rolling along nicely, etc. You do have to keep those people – you'd need to keep the business people and modelling people involved closely continuously [Clark, ID36].

Clark divided his BI team into two groups: those who understand business and those who know about data. He noted that these two groups do not have a shared understanding of data and the business, and there is a need for a person who has an end-to-end view to facilitate the interaction between these two parties. Clark further elaborated on the necessity for collaboration between two groups within his company: the BI team that produce the reports and the business analysts who are responsible for applying the BI reports.

In the business line I was in, we had a team, I had a team called Risk Information Management Services. So this business line, which handled individuals, also had active compliance areas and advice areas, etc. The way we structured ourselves was I had people who, even though they worked for me, they were responsible to key business people in those areas and for specific types of risks or business objectives. So we also had in my team, we had data miners ourselves, we had the people who could do the real smart stuff etc., so what it meant was that our job was – the job of those people was to make sure that they represented the business and also make sure it happened, right? And that design – that job design was particularly successful [Clark, ID41].

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To add to his previous assessment, Clark described his role as a facilitator of this communication as these two groups were not able to speak in a same language. In his view, the data analysts need to learn how to communicate with the business people.

What you'll find in a lot of places is they'll have the business and then they will have a totally separate corporate area that's responsible for delivering business intelligence or systems, or whatever. And the interaction between those two is not very good because these people don't talk the same language these people talk. So the way I tried to solve that was by having these individuals who were the conduit, if you like, the liaison point, but they were people who had specific type of skills that would enable them to do that. Now, to me, they are the future of business intelligence [Clark, ID43].

Clark further elaborated on the fact that a vital skill for data analysts is communication. He noted that “the most important thing that people have to have, rather than technical skills, is communication”. He also noted that data analysts need to be able to communicate effectively by building relationships with the people they are working with. This communication can be oral or written and it is also about knowing how to walk BI end users through pictures of their analytical thinking.

What they're going to find is that, particularly on the business side, you'll end up – you'll be meeting people who are highly experienced but have pretty fixed views of the world and you'll need to be able to look at that problem with them in different ways. So they need to be quite flexible in their thinking patterns as well, and what's really important here – I mentioned earlier about

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we spent the first few years once we got the data warehouse working out what the data meant. That is incredibly important. In large organisations where the data is simple, it mightn't take too long. So I look at the retail industry and there are a lot of star schemas out there that can adequately represent a lot of the different data requirements out there. Certainly isn't the case in more complex organisations and it's important that these people are able to understand what the data really means. So I think it is important to have the right people in those sorts of jobs, it really is. Get the wrong person and it just won't work [Clark, ID43].

Clark added that for presenting reports for various decision-makers who have different personalities and identities, it is critical to communicate with them properly. In this line, data analysts should consider “the way an organisation is structured”. He noted that “the way people think is representative of the work that they do”, therefore data analysts should understand the way BI end users think and how their organisation is structured and will use the reports.

If you have an organisation that's structured into, cut into really small bits and each person is responsible for that small bit, then their focus is going to be on the small bit and so, consequently, when you come in and talk about this much broader concept, they're not going to understand any of it or what'll happen is, they'll focus on the small bit of what you're talking about that's relevant to them. So sometimes – and this is where that whole bit I was talking about – it's important that the people are able to communicate effectively with the audience they're engaging. It is really important that people have a good ability to really be able to analyse the audience that they're dealing with. And look, it is basic stuff [Clark, ID49].

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In this line, Clark cautioned on the lack of teaching of this skill at universities. He, therefore, gave his experience of attending a course that was mainly about identifying the identity of audience.

I remember doing training courses where the process you go through is to identify your audience and their needs and all the rest of it. But I think this is the sort of stuff that we should put more emphasis on. I don't think it's – I don't know, I don't remember doing those sorts of things at university, but I do know from my experience that these are the things that really matter in working in a workplace [Clark, ID50].

Finally, Clark noted that there are many factors that are deterministic in the success of BI and therefore it is not possible to have merely one person with all the skills. For example, he explained that each individual within his organisation does not need to know about data mining and they also do not have enough time to build all the required skills. Clark, therefore, ought to combine various skills from different people to prepare BI solutions that integrate business rules and data rules.

I had people with a whole heap of different backgrounds and skills. I had quantitative researchers, I had qualitative researchers, I had data miners, I had statisticians. The thing is bringing those people together into those teams for the period you need them to do what you need to do, and I think what's important 'though is to understand what it is that you are trying to do. So it's pretty easy to have people working together and they produce fantastic things but then the business areas will go, "I have no idea what that is and what to do with it." And look, we've been through that. I'm not denying it. It took us

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a while to learn how to make sure that we delivered something that was useful [Clark, ID53].

Data presentation: Clark elaborated on various approach for presenting information for BI end users and the importance of its understanding by them. He cautioned that there is no merit in preparing remarkable reports that are not understandable for the users. In his role, thus, he is always concerned to produce reports that are presented based on the needs and skills of BI end users.

It [the report] may be really clever but if you can't do something with it ... And that often is the problem with – you know, there used to be this big focus, a few years ago, on executive information systems and they were wonderful and they were very pretty but the problem was 'though that they weren't connected with the real world. So an executive would get one of those and go, "Oh, wow. That's a problem", but then if it wasn't able to be understood by the people who were actually doing the work and used in some way, it was as good as useless. So our focus is really on making sure that we can integrate this intelligence in with our business activities. So we do a lot of work around that [Clark, ID12].

He noted that there is no specific way of presenting the reports as they ought to be personalised based on the characteristics of the end users. In his view, this personalisation occurs through the communication between BI end users and data analysts. To emphasise the need for personalising reports, he criticised one of the BI tools, Cognos. He noted that even though it is widely used in industry, it does not have enough capabilities for personalisation and the reports are somehow static.

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I quite like Cognos for doing my initial analysis but as soon as you get past that point where you've gone, "Well I've got the high level understanding now", it's virtually useless because it's pretty fixed in the way you present things, you know? Yes, you can turn it into a graph and etc. but – so often it is up to – and it depends now whether you're going to provide something that's going to be used in, say, a production sense, so a bit like the Refund Integrity that someone's going to actually have to build that so that it comes out that way, or whether you're doing a one-off intelligence report. If you're doing the one-off intelligence report it's up to the individual to work out the different ways in which you can actually present that material to actually get across the message that needs to be got across [Clark, ID26].

Clark further highlighted the importance of interacting with BI tools by BI end users. In his view, this approach enhances the reports as BI end users can apply their needs to the reports based on their understanding. He gave his experience in a typical project in which managers used self-service BI to generate reports that were customised based on the characteristics of the users.

That project was a specific example of a custom solution. We do also use software, like off-the-shelf software, and so Cognos is a typical example. You might have heard of Cognos Power-play, which is multidimensional analysis tool. We do use that too – we take the data about our clients and we push it into these cubes which allow individuals, well virtually any individuals working in the office, to use that to do this high level analysis. So, you know, things around: well, how many clients claimed this type of thing? What sort of amounts did they claim, etc.? Without actually knowing the fine details of

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which client, they can look at the general trends of what's happening [Clark, ID13].

In another case, these reports were presented for clients to justify the actions that are taken. However, using BI reports for this purpose has been controversial in some cases, as clients may ask for the reasoning behind the decisions.

So in that particular case [suspension of a service for an individual], what we had to do was we had to give them enough detailed information about the return that helped to explain why we stopped it and why they needed to look at it. And it needed to be enough so that when they talk to the client they could say, "Well look, based on this and this, we clearly don't think this can be right because – and this is the reason." So it was, in that particular instance, the information we're providing is quite detailed, it is table format, it gives specific examples [Clark, ID24].

He further added to this previous view by noting that presenting the information is not always in detail, as in some situations a brief presentation could be more efficient.

In another case – we actually have a tool called a Client Agent Profiler Tool ... It was a single page; it was a picture of a graph that showed them how they were behaving in comparison to their peers. So no details at all, or very little, there were just some down the bottom, but it was a very powerful tool because immediately a person could look at it and go, "Oh, I've got a problem" [Clark, ID24].

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Intuition: Clark noted that analytics and its plausible outcomes are important applications of BI within his organisation. The use of prediction models is not only limited to operation level decisions, but also includes risk models at strategic levels.

What we do is we use business intelligence and analytics tools etc. to help us draw those conclusions at everywhere from a systemic level down to an individual transaction level. The idea is that (a) we'll know where our risks and priority areas are, and (b) once we do know that, we'll be able to identify those clients who are much higher risk and the people we need to actually touch, so that we don't touch the people that we don't need to [Clark, ID18].

His organisation usually uses predictive models to have a better understanding of their clients. He noted that the decision-makers in his company prioritise the customers and use BI models to predict defraud of small businesses and individuals. However, for deciding on large enterprises, for which the risk of fuzzy decisions is high, decisions are mainly made by experienced individuals.

Exploration: Clark highlighted the importance of interaction with the presented information and exploring the results by BI end users. To this aim, data analysts should motivate decision-makers to interact with reports. They also ought to engage with decision-makers to teach them how to interact with BI tools and generate reports.

Having those oral, written [communication and] relationship building is particularly important as well, and as you say it's a soft skill. But it's about how to engage people, it's how to convince them, how to really lead them on the path with you, and it's pretty important [Clark, ID45].

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In this line, he again shared his experience of undertaking an academic course to improve his skills for communicating with people in a business environment. He noted that not only is it crucial to present the reports in the right format for decision-makers, but end users also need to have required skills to use and interpret the generated reports.

I think also important is this concept of information design. It really is a skill, and I'm not saying, I'm not very good at it. Luckily, I've got information designers who work for me. But the ability to be able to present the information that tells a story that needs to be told is really, really important. Now, some people like words, some people like pictures, some people like [to] avoid conversations; it's knowing how to be able to present that information that's pretty important [Clark, ID46].

Clark found creative thinking vital for using interactive BI reports for decision-making. He discussed the benefit of his experience of attending the course about decision-making and what he learned for using his intuition while working with the numbers.

The bottom one, which I hand wrote because I suddenly realised how important that is, is what I call decision techniques. There are a whole range of techniques about ways in which you can make decisions and your average business person operates on what I call an intuitive level. I'm not saying it's wrong because often it's based upon years of experience and they're making decisions based on a set of facts that they don't even consciously recognise. But it's important to be able to lead them on that path to be able to make a good decision and there are a range of techniques that you can use for that. I

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actually did do a course at Monash Uni. It was – I think it was part of – I started off doing a masters; didn't finish it, which was around decision support or decision techniques [Clark, ID48].

In Clark's view, learning how to make a decision model is basically different from generating a BI report. He noted that the latter would be easier, however it is mostly forgotten in the teaching courses. Thus, both decision-makers and data analysts should learn these techniques.

It is really important that people can help the business people in making good decisions. I would really like to see that being taught because some of them are – I mean, it's nothing really – well some of them are difficult. I hated Bayesian Analysis. But there is a lot of simple techniques for helping people make good informed decisions out there, and I think we should be teaching graduates that sort of stuff [Clark, ID48].

In Clark's experience the role of communication between data analysts and BI end users was significant. He, therefore, described his role as a translator between technical and business sides. In his view, communication between these two parties is required to leverage the understanding of technical people about the business side and to improve the BI skills of decision-makers and BI end users.

4.3.6 Textural description of interview with Shaun

Shaun is an Executive Director of a benchmarking company, which was initiated in Europe more than 20 years ago. Her company offers various services including price benchmarking, process benchmarking, spend analytics and enterprise support decision-making. Shaun holds a bachelor's degree in education

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and a master's degree in business. She has worked in her current role since the start of her company in Australia. Prior to that, she worked with a business process outsourcing organisation. She has been in charge of operations and business development and basically the operations of the business. Her company collaborates with various sectors.

During her experiences, Shaun realised that data is not used to its fullest by organisations. She noted that data should be used in an ongoing manner not only for everyday operational reports but also for trend analysis or predicting customer behaviour.

One of the good things about that is they are realising that the data has more applications than just that point in time, which is kind of shooting ourselves in the foot a bit. But quite often organisations will collect data with a particular purpose. They use it, they generate a report, they make a decision or not, and then they leave the data. But that data actually would be useful on an ongoing basis for something else, always is. Maybe it's trend analysis, maybe it's looking for baskets – whatever it is. We say you need to have almost like a repository of that information because it will be used for other things [Shaun, ID51].

Shaun asserted that organisations need to have a comprehensive understanding of their data and its applications. She cautioned on relying on high volumes of data without considering its quality. In this line, she noted that organisations need to consider all sources of data, whether internal or external, for various applications including benchmarking.

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I see the use of the word big data now and it really, for me, doesn't quite do it. It's not about – as I put in the article, it's not about quantity, it's about quality. But I think that the access to open source information, so information on other organisations, whether that be in effect, benchmarking, anonymised, un-attributable, is gold. To have that insight is really what organisations should be aiming for, whether that's through a formal mechanism – which is preferred, obviously, because it's been through a more rigorous checking. I think that the ability to be able to tap that sort of information into your own systems and look at that is really where organisations will be heading [Shaun, ID98].

Shaun discussed the problem with data sources within the organisations, which result in low-quality data. She thus recommended improving business processes to achieve proper data for BI.

We don't actually say that to the client, like have you got your problem right, but we know from experience that they might be in the market for some reporting and analytic software, but actually the problem is that the data they're extracting from their other source system is not being extracted correctly. They haven't asked for the extent of it and in fact the data that's being fed into that system isn't being fed in properly, so it might be an issue further down or back in the workflow [Shaun, ID13].

Shaun further discussed the hardships of presenting information for busy decision-makers [Shaun, ID38]. In this line, she highlighted the necessity of presenting brief reports and avoiding information overload while providing decision-makers with recommendations. A number of common codes were

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extracted from Shaun's interview, including scope definition, integrity, turn into action, exploration, trust in data and intuition. The following will discuss each of them with the reference to interview notes.

Scope definition: Shaun understood that developing BI scope within organisation requires an evolutionary approach. As a consultant who assist organisations to develop their BI solutions, Shaun attempts to receive feedback from her clients to identify the business problem in an ongoing manner. In this line, she gave a typical example of organisations that employ BI solutions without first defining their scope:

A really good example of that was where they've engaged an Oracle or a SAP but they haven't enabled a spend analytics module or reporting modules or trained anybody in it. So it's the scope and then it's articulating what they believe the deliverables will be from that [Shaun, ID15].

She thus received several requests from her clients to modify and improve the BI solutions that they have developed previously [Shaun, ID85]. She explained that, typically, vendors do not collect data for analytic purposes, and consequently they are not clear about the outputs of their BI systems.

One of the big challenges we find is that vendors rarely see the product of the data or the outputs of the data they're giving. So in the case of – even in the higher ed [education] sector, but for government in particular, they might require their vendors to give large amounts of transaction reporting and information based on what they've spent or the processes and things like that. They then use that for the purposes of analysis and decision-making and the vendor sits there thinking well, what happened with that? Did anything come

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back from that? So one of the things we talk about with our clients is if you are going to put in place with your vendors fairly complex regular, repeatable reporting, they get something back from that [Shaun, ID2].

Shaun emphasised the importance of ongoing interaction between BI end users and developers. Moreover, she cautioned on using BI reports without any feedback from users, as she believes that various points of view should be integrated to achieve the desired BI outcome.

Whether that's a summary of the data they've sent or a couple of insights into the market or into the client, it's still important, otherwise it's like anything, even I'm sure in the faculty, you provide reports – if nobody's coming back to you with any questions those reports become more and more redundant. So that sits a little bit with what we do with vendors in that we are working on behalf of the client but we often talk to clients about making sure that for that large piece of data or that ongoing data you're going to receive – then vendor requires something back to create the carrot for them to keep providing it [Shaun, ID3].

Shaun highlighted the demand for identifying the right business problem. She claimed that although clients usually have already identified a need in their organisation and are aware of the problem that should be fixed [Shaun, ID12], she prefers to verify whether they have articulated that problem accurately.

So first of all it's the problem identification, which a client usually has and we just need to verify. Then there is the challenge of articulating the scope of what they want. So whilst they know they've got a problem, they're not necessarily thinking about the scope [Shaun, ID14].

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In this line, she highlighted the importance of spending a considerable amount of time identifying the business problem and defining the BI scope. She highlighted the interest of her company in a long process of scope definition as she believes the longer it takes the more accurate the final proposal or delivery will be. It also assists in developing a stronger relationship with clients [Shaun, ID16]. In this regard, she cautioned on the clarity of business problem:

If the problem is still not clear by the time you've got to the end or the decision-making phase, then again it's been a failed process, almost [Shaun, ID44].

Shaun elaborated on the necessity of customising BI solutions based on the structure and strategy of organisations. She noted that enough time should be spent for articulating business problems and adopting BI solutions.

There's an example at the moment with South Australia Health, they've had an Oracle – it was in the papers – an Oracle implementation, it's cost a fortune, it's taken two years. Why would people be surprised? It's crazy. That's often the case, because that pre-engagement work has not been through enough, and I think that – you've seen it with SAP and all the other big ones, there's always this oh, it didn't meet our expectations; well, you didn't set your expectation, you didn't articulate them, you didn't articulate the problem. But now I think IT is likely to take much longer than it used to because the risk and the dollar risk associated with it is well known [Shaun, ID46].

Integrity: Shaun recognised that a single view of a business environment by BI could be achieved through an ongoing collaboration between BI stakeholders.

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She gave her typical experience of holding meetings between various BI users. She explained that BI end users within the same organisation, or even same department, usually do not have a shared understanding of BI scope. In her view, these conflicts could be overcome through an ongoing conversation between various BI stakeholders.

We were at a meeting this morning and much to my frustration 18 people, 45 minutes, I walk out and I'm like – and David [her colleague] said to me, “You know, our main business is to get people in a room to talk to one other in an organisation”. So half of that meeting was a debate that they were having amongst themselves about what they – and we were just drawing out. So that's an ongoing challenge; we're bringing people in the same organisation together to have a conversation. That can be typically what it looks like. The organisations, most of them will say and articulate they're looking for savings, whatever they understand that to be [Shaun, ID20].

She then captured the essence of communication between data analysts and BI end users. Indeed, she observed that data analysis is not the only required element of BI, but delivering BI outcomes to audiences and enabling them to interpret reports is also of crucial importance [Shaun, ID114]. As a consultant, she noticed the role of discussion with her clients to underpin their BI needs.

Our analysts are 100 per cent with the data, the moving around of the information with the data analyst, but the benefit is that they can go out and sit with a client and the clients like them sitting with them, and they can talk about the information, and they can say can you see that this data shows you this? Would it be better if you actually had this as what we call a heat map,

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that just has two colours on it, and it says this is compliant and this isn't. So they can articulate that with the client [Shaun, ID115].

Gathering people with various points of view and achieving a shared understanding of BI capabilities and business problems was the rigid part of Shaun's work. She described her experience of holding a meeting with her clients who even did not know each other and consequently did not have an agreement about the BI scope.

In the meeting this morning, our aim, clearly that we didn't realise, was to get those people in the same room to talk to each other. It's phenomenal how many meetings we have like that where we say have you met – have you met Jim from IT, this is Steve from finance, and they're "Hi, how are you, I haven't seen you for ages", and I'm like "How's it going?" I'm sitting there and David like this is what we do, we go to meetings and we put people together to talk about things and then we walk out a bit confused [Shaun, ID117].

She further highlighted the significance of collaboration between people from various departments with diverse skills. In this line, she gave her experience of developing BI in a university:

We've got two clients there, one in procurement, one in finance. The finance guy is superior, unbelievably smart data analytics. He's working on the same sets of data as the analyst in procurement. Do they ever get together? He could do what she's trying to do in five minutes and then go on with his work and do, and they could have this same baseline. Together they would be a powerful team. So when they come here they meet – yeah, "How are you, haven't seen you since the last time you came here" [Shaun, ID118].

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Shaun noted that most of reports are provided for various individuals within organisations [Shaun, ID119]. She explained that, usually, BI stakeholders are not defined within organisations and in several circumstances, at the final stages, new stakeholders with new demands appear.

It may be that some of them haven't been engaged through the process, so for example we recently did some benchmarking for financial services companies and on the delivery of the report – so most of the time we were working with procurement and finance; at the end of the report we were working with marketing [Shaun, ID120].

Finally, Shaun elaborated on the skills of different BI users within various departments. For instance, she noted that usually individuals in marketing departments have a better understanding of BI outcomes and thus are involved more in the process of report development.

They [marketing department] are actually buying this or they're interacting with this information. More often than not that's a really good outcome for us because they then say you could measure this, and we go, yes, that's what we do. Then they say can you measure this? So for us that becomes a really good dialogue, but it is that bringing of stakeholders together [Shaun, ID121].

Turn into action: Shaun understood the need for turning BI outcomes into action and highlighted the importance of generating reports that are timely and actionable. She recognised the age of reports as a vital characteristic of actionable reports. Shaun further explained that for turning a BI report into action the age of the reports should be considered and the use of old reports, which no longer are

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meaningful in the business environment and beneficial for company, should be avoided.

Our reports are actually about the marketplace, they're extremely time dependent. So we know once we deliver a report we've got to get the client to move fairly quickly because six months later that might be what we call aged in the market [Shaun, ID49].

She also criticised using real-time reports in Australia [Shaun, ID86]. She noted that even though there are a number of organisations that use BI to constantly monitor their business environment, most of her clients use retrospective data. To further support this assessment, she noted that even in hospitals BI reports about beds and patients, which are monitored online, are not real-time [Shaun, ID88]. Apart from real-time reporting, Shaun emphasised the importance of trend analysis and what-if scenarios. She further explained that organisations need to be nimble to achieve a “great deal of real time [BI]” [Shaun, ID89].

I think that timing for some decisions is extremely critical. So a case of that is if New South Wales are going to go out for – New South Wales government, say, have gone out for a new catalogue solution for their whole of government buying. No other state is going to move until they've made a decision; why would you? Why would you not wait and see what they do and then maybe pick up the vendors that lost out and see whether there's an opportunity. So I think timing with regards to competition is definitely an influence. Again, the banks are another one. You can guarantee that one of the banks will move and then the others will follow. They're waiting to see what each other does [Shaun, ID94].

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In this line, she added that Australian companies are risk adverse compared to global leader companies that are more nimble in decision-making and which use on-time reports to make decisions [Shaun, ID95].

That's normally poor decision-making, yeah, and that always – that sort of behaviour I guess is what stymies it for the – being I guess a bit more risky. It's a small market, we see people who have burnt themselves down that path. You can also see the benefits of being able to be nimble and take advantage. I think the other piece of them being removed from it is – and how often do we see that an organisation might be tasked – an organisation might have a particular agenda, a business proposal that they need to make a decision on and then something comes in that completely swamps that because of an environmental influence or something like that's happened. They basically refocus [Shaun, ID97].

In the meantime, however, Shaun highlighted the need for adequate time to turn reports into action as often decision-makers, especially in large organisations, don't act on reports quickly [Shaun, ID91]. Shaun further suggested amending insights in the reports to make them more actionable, as decision-makers prefer to see information that is succinct and pointy and is above or below the normal line. She explained that companies are operating in an unsettled environment exposed to ongoing changes and external factors and they require a big picture of the business environment; however, “they often demand pointy information which is drilled down” [Shaun, ID55].

So what you see in all of our reports and our dashboards that come out of the solution are always three actions. There might be six recommendations and

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17 key findings, but there's always three actions and they sit there at the top of any report that we provide a client. That is our biggest challenge is to get the clients to then action those [Shaun, ID27].

To further support this assessment, she gave an example of reports that can be turned into action:

Some of them are extremely prescriptive; they will say in this item in your organisation if you reduced your price by three per cent you would achieve \$20,000. It can be that specific. We always have three at the front of every report [Shaun, ID28].

Intuition: Shaun recognised that there are some intuitive decision-makers who are mainly looking for options in reports and rarely use reports as insights for new innovative decisions. In her view, these decision-makers look for numbers in the reports to justify their action, instead of using the reports as guides for taking action.

Few say we're looking for a tool that will enable us to do decision-making; to be honest, I rarely hear that language, which is really what they are looking for [Shaun, ID21].

In this line, she emphasised the importance of embedding options in the reports. She noted that in several situations BI end users wanted to present BI reports to others [Shaun, ID111]; thus, she provided them with interactive web interfaces.

I think they're looking for a specific outcome and sometimes they're not even clear on the method of how they're going to get there. They might think it was

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going to be enabled by BI but they're not exactly sure how that's going to work. So again, the key is in that scoping, that articulating – and also the output of what they're going to do [Shaun, ID23].

Shaun further elaborated on another aspect of intuitive thinking by BI, which is uncertainty in reports. She noted that BI end users need to know BI outcomes can be used in a plausible manner and the lack of enough data or low-quality data can result in uncertain BI models.

Whilst accuracy might mean this is the most likely outcome, it means most likely not the definite. So in that we know there's a grey area or a percentage of variants in that, but I'm not sure that people would necessarily know that unless they're told those assumptions within the information [Shaun, ID54].

Trust in data: Shaun highlighted the importance of trust in data by BI end users. She noted that decision-makers are mainly suspicious about data and prefer to investigate reports. In this line, she explained that, in some situations, data analysts might be questioned by BI end users; therefore, data analysts should always be prepared and confident to address the vagueness in reports.

If you're not confident in what you might be asked and you might have to then explain or you can't articulate it, then you're not going to show it [Shaun, ID75].

Shaun mentioned the “constant challenge” is that BI end users need not only the required skill for interacting with data, they need also the authority and confidence. Indeed, her experience shows that a lot of barriers will occur if BI end users don't have enough confidence for exploring data [Shaun, ID80].

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We give it at an item level and then we aggregate it up and we say this is where you sit in the market. You might be six per cent by value better than everybody else in the market at that point in time who's buying that product or service. It's a value; it's a percentage but it also might be related to \$2 million. Now if a client looks at that and they believe they are actually better in the market than that or worse, or they have a preconceived idea of where they sit, the first thing that will happen if they don't sit with that is they will call into question the data. That's the first thing they do, they say that oh, the data was wrong, or they'll say we need to look at the data we gave you. The second thing they'll do is they'll call into question our methodology; the third thing they'll do is they'll call into question the comparative group. So we might say we've compared you with everybody in the eastern seaboard who spends between \$10 million and \$15 million, and they'll say oh no, we only want to be on the eastern seaboard, \$10 million to \$15 million, same sector. So they'll start to narrow it down, so we get closer and closer. Sometimes we don't get closer to where they believe they should be [Shaun, ID59].

Shaun recognised that many decision-makers are reluctant to use interactive BI systems [Shaun, ID108]. In this line, she gave a typical experience of providing decision-makers with interactive interfaces:

So with regards to I guess almost like the psychology of providing information, so when we provide a report to clients now – when we did this we didn't used to do it. We send them the Procure Trak [her company] web view and we send them a Word report. We track who looks at the web view,

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so we can see who's gone to it. The majority are still looking at the hard copy Word report [Shaun, ID109].

Exploration: Shaun elaborated on the need for exploring the data by end users of BI systems. She cautioned on the required skills of BI end users for this engagement as a variety of decision-makers are not able to interpret basic BI reports such as graphs. She therefore cannot assume that all of her clients can explore interactive reports [Shaun, ID65]. She noted that lack of required skills could also affect the confidence of BI end users for drilling down into reports [Shaun, ID73]. In this line, she suggested engaging with BI end users to leverage their skills:

I think it's the fact also that they can't understand what sits behind it and how it gets to that. So it's a bit about the visuals, but for a start most of this is irrelevant until they understand where they are. So the first thing is to say do you understand this for you, what this tells you? If you're number 11, what is this just telling you on your own? So we just concentrate with them on their own and then we broaden it out and broaden it out. That's the first thing, and it's a minority but there are people who cannot read graphs, but I think it's more a visual – and also there's people who wouldn't be able to concentrate long enough to actually take time to read, those so-called intuitive [people] [Shaun, ID68].

Shaun further added that BI end users are not clear about their needs in the primary stages of BI development. She thus tries to engage with her clients to clarify requirements [Shaun, ID42].

So we don't market as consultants, so we say we give market business intelligence. Quite often now we have to – if we want to be engaged again

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we're going to have to drag that client along to the action end. What we say to our clients is we will give you the information to perform that action yourself. We do have clients who do that, but [with] some it's very, very painful [Shaun, ID81].

Shaun also explained that she does not put her organisation at the consultancy end as she believes external consultant can't prepare BI reports. Her aim is, therefore, to make individuals within organisations capable of exploring BI outcomes [Shaun, ID83].

In Shaun's experience, a clear definition of BI is required to use BI reports to their fullest for understanding organisational environments. In her view, considerable amounts of time should be spent on the primary steps of BI development to achieve a shared undertaking of BI requirements and outcomes. This process requires several meetings between various BI stakeholders.

4.3.7 Textural description of interview with Hill

Hill is a Managing Director of an international consulting company, which focuses on various aspects of information management including master data management and BI. Their BI solutions cover structured and unstructured information management. His company was initiated in Europe in late 1998, and then expanded in various countries around the world, including Australia. Hill's jurisdiction covers some parts of Asia, in which he and his team assist companies to better manage their information and also understand and exploit how to gain business value from information. From Hill's point of view, BI is about information availability, and data quality plays a significant role on the efficiency of BI systems:

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Imagine you were a manager and you're making a critical business decision on 70 per cent of the actual facts because the other 30 per cent is not healthy enough to be able to make a decision. That could be the difference between a success and a failure. So that's where data quality comes into it. One is, it's 30 per cent, it's not good enough to make a decision on, so we'll put it in the unknown bucket. But then if you manage that, get the master data management, so the proper information management around that other 30 per cent, then that forms part of the bigger picture and business intelligence is the availability of that information to make a decision [Hill, ID7].

A number of common codes were extracted from Hill's interview, including scope definition, BI customisation, process alignment and turn into action. The following discuss each of these themes with the reference to interview notes.

Scope definition: Hill recognised that organisations face an evolution in their information management and their BI systems. He noted that BI was traditionally about information availability, however, nowadays it is more about information management. He asserted that many organisations are not aware of their requirements and the scope of BI. In this line, he gave his experience of facing organisations that asked for BI solutions, when they were actually asking for information management initiatives.

What is the point of "installing a tap to put on the water tank" if the water is going to be dirty? The outcome is drinking clean water. So if you're selling me a tap, is the tap a form of purification as well? Because then I'm interested. But you're actually asking me for more than a tap. You're asking for the tap with clean water and that's information management as opposed to business

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intelligence. Which brings me to the point of the definition of business intelligence and how that's evolved over time [Hill, ID13].

He further noted that organisations need to fill this gap in an ongoing approach. He added that one of the primary needs for successful BI use within organisations is clear definition of inputs and outputs. To further support this assessment, he gave an example of a bank that does not have a clear definition of their customers after several years of using BI.

The fact that I have four credit cards, does that mean I'm four customers or is that one customer? Now a different – two GMs might be saying, no, no, that's one customer because I get remunerated for you having a credit card. I don't get remunerated for you having a loan. So you're two customers from a bank perspective, or from my perspective as a GM. But on the outside, when marketing look at you they say, you're one person. We look at you as one customer. When the definitions aren't clear, the state of your data is not good enough to make decisions and your business processes will help dictate the state of data or let's call them the definitions, clear definitions that are owned [Hill, ID90].

Finally, Hill elaborated on the time needed to define the scope of BI. In his view, the scope of BI should be defined based on the structure, strategy and culture of organisations. He further cautioned on BI solutions that are implemented without considering the specific requirement of organisations.

I think that the main point of value is the business expectation. If you've been digging a hole for the last 15 years, you're not going to cover that hole in the next six months or 12 months. It might take you just as long, even longer to

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recover that. Now that is something that businesses cannot comprehend. It's a bit like being in government, "I've got two years to prove myself." So now you're starting to see terms like agile BI. "We're going to quickly fill up the little holes that matter the most" is the promise, it's not that easy, but explaining that to an executive is probably the toughest part [Hill, ID28].

Process alignment: Hill understood the need for alignment between business processes and BI systems. He noted that the success of BI projects highly depends on the level of engagement of solution providers in business processes. Indeed, he emphasised that the more they are involved in the whole process, the more they will achieve success. In this line, he suggested that organisations should have a clear BI scope and, more importantly, they should determine to what extent it should improve their business processes.

So you have to be very clear on the scope that you're providing. So I guess what I'm suggesting that the successful way to execute this is to understand the definition of success. If I'm going to improve my customer on-boarding process as a bank executive, what are the key success criteria? What happens today? What do I expect to see tomorrow or in three months' time? Therefore in between what does halfway look like? [Hill, ID83].

Hill further elaborated on another element of process alignment with BI, which is the source of data. Hill noted one of the main barriers of using analytics for understanding business environments is the lack of quality data. In his view healthy data can be achieved by business processes that are designed based on data requirements.

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Companies just don't have their data in a good state to be able to do those [analytics and visualisation]. If their data was good and their processes were good, they would get a lot of value out of the analytics, but the two fundamentals are does your process exist? If you can tell me an organisation, does that exist, then move to the next stage. If your process exists, you're right. What is the state? [Hill, ID89].

Hill further emphasised that business processes should provide the required data for analytics. He noted that if effective business processes for BI are designed, organisations can internally generate a great amount of transactions, and even big data.

Where we see people trying to analyse it [data] in real time so that they can do something or catch it through another process. I mean you spoke about the concepts of big data. How does big data fit into this? I mean what was it yesterday that didn't exist, it was just data. So lots of it means we're having more transactions coming through our processes, that's what it means [Hill, ID101].

BI customisation: Hill understood the need for BI customisation and recommended that BI requirements should be investigated from the foundation. In his view, the success of BI is strongly dependent on its customisation based on organisational structure and process. Hill noted that BI customisation starts from investigating business operation and its inputs and outputs, then, managing changes. He further emphasised that BI is not only limited to technology implementation, but it is also about the ways people make decisions and the way

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processes operate. He then elaborated on his approach for BI customisation and information management.

So we typically have a few perspectives that we cover; one is what is your business strategy and what's the corresponding strategy for information management related to the business strategy. What are the right architectures, and structures that will help facilitate this? What are the right technology characteristics? What are the organisational structures and finally, what type of policies and governance do we have in place to ensure that people aren't going to break the laws [Hill, ID11].

Hill observed that lack of enough budgeting is an obstacle for comprehensive BI customisation. To further support this assessment, he gave a typical example of BI budgeting within Australian organisations. He cautioned that the current structure of a typical Australian company results in insufficient BI budget and consequently hinders efficient BI customisation.

I think 80 per cent of initiatives are technology led, and it comes down to how organisations are structured. People get an IT budget. The CIO or whoever it may be will go and ask the business stakeholders, "I need \$X to transform the ..." or "\$X to go and manage your Business-As-Usual IT requirements". So technology requirements typically have budget allocated from my observations. And the budget typically sits in IT – I mean it's a common thread [Hill, ID23].

Hill mentioned that there are few organisations that start BI solutions from the beginning and customise BI based on their structure and strategies. In this line, he cautioned on copying BI solutions without considering the requirements for BI

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customisation. Indeed, he noted that in the process of copying BI solutions, the failures of BI implementation can also be inherited.

There are some companies, very few, who start from the beginning. NBN is a great example, where that's happening, where they're starting a brand new company from scratch. But in the process they try to copy the other companies. Now in the process of copying the other companies or following an approach, you also run the risk of copying failures [Hill, ID30].

Hill further discussed that most organisations don't employ a structured approach for BI customisation and typically once "something unfavourable has happened" within their organisation, they try to use BI for business gaps. In this line, he emphasised that an ongoing and evolutionary approach for BI customisation, along with healthy data, can assist organisations to tackle many business difficulties.

If you can manage that "unknown" percentage of data in the proper way, you know, there's a lot of opportunity. But that's what happens and there's a business pain or a driver, which is "Go and fix this, because it's affecting us in more ways than one, there's inefficiencies in our ability to make decisions" [Hill, ID25].

Hill, finally, highlighted the necessity of specific skills for managing BI projects. He noted that BI experience is required to underpin specific needs of BI and its customisation. In this line, he cautioned on conducting BI projects with experienced project managers who are not familiar with BI.

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Unfortunately I'm probably going to say, nine out of ten instances they will get an inexperienced project manager. Very experienced at project management but very but inexperienced at business cases, or they appoint a business analyst or someone who is not quite qualified to manage and propose a very, very strong business case. But even if they get beyond that point, the expectations created out of the business case are so great that it's actually set the project up for failure right at the start. So a common thing that happens and you can go and interview the largest telco in Australia and ask them how much money they've spent on transformation projects [Hill, ID27].

Turn into action: Hill elaborated on the need for providing decision-makers with actionable reports. In this line, he suggested providing them with clear KPIs.

Those KPIs are seldom defined. That's what I'm seeing. So when the KPIs aren't defined you're not really sure what you're solving. If we could define those KPIs of what success looks like and we're doing that, there's a water utility we're working with right now who said, "Look, success looks like this. We need to be able to go and bill our customers that we haven't got all the information on." Now, just collecting an ABN or collecting a BSB number means we can go and transact with them. That \$7 million has been sitting there for the last three months, we haven't billed it, we should be billing it [Hill, ID86].

Hill further emphasised the communication between data analysts and decision-makers for turning BI outcomes into action. He also elaborated on the age of data and its crucial importance for decision-making.

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If you take the concepts of a process being “data in motion”, right, then your process is your data. Data is a dead event. It’s like looking at the graveyard. Why should we go and look at the graveyard to understand what’s going on in our business and look at three months of death when we can watch the people who are sick. Why wait till the end when they’re dead, watch them as they’re sick and then we can respond and do things, that’s where business intelligence [is] [Hill, ID50].

Hill noted that to turn BI into action, BI systems should mirror business processes. To this aim, business performance monitoring is at the heart of modern BI solutions. Indeed, it is the entry point that shows how business systems work [Hill, ID44]. He then talked about real-time BI and its importance for business performance monitoring:

I guess where I am seeing things right now, imagine an organisation that just knew this very, very well and was able to respond to these outputs as soon as possible. That’s where I’m seeing the evolution of business intelligence going. So I know my process and this is the standard for the process. If I have a process deviation, well, let me make a decision on it straight away. Now some people call that real-time BI, but I just call that process improvement [Hill, ID50].

In Hill’s experience, business processes, strategy and structure should be aligned with BI systems to use BI to its fullest for decision-making and turning decision into action. In his view, first the processes of updating and creating data have to be improved to create high-quality data. Second, BI outcomes and reports should be used to modify business processes and move toward BI-based firms.

4.4 Summary

This chapter described research activities associated with data collection and their understanding through phenomenological reduction. First a brief profile of each study participant was provided in Section 4.1, to introduce them to the readers and to establish their credentials as active users or developers of BI solutions. Section 4.2 presented the interview questions to explain the approach used in interviews as the main method of data collection. My prejudgments and biases that were likely to affect this research were also identified as part of the epoché process.

Then, phenomenological reduction was discussed (see Section 4.3) to prepare textural descriptions of study participants' experiences. The steps undertaken for this were presented. The extracted preliminary common codes were shown. Then it was explained how they were grouped to generate the final codes. The clustering of the final codes for shaping the final themes was then illustrated. Finally, three individual textural descriptions that cover all the extracted themes were presented.

The next chapter will bring all the remaining interviews into the picture by presenting the composite textural description of this study. It elaborates on each theme from the points of view of various study participants.

5 Composite textural description

This chapter presents the composite textural description of the collected interviews. As explained in Section 3.2.3 the objective of such a description is to report similarities and differences in participants' experiences. As a result, details of identified themes and concepts related to BI use for the organisational sensemaking are disclosed.

Nine principal themes were identified in the process of phenomenological reduction; namely, "scope definition", "process alignment", "BI customisation", "integrity", "turn into action", "data presentation", "intuition", "trust in data" and "data presentation" (see Section 4.3.3 for details of thematic analysis). In the following sections, the role of each of these themes is explained from the points of view of various study participants to include those whose view were not included individual textural description presented in Sections 4.3.5, 4.3.6 and 4.3.7 but the analysis of their interviews can be found in Appendix 4.

5.1 Scope definition

One of the first steps in using BI within the organisations is defining the scope for BI in achieving a shared understanding of the types of required reports. This commonly stems from the fact that business information is valued and analysed differently across different functional contexts. Several study participants understood this very issue and described several situations where clear communication between BI stakeholders was needed to define expectations as to BI functionality. Rachel, for instance, asserted that a clear statement of business

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problems was needed to assure the expectations of BI decision-makers as to the use of BI analytics.

The first thing is defining the problem, and I'm a particular stickler for this, is making sure that when speaking to the client, is making sure that the problem is very clearly defined and the expectations of the analysis are very clearly defined, so I know – and those are actually two different things. Because quite often people very clearly define a problem but what they expect from the analysis is completely different to answering the problem that they've just posed [Rachel, Research and Analytics Director, ID15].

Shaun further added to Rachel's statement on the importance of clarifying BI scope and spending significant amounts of time analysing business requirements. She added that most of other companies employ the same approach as “the longer it takes the more accurate the final proposal or delivery will be but also the stronger the relationship will be” [Shaun, Executive Director, ID16]. The complexity of scope definition for BI is even more complicated when none of the stakeholders has a clear and holistic view of the organisation, which may contribute to conflicts of interest. Scott elaborated on the need for two types of people with various skill sets for defining the scope of BI within organisations; first, data analysts or data scientists, who manage the outcome of data; second, the individuals who have a comprehensive understanding of business.

You want the data scientist, who understands the business and understands the data sources to be able to mash them up, aggregate them together and provide a stream of information, and then you'll want the person who needs to use the information in a business context to be able to visualise and explain

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what they are deriving from an outcome point of view. And yes, there are some places where they are the same person because they have that end-to-end view, but there are a lot of places where they don't and obviously there is some blurring and those people need to communicate very well when there's two different people [Scott, General Manager, Developer and Platform Evangelist, ID26].

To add to this view, Shaun gave her recent experience by explaining that the large number of meetings of BI stakeholders involved in such a process might complicate effective communication and consensus building [Shaun, Executive Director, ID20]. In fact, Daniel, Shaun's colleague and a data analyst in the same organisation, remarked that due to a narrow view of BI capabilities and self-interests, facilitation of communication between different BI users within the organisation is often needed to achieve a shared understanding of BI scope and requirements.

In that scenario [reporting for two different departments within an organisation] you will have two separate people. So one person will be focused on finance and they'll have their reports for their stakeholders, then we have one for purchasing. They might have the same stakeholders, but when we're talking to that person in finance – it'll be completely – or not completely different – but they'll both have different focuses anyway. So we'd never have one person that focuses on three or four different things [Daniel, Data Analyst, ID32].

Considering the difficulties in defining the scope for BI within the organisation, several study participants suggested an evolutionary approach for

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achieving a shared understanding of BI requirements. In particular, Alfred elaborated on the evolutionary nature of BI by contrasting BI development and application development. He mentioned that BI development is more complex than application development as it is not a structured process and BI users cannot decide on the requirements until they see the outcomes.

BI, a lot of the time, what we find is that people don't actually understand what they want until they see it. So even if – you might have the best laid out designs and plans, and we attempt to not do too much designing and planning around that. More try and surface the data up to a couple of key users that intricately know the business and let them play around and get them to help us define the requirements a bit better after they've seen their data. Then move forward [Alfred, Data Integration and Management Director, ID18].

Daniel further elaborated on how the demands of BI users, or what their company is looking for, are constantly evolving or changing; however, he cautioned that the change in BI needs should be considered as a positive sign as it indicates that “BI users are getting more mature or the way that they are looking at BI is a bit more developed”. He then gave a typical conversation that may occur while defining BI requirements.

If we're starting with a client that has no idea about what they're doing or the data that they have, then it's really about “Okay, here's a summary of your business and each month we're going to focus on a particular area”. So this month – we'll still have your three or four standard views, for example, or reports – now, this month we're going to focus on this particular area. And

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then two months later, we'll focus on this particular area [Daniel, Data Analyst, ID28].

Clark also spoke about the evolutionary nature of defining the scope of BI and achieving a shared understanding of BI requirements. He also admitted that after several years of using BI in his organisation, still the reports are not what end users of BI need. Clark elaborated on his experience in using an iterative approach for preparing and using the BI reports needed for decision-makers within his organisation. He compared and contrasted managing BI projects with other projects within organisations. He noted that while a BI project is very iterative, in other typical projects, the project is simply defined and then analysis is done; however, in his approach for developing BI reports, everything occurs up front. In this line, he further provided examples of his conversations with BI end users:

If we can tell you which agents are the high risk ones, and we have conversations around what that might be before we started building the models, But we said, "How will this happen? How will you have a conversation? What will you be looking for? How will you then deal with it?" So we went through all that upfront and then what we did is we produced this one page and we said, "How about if we delivered something like this?" We haven't even worked out how to do it yet. But we said, "How about if we delivered something like this?" And they looked at it and said, "Oh, yes, that would work but we'd also need to know this." So it was sort of iterative [Clark, Operations Director, ID28].

In Clark's view, BI is not static as in an environment with voluminous feedback, BI models age relatively speedily. In his company, for instance, their

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clients' behaviours change quickly and, consequently, the generated models don't work the way they used to work the first time and they need to employ an evolving approach. He further elaborated on the way he developed the model after a shared understanding of a business problem was achieved and the needs of BI reports were clarified. He noted that model building is an iterative process that requires continuous communication between data analysts and BI end users.

What we did is we got to the point where we built a model that was able to produce that. We worked out where to get the underlying data and then we went back again and they went, "Oh, yes, well that's good but hey, I don't think that works and I don't think that works", and we went through that process. And reality is that good business intelligence works in that way. It is a constantly evolving thing [Clark, Operations Director, ID28].

In summary, the experience of the study participants uncovered various aspects of the "BI scope" theme. First, the problem that BI aims to solve should be identified. Then, various BI stakeholders should collaborate to achieve a shared understanding of BI objectives. Finally, the scope of BI should be modified in an evolutionary approach to be aligned with new needs of BI end users and the organisation.

5.2 Process alignment

Competitive advantages could be achieved through ceasing the constant pursuit of business opportunities and aligning of strategic business goals with operationalised business processes. For many organisations, processes are a valuable source of organisational capital because they can act as a competitive

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advantage in a highly competitive business environment. In spite of the time and cost involved in changing business processes, upon the introduction of BI, organisations need to modify their business processes to use appropriate data for analytics.

The study participants underscored this issue and discussed the implications of process alignment with BI systems. Scott, for instance, cautioned on mapping business processes with BI as a new technology in the organisation [Scott, General and Development Manager, ID37]. Companies need to take action based on BI reports to improve current business processes and strengthen BI systems in an iterative and evolutionary manner. Hill, a Managing Director, mentioned that the success of BI depends on the extent to which organisations get involved in this process, as the more organisations can turn reports into action, the more likely they are to achieve success. Roy further added to this view by noting business process flow is triggered by analytics:

It [actions by BI reports] is governed by business rules and businesses have an insight into what the business process flow is. But influencing that business process flow is analytics in terms of what we know about the customer and what step to take next. So it is a business process. But it's a business process that is informed through the use of advanced analytics [Roy, Software Sales Manager, ID34].

Robert, a Channel Technical Manager, understood this issue and suggested that a solution is often required to fix some current process, and as a result companies defer to him to fix inefficient processes. In this line, Jeffrey, a National Manager for Financial Reporting and Analysis, stated that if the process exists it is

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certainly necessary to get involved in its enactment in order to understand it, and on some occasions it is necessary to reshape the process in order to ensure it is reflective of what people want to see. He further described a typical scenario of creating dashboards for managers to provide them with the ability to track their own spreadsheets. In his experience, he found that there was no connectivity between business units in order to get a holistic view.

[We] looked at the processes in isolation through the stages and kind of explain to people what their responsibility was in that process and what it impacted on for the next stages, so they could get a context of that. So then we came back and mapped out who should do what, when it should be done, and how it should be done and how it should be communicated up the line to allow for this end result to be accurate [Jeffrey, National Manager for Financial Reporting and Analysis, ID60].

Interestingly, he faced massive resistance from BI users. He then mentioned that neither BI users nor BI systems were wrong, still the process feeding data into BI was incorrect, which made him spend excessive time and effort in educating end users. To resolve this issue, he had to go back and look at the process and ensure that everything had been mapped timely, efficiently and accurately in the source and then fix the source. Apart from the need for modifying business processes, some study participants cautioned that data used in BI systems is collected from reporting systems, which are not designed specifically for BI. Nathan added to this view by elaborating on the gap between the collected data and the expected applications.

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The difficulty is that, data was captured for a particular purpose, now we want to do something else with it. What's the gap between the two? Because the data wasn't captured for the purposes of analytics typically. If the system was designed with analytics in mind, then perhaps that would be a lot more of a streamlined process but typically you have a GIS [Geographical Information Systems], you'll have a CRM [Customer Relationship Management] system, a few other systems, and you're trying to optimise certain business processes and then companies want to differentiate in terms of how they bring that together to get some understanding of opportunity [Nathan, Director of Sales and Marketing, ID30].

Along these lines, Robert gave the essence of his experience facing a Chinese bank that had requested a BI solution. After several interviews, however, he realised what they needed was a new data source, not a BI solution. Robert noted that there were various types of data coming from everywhere and the bank needed to put it all together and then do some BI on top of that. Robert realised that their problem could just be resolved with a dynamic data warehouse that could hold and integrate millions of records. Robert added that in this company, BI implementation happened after data warehousing, which resulted in the familiar story of “garbage in, garbage out”.

The customer didn't know what they wanted before I got there. They thought that it was just a BI issue but when we did a whiteboard and started looking at their existing environment, starting to look at where they wanted to be, how they wanted to get there was not the best practice way. That was my role just to guide the customer that an understanding of where they are and the existing infrastructure, the existing environment, the existing executive support and an

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understanding on how to get that best practice situation. So the BI implementation happened after the warehousing. So that garbage in, garbage out thing happened after the data was cleansed, after the data was mined in the proper data warehousing, which made the BI look good [Robert, Channel Technical Manager, ID4].

Several study participants recognised the above issue as one of the biggest roadblocks and challenges for BI solutions, and one that they face every day. Indeed, everything comes back to the root of the raw data. It is crucial that “the processes are mapped in terms of how the data is pushed out to a BI platform and the business rules are written, and it only pulls what is in the source system” [Jeffrey, National Manager for Financial Reporting and Analysis, ID61].

In summary, the “process alignment” theme contains three final codes; business process, business change and data source. In the view of the study participants, business processes should be aligned with BI systems in two ways. First, the current processes for updating data need to be modified to achieve high-quality data for BI. This will result in more reliable BI outputs that can be used to create a single point of truth for organisations. Second, BI-generated reports should be used to modify existing business processes within the organisation.

5.3 Integrity

Several study participants elaborated on the need for integrating business rules and data rules to achieve a single version of truth within the organisation. They referred to situations where a lack of such integration resulted in scepticism from decision-makers. Daniel noted in this situation that BI stakeholders have to

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apply those business rules differently as there is not an integrated approach and calculations and savings will be different. He then captured the experience of organisations reading from the same source while having different business rules, resulting in different calculations and results:

This is pencils just for the pencil guy – butchers just for the butcher guy. But as long as my formulas, or my methodology's exactly the same, then I'm happy with that. You don't want the same data source and then different types of people manipulating or changing because you'll have "Oh, we spent 50 million dollars. Oh no, we've got 48" – then you're totally not going to trust the data. And ultimately that's what gives people, particularly the stakeholders, the ability not to take action because if they don't trust the data, they're not going to do anything but if everyone's on the same page, everyone's got the same type of report and everyone understands how the data's produced, then they can be more confident in creating those actions [Daniel, Data Analyst, ID36].

The major issues for aligning business rules and data rules is that they are managed and used by different groups of people within organisations. These groups usually own different interests and roles. In this line, several study participants spoke about the gap between business-side analysts and data-side analysts. Clark, for example, underscored this problem in a particular project and tried to resolve it by holding several meetings between different BI stakeholders to achieve a single version of truth of business rules:

The way we did that was that right from the start I had people from each of those areas in a small working party so I got represented all their views so

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that if, you know, the analytics person says, “I’m going to pass you back a score”, the business person would go, “Well I have no idea of what a score of 2.5 means? What do I do with it?” It’s very important that you do take an integrated approach to deploying business intelligence otherwise you end up producing stuff that can be very smart but no one knows how to use it [Clark, Operations Director, ID9].

One of the needs for integration of business rules and data rules is a single unified description and view across different departments. Ruofan cautioned on the necessity for an enterprise view of customers [Ruofan, Senior Business Analyst, ID9]. In this line, Shane added that an integrated enterprise system with various sources of data that provides a single view of customers with data from either transactional systems or CRM systems is needed [Shane, Technology Strategist, ID14]. He noted that communication between data analysts, BI developers and BI end users is needed to achieve a shared understanding of the system. He further explained even though BI users require various views of the system and customers, this variety in user view should not eliminate the integrity and single view of the system:

We were all building custom web interfaces to things like that and this web interface was sort of trying to integrate data between two stores and so on. So we’re eliminating that and we’re saying, yes, of course these things will have their own web interfaces but you’re only seeing one small view. You’ve really got to be going to these big cubes here, it is starting to become B-Cube now – where these operational systems are feeding into [Shane, Technology Strategist, ID62].

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While to this point the need for integrity between business rules and data rules was discussed, some study participants understood the need for using external data for creating a holistic view of the business environment. Andrew, for example, elaborated on external data sources for creating a view of customers. He mentioned that if he encounters a situation without enough data for decision-making, he refers to external data to generate models and reports for understanding customer behaviour. For example, he referred to external data from the ABS (Australian Bureau of Statistics) that is typically used within his organisation whenever a new service is going to be launched. In these situations, the demographics of the local population is used to estimate what the demand for the service might be. Prior to that, they also used information from Medicare to look at market patterns and tried to use those patterns to forecast the demands of their new services. He added that even the external data did not provide a precise view of the business environment, though it was a relatively beneficial guide for making decision on new services [Andrew, Manager of Diagnostic Imaging, ID10]. He further noted that his organisation has not used the capabilities of external data to its fullest and there is a need to use it broadly for any new services. To this aim, they can even use data from similar experiences in other hospitals across Australia. He then captured the essence of his new experience:

A good example was adult orthopaedic surgery, they took it out of LA Hospital and put it all here, so all the adult orthopaedic work, or the majority of it, is done here at MA hospital. But in the process of doing that they didn't estimate the impact of making that change. They knew that there would be some impact, because obviously people who break bones need to have X-rays done so there's going to be some more imaging done, but the modelling didn't take

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into account what the real effect was going to be, which was substantial [Andrew, Manager of Diagnostic Imaging, ID29].

In summary, for understanding business environments and making quality decisions, organisations need to create a single version of truth from the available data. The “integrity” theme therefore describes various aspects of this view. In the experience of the study participants, in modern BI systems, organisations need to integrate all available data sources, including structured/unstructured and internal/external sources. The study participants, specifically, emphasised the role of social media for creating unstructured data that can be used to provide decision-makers with reports and predictive models.

5.4 BI customisation

One of the requirements for using BI within organisations is customising BI tools based on the needs, culture and structure of the organisation. However, as Hill, a Managing Director, noted, due to the cost and time involved in BI implementation some organisations prefer to copy BI solutions. Hill also observed that very few organisations initiate BI solutions from scratch. He cautioned that companies that try to copy the other companies and follow an approach without considering their specific requirements are exposed to the risk of copying failures [Hill, Managing Director, ID30]. He elaborated on the need for alignment between business strategies based on information system strategies.

Roy, a Software Sales Manager, further highlighted the importance of BI customisation by elaborating on the need for going into certain levels of detail with the customer to understand the underlying business problem. He mentioned the

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impossibility of selling BI products over the phone as it requires a very long sale cycle to support underlying business needs. Robert also noted that even businesses with the same functionality have various requirements; thus customised BI solutions are different.

All companies are different. All businesses within the same industry are different. All businesses within the same functionality are different. We have a team at ASP [his company] and we have a team in our business partners that sit with the customer through the process we design. They have various forms of documentation, various forms of experience and various forms of expertise to guide them through that. There is no one silver bullet to help them with the redesign. It has to be a guidance and an expert analysis review for them to be successful at it [Robert, Channel Technical Manager, ID36].

In this line, Clark emphasised that there is no BI package that precisely meet all the needs of organisations [Clark, Operations Director, ID16]. He emphasised BI adoption by individuals and organisations. In his work, he strongly focuses on organisational and individual requirements and tries to deliver meaningful and understandable BI solutions to end users. He gave an example of an executive information system that was used in his organisation for a few years. In his experience, even the solution seemed to be wonderful, with well-designed interfaces, but they were not adapted based on the requirement of his organisation and indeed it was not connected with the real world [Clark, Operations Director, ID12]. He then captured the essence of his experience of customising successful BI solutions within his company. He noted that a lengthy process is needed for all of their systems to be working within their enterprise architecture:

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We haven't necessarily got all that integrated into the Siebel system yet because it's still, we're still learning how to do that in an efficient way. I most probably shouldn't say that, but ... So for instance, with that particular project we have been sending out letters through a custom made solution at this point until we get to the point where we integrate that back into Siebel, yes. But we do – most of what we do we're trying to develop it within this enterprise architecture. We have this concept of patterns. In other words, you use this pattern to solve this sort of problem and this pattern to solve another problem. So, yes, it's just a matter of time [Clark, Operations Director, ID15].

Ruofan further explained that individuals and organisations usually come up with new ideas. For example, they want to use a particular feature in various contexts; thus the requirements are different. Accordingly, new tools should be developed or some future improvement should occur to address new requirements; however, sometimes they become ideas for the vendor to develop in a certain direction [Ruofan, Data Integration and Management Director, ID22].

While to this point some study participants spoke about organisational needs for adopting BI solutions, other study participants emphasised the need for change in individual behaviour. Matt, for instance, elaborated on the need for support from higher level managers and executives. From his point of view, his team “can think about how these things can be used, but unless there is support from the relevant people they cannot make this happen themselves” [Matt, BI Manager, ID26].

We've presented to the senior executive, we've spoken to her about these things. They like the idea, it sounds fine to them, but if you ask them to put any money up for some of this sort of stuff then they tend to go on to say well,

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maybe things aren't so bad the way they are, I think we can get by with what we currently have. It's a cultural thing [Matt, BI Manager, ID19].

Alfred also elaborated on the necessity for change in individuals' thinking toward using BI systems. He noted that working with information does not require many changes to business processes; however, BI end users should learn how to use it and make decisions based on BI.

Generally, because it's information, I haven't seen as much of a change management problem as I have with application development where it can change the way people behave and operate with the system. This is they need some information. It's a month-end process or whatever it is. This is the portal they go to, then run the reports [Alfred, Data Integration and Management Director, ID31].

In summary, the study participants cautioned on copying BI solutions without considering the differences in the needs and capabilities of various firms. In their view, BI tools need to be customised and adopted based on the strategy, structure and identity of organisations.

5.5 Turn into action

Companies need to take action based on BI reports to improve current business processes and strengthen BI systems in an iterative and evolutionary manner [Jeffrey; Hill; Roy]. To this aim, the age of reports was identified to be one of the impediments for turning reports into action. Shaun mentioned that she is often contacted by her clients who are looking at a report from 12 months ago, and she is surprised when decision-makers are using those old reports [Shaun,

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Executive Director, ID50]. Ruofan also cautioned on the importance of using actionable reports in appropriate time. He noted that to gain advantage of BI, “its end users have to respond to the real world rapidly, as soon as possible basically every day”. Usually in organisations, IT teams and BI teams have their own standards and processes, and they need to be reviewed by many people in business teams. Ruofan noted the length of this process is crucial, as the older the information the less value it will have.

This process – if you’re lucky it will be six months. The business is not going to wait for a new piece of alert data that some vendor data supplier can now provide in order to say I can give you this data if you sign the contract with me, and there’s – by the way technology, and how long would it take for you to bring this data in that I can then include it into my – whatever – analytic tools. That is the issue, I’m not sure am I the only one or we’re the only organisation facing this because the business want to basically respond within the week [Ruofan, Data Integration and Management Director, ID28].

Madison elaborated on another BI capability for turning decisions into action. He elaborated on performance measurement that can guide decision-makers into actions. He noted that on-time reports can be used to turn decision into action, especially at the operational level where efficiency of action can be measured using data. Usually BI end users design a number of objectives for their processes and use data to examine whether those objectives are being achieved.

If it’s procurement it’s like, you know, ordering the right goods at the right time – so there’s a number of multiple objectives that they want from it that you can use the data to assess whether those objectives are being met or not.

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But then you've got them tied up to other things as well. So buying at the right time – well, what does my inventory look like? You know, with those kind of things too [Madison, Director of Enterprise Intelligence, ID75].

Dale, however, spoke about using performance measurement for higher level decision-making. In his view, BI is capable of providing performance measurement not only for current business problems, but also insight for strategic decisions. He gave his recent experience of working in the government sector to provide insights to decision-makers.

They've [the users within the government sector] actually come out and said, we need some facts behind this. So data is actually the core solution really to show what's going on, so we're responding to the request to actually bring in data to come up with a solution – whereas some of the other broader strategic type activities find where we can, I don't know, enter a market or identify cost reduction opportunities. Data is kind of like used as a vehicle to get that solution, whereas the project that I'm referring to before really the actual answer is, here's the data and this is the insight from the data [Dale, Enterprise Intelligence Data Analyst, ID37].

In this line, Sahil further highlighted the role of KPIs as a performance measurement tool in turning decisions into action. He gave his experience of using KPIs in his role in one of the government sectors. He noted that he uses KPIs to quantify strategic decisions and turn them into everyday operational actions.

BI end users drill deeper into existing reports or create new reports to achieve a better understanding of business operations. Rachel elaborated on the need for running ad hoc queries when a new request or business problem arises. In her

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organisation, BI users usually request specialised reports that can't be done through just the usual slice-and-dice tools. She gave some examples of these queries that can further be turned into action [Rachel, Research and Analytics Director, ID27]. Arnaldo further added that if BI end users don't have sufficient skills to run ad hoc queries, an ongoing communication between them and data analysts is required to validate queries and use them for immediate action.

Usually, it [a request for BI report] depends where it is coming from and depends what measure and it could be that one of the managers here – say they want to look at a particular target or measure. We'll get a request through IT. It will come through to our area. We'll assess it and then we may do initially data extractions for them. If we keep getting, it's an ongoing thing – it usually comes through as an ad hoc request. I want to see this, can we look at this or can we look at it in this way [Arnaldo, Business Intelligence Developer, ID44].

Dale also highlighted the role of interactive reports for gaining more insight, which can eventually result in actions. He, however, cautioned on limiting ad hoc analysis to everyday operational queries. He noted that certain levels of interaction by BI end users are required to drill down reports and achieve additional insights about “what's driving that business function, which wasn't necessarily the original question they've asked”.

I would use data to answer questions, but that's no longer seen as valuable – I mean that's the real baseline type stuff. So if I'm looking at payroll for example, sure I can answer the questions by taking the data for the full population and running analytics on it and saying, well this is what's

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happening, but clients are finding it more valuable for us to be able to show them, even interactively, to be able to say, this is what you're paying your employees, now let's slice and dice it for you to give you some insight about, you know, which types of employees are driving which types of pay types – you know, which months tend to create spikes here and there, what's causing that [Dale, Enterprise Intelligence Data Analyst, ID38].

Shane, a Technology Strategist, suggested enabling decision-makers to gain business insights through information analysis using applications optimised for mobile devices. Along this line, he gave the essence of his experience of implementing BI solutions in one of the big Australian industry sectors. He pinpointed the presentation of reports and KPIs on portable devices and its effectiveness on executive decision-making.

Everyone's got their view. So you've got the people who sit on that side of the table who've basically got their access to that cubes or other cubes, and then you've got your presentation. So theoretically they're all sitting around using digital devices now, but they all ultimately manifest themselves into these things [Shane, Technology Strategist, ID94].

Finally, Alfred elaborated on the role of live data, which can be accessed on portable devices, for turning decisions into action. Although, in his organisation BI reports are not purely real-time, alerts and their near real-time reporting greatly assist decision-makers to manage their patients.

They [the hospitals with which he works] also have near real time. So within five second updates for a suite of data integrity checks. So they [staff] enter data into the front end in their core patient management system and then they

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can go and look at these integrity checks and make sure that all the data they've entered for that client and any others are all correct. So it replicates back – not back and forwards, but into that report within five seconds. They look. If there's any red on the screen then they go back into the system, fix it up. By the time they've gone and hit refresh of the button, it's gone to green [Alfred, Data Integration and Management Director, ID74].

Even though several study participants spoke about the role of automated outcomes such as alerts and notifications in turning BI into action, Emily cautioned on using them for strategic decision-making. She noted that BI has more applications than alerts, and further suggested using extracted trends from BI tools for higher level decisions.

You have probably, you have both ways of reporting. Being able to show alerts. But at the same time, alerts is not everything. That's a higher level of alerting, that's great. But you need to have also to be able to look at data on the lower level, because you don't always just want to look at the alerts. You want to look at the data as well and see other trends and other projections [Emily, Senior Delivery Analyst, ID70].

In summary, BI systems provide several tools and features that can assist decision-makers in turning decision in action. First, BI presents insights about organisational environments in various forms, including dashboards, scorecards and patterns. Second, BI provides decision-makers with automated alarms and reports that assist BI end users to pay special attention to events when needed. Third, decision-makers can run ad hoc queries to request specific information that is required for taking action. Also, mobile BI allows decision-makers to access

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reports everywhere on portable devices, which can potentially assist in taking action based on provided information.

5.6 Data presentation

Decision-makers who often face a severe lack of time are unwilling to labour through tables and charts of data or perform complicated data manipulation. During his career, Jeffrey has realised that there are various types of decision-makers; His approach, therefore, is personalising data based on their preferences:

In terms of any reporting we do outside of BI or whatever, we try to appeal to both so that we don't have to do multiple reports. But our BI solution is certainly tailored so that there are graphs when we can but a supporting dataset that goes with the graph, and then the users can then export that if they need to do their own analysis [Jeffrey, National Manager for Financial Reporting and Analysis, ID37].

Nathan further explained that even if executives have the numerical know-how they would delegate some of the lower level substantiation of a good decision to their direct reports, and he “would be quite suspicious of a CEO that spends all of his time in spreadsheets” as this is not a good way of using their time [Nathan, Director of Sales and Marketing, ID21]. Shaun added to the issue of time constraints for chief-level managers:

My experience of the top level is they're not necessarily going to be interested in the detail that sits behind that recommendation or that information that allows the action. They are relying on it (a) to be 100 per cent correct and (b) for somebody to explain it to them if they need to be. They're not going to be

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wasting time sitting there trying to understand why the graph is going down when they think it should be going up. I think that in some cases when you're dealing with the top level, the C level, you are not going to have the time to explain that [Shaun, Executive Director, ID38].

Shaun also highlighted the importance of simplicity and trends in reports [Shaun, Executive Director, ID39], and further explained that while executives recognise that a business environment is unsettled and there is always ongoing change, which is often confounded by the external factors, they would like to see items above or below the line. Rachel highlighted the importance of succinct and targeted reports in order to provide decision-makers with necessary information. She cautioned on providing decision-makers with reports that they have to go through and figure out the answer as they “want to be told” [Rachel, Research and Analytics Director, ID37]. She then gave her approach of preparing the reports:

The way that I write reports is, at the very top I put in two sentences saying what the answer is to this, so there's no surprises. It's just: “This report found ... this”, and it states it right at the beginning; it's an executive summary that if they want, that's all they need to read is “This is ... the result”. And then I have a rule of I really don't have reports that are greater than two pages [Rachel, Research and Analytics Director, ID37].

Roy also elaborated on succinct and pointy reports containing best options for decision-makers at board level; he even expanded this view to operational level decision-makers. In his view, it's not only that busy decision-makers would rather see pointy reports that show trends below or above specific lines, but that individuals at operational levels also prefer succinct reports.

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Equally to [high-level decision-makers], the operator in the call centre who's inter – who's engaging with your customer, you want them to also make the best action – the best decision based on the information that you have. So you've got strategic decision, you've got operational decision; both of those can be driven by analytics [Roy, Software Sales Manager, ID32].

In spite of the call for specific options in BI reports for decision-makers, in complex situations it is possible that illustrating options is challenging. Instead, preliminary visualisations could assist decision-makers in extracting options in such situations. BI reports, then, could be generated based on what decision-makers have extracted from the visuals. Ross contrasted BI and visualisation to note how visualisation could be used by decision-makers to explore various options for choosing the right start for generating reports.

Data visualisation helps you find questions that you didn't know you wanted to ask. Whereas business intelligence, and this is a great quote from someone, is like driving your car while looking in the rear-view mirror. And that really absolutely defines how we see the two fields separating. So at a less facetious point, data visualisation is about a way of exploring data and finding what are some of those insights or points that you then want to feed into a more regular business intelligence system that you wanted and have monitored that then feed into a reporting system that says here are the things that I want to be able to track and monitor and which attributes we want to be looking at. So that's how I sort of separate those two out of there. And they cross, they interact, but visualisation is not business intelligence and business intelligence can use data visualisation but tends – that's just our view on that type of thing [Ross, Founder of a Data Visualisation Company, ID33].

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In his view, visualisation is about providing insights from BI as clearly as possible to end users, knowing that this is the information they are looking for. Therefore, data visualisation is about a way of exploring data and finding insights or points that decision-makers want to feed into a more regular BI systems. He then gave his experience of visualising specific metrics in the form of dashboards:

We had a project, the ones where there is – the projects that have been much more metric decision focused or outcome focused in terms of I want to be able to visualise these particular data points so I can find them and I know what I'm trying to look for, they are the ones that we end up implementing much more as a “dashboard” because the dimensions are better understood and how they go because someone's already known what they're looking for. So that's the class of one's where we tend to fit into that [Ross, Founder of a Data Visualisation Company, ID34].

Ross further highlighted the necessity of clear reports that are self-explanatory. He cautioned on the need for further explanation after visualisation. Indeed, in his view, it would be a failure if a data visualisation is created only for “someone to go for a whole lot of steps or cognitive process to understand the data”. In this line, Myla, as a Data Analyst, gave her approach for preparing self-explanatory reports:

My style is to make all the argument self-explanatory, so if I want to say a certain relationship is one that you really need to examine, I would put a few charts that gives the readers, or the clients, a story. So I think that making it visual instead of having me interpret it for them makes it easier for them [Myla, Data Analyst, ID12].

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Shane further elaborated on storytelling for data presentation, as this is the way people communicate and talk. BI end users could be a part of this story when data visualisation is combined by self-service BI. In his view, as part of the story, decision-makers should interact with information and answer questions [Shane, Technology Strategist, ID88].

In summary, the study participants emphasised presenting the outputs of BI based on the characteristics and identity of BI end users. They emphasised storytelling while presenting reports. They also highlighted that the level of detail in reports depends on BI end users and indeed reports should be personalised based on their needs, characteristics and abilities.

5.7 Intuition

The study participants understood that justifying actions is one of the reasons why some intuitive decision-makers use BI reports. In such situations, extensive reports are not effective, as decision-makers are looking for specific numbers or patterns that they already have in mind [Chandler, Director of Financial Governance and Planning, ID43], and BI systems simply provide decision-makers with tools to support what they already think are the possible options. The study participants emphasised keeping a balance between providing such options compared to offering whole answers or solutions. Chandler noted that since in reality executives and senior management are only looking at a couple of numbers and specific drivers, data analysts should focus on those lower level and operational drivers. Chandler further gave a typical experience of executives facing extensive

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predictive models that did not meet their expectations and where the anticipated targets were not highlighted in the report:

There's normally a number in somebody's head. That's person sitting at the top of the food chain. So a lot of the planning and budgeting exercise is actually getting to that number, then feeding that down through the operational plans. So we have built some models that do statistical analysis of historical data and give you the best modelling outcome and the likely modelling outcome. But we actually found that not many people were actually typically that interested in those because it wasn't actually flexible enough for them to get to that number. It gave them a number, but it was not necessarily the number that the senior management had in their head. That's the number that you have to get to, at the end of the day [Chandler, Director of Financial Governance and Planning, ID43].

Chandler further noted that even though statistical modelling will give BI end users predictable outcomes, their use for decision-making should be treated “with a hell of a lot of caution in business environments”. He explained that sceptical decision-makers may not easily trust the plausible outcomes of prediction models. Rachel, in response to Chandler's concern for using prediction models, suggested that using prediction models as validation tools for decision-makers who would like to justify their actions or understanding is warranted:

The predictive models are not necessarily used just to predict what's going to happen in the future. The predictive models are often used also to predict what a [customer's] behaviour should be. So it's not predicting – and that might be for current year. So knowing what we know about that [customer], or the

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environment, or what's going on, that models what a [customer] should be doing in the current year. So it's not so much looking into the future, it's just trying to validate what they're currently reporting against what we expect they should be reporting. So it's not future, it's just kind of a validation tool [Rachel, Research and Analytics Director, ID29].

In contrast, Andrew, a Manager of Diagnostic Imaging, further emphasised that higher level decision-maker are interested in uncertain scenarios provided by BI. He subsequently recommended using predictive models for them as they prefer to know what might be going to happen; however, he noted that clinicians, the operational level users of BI, are less interested in these models:

The manager clinicians are interested in those numbers, but most of the clinicians per se are not that interested. They'll probably have a bit of an interest if they feel that they're getting busier, you know, why are we getting busier or those sorts of things, but they're not that interested in the analysis side of things and the data. It seems to be the way that they are. They're a bit more focused on other things. They focus more on just the clinical side of things, rather than worrying about what might be happening data wise [Andrew, Manager of Diagnostic Imaging, ID28].

In summary, in the view of the study participants, intuitive decision-makers look for specific numbers in BI reports as they would like to justify what they have in their minds. Presenting pointy information with plausible reports assists intuitive decision-makers. In the experience of study participants, uncertain reports motivate intuitive end users to make their own judgments on the presented information and numbers.

5.8 Trust in data

The identity of decision-makers could be depicted through their management style of either trusting data for making fact-based decisions or relying on their intuition for making gut-based decisions. Scepticism toward BI reports hinders intuitive decision-makers from using BI. In the view of the study participants, sceptical decision-makers either feel they will lose their power or they could simply not trust the reports. Madison stated that this issue is even more likely to happen for recommendations models. He noted that unless decision-makers see the benefits of BI reports they will not trust BI reports. Andrew further cautioned on presenting strategic reports differently, in terms of details, to sceptical decision-makers; he also contrasted operational reports with strategic reports. He noted that in terms of operation it is a straightforward comparison between what the organisation is aiming for and what the organisation has done. However, for strategic reports more effort is required to show the details:

We need to give it [strategic reports] more detail because it's not just comparing one number with another number, there needs to be something sitting underneath what we're forecasting to support it and there needs to be more information, probably more data, rather than just saying this is what we believe it will be based on research or based on data analysis. We actually have to explain what the analysis is when we're looking at strategy, and I guess that's about giving people some comfort that we've got appropriate methodology in the modelling [Andrew, Manager of Diagnostic Imaging, ID58].

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Andrew further spoke about the complex business environment in the health sector and explained that decision-makers need to know about different numbers and options to be able to use data [Andrew, Manager of Diagnostic Imaging, ID33]. Rachel further elaborated on the resistance of sceptical decision-makers in established organisations and then suggested presenting reports in a plausible and easy-to-understand manner for decision-makers:

It's a very, very long-term organisation, so you've got a lot of people with a lot of experience, so use of analytics and the presentation of analytics has to either, rightly or wrongly, it needs to be aware of people who have got some very strong opinions and beliefs about what is actually going on. And if you're going to be developing a model which is contrary to these positions, or long-held standing positions, you have to present your results in a very plausible and easy-to-understand [way] [Rachel, Research and Analytics Director, ID32].

Providing sceptical decision-makers with the opportunity to interact with and validate reports increases trust. In this regard, Roy recognised a self-service interface, which is usable, intuitive and user-friendly, as “a big push in a big area”:

What you'll see with self-service comes usability and trying to make the tools as intuitive and user-friendly as possible. I know now that some of our work in the labs, and indeed some of the work even with our business partners, is about – it's now not just about what is actually the numbers that are presented on the iPad. An awful lot of the – an awful lot of execs want to carry around and iPad and take the information into board meetings and use it live. A lot

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of the work is going into how to make that as user-friendly to operate and get round for exec as possible [Roy, Software Sales Manager, ID18].

Daniel, an experienced Data Analyst, added to this view by noting his willingness to anticipate decision-makers' needs and provide them with the opportunity to customise and tailor their reports. Jeffrey further suggested interaction as a solution to resolve this issue, since decision-makers lose their confidence in using prescribed solutions and would rather control and investigate what is behind BI reports:

Business loses confidence a little bit in the BI platform. They want the control, they want to go that's what's in BI, but I know this is coming and I'll adjust this. But what we're trying to do is change that and say well that is what's in BI and that is what we're reporting [Jeffrey, National Manager for Financial Reporting and Analysis, ID13].

He further suggested engaging with BI end users and personalising reports based on their needs as a solution to scepticism. He noted that decision-makers need to be assisted and trained to be able to interact with reports. He further explained if decision-makers are able to interact with reports, they will feel they have control over what they are using [Jeffrey, National Manager for Financial Reporting and Analysis, ID10]. This leverages their confidence in using BI outcomes for decision-making.

In summary, the study participants elaborated on the importance of trusting in data by BI end users. They talked about situations where they faced resistance from sceptical decision-makers. In the view of study participants, interacting with

BI reports and validating reports can assist in leveraging the trust of sceptical decision-makers toward using BI outcomes.

5.9 Exploration

The analytical skills of individuals influence their interactions with BI systems and subsequently impact the effectiveness of BI systems in helping decision-makers to understand their organisation. Shane, for example, strongly encouraged development of skills sufficient to manipulate BI reports [Shane, Technology Strategist, ID22]. Ian described situations where lack of skill impeded decision-makers even from articulating the right questions:

The problem was they were saying the data was wrong and I said “No the data is not wrong”. It doesn’t match our report. You’re not asking it the right question. So once you show them to ask them the right question, how to tick the right boxes, it’s the same, yeah exactly it is. They kept blaming the data and it wasn’t the data [Ian, Operations Manager, ID54].

Dale also cautioned on the use of self-service analytics by unskilled managers acting on BI reports without the presence of an analyst capable of explaining the results and their meanings, as well as how such results should be used in action. He spoke about the BI end users in his company and noted that they still need some assistance to go through reports interactively. He further noted that he still doesn’t deliver reports to decision-makers without further engagement as he believes they are not yet capable of understanding reports due to lack skill [Dale, Enterprise Intelligence Data Analyst, ID49]. Daniel added to this view by noting that the main issue for understanding an organisation through BI is clarifying what decision-

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makers want to see in business terms, rather than in terms of BI functionality. He said, “we have to sit down with them and take them through that process”.

A lot of times, they [BI end users]’ll look at this and they’ll say “Oh, how do I do this?”, “How do I do that?”, “How do I know to do that?” and you take a step back and say “What is it that you want to do?” They’ll say “This, this and this” – then we’ll work towards that. And over time, once they’re comfortable with understanding what they want out of it, and then applying whatever the functions are – or the features in this – then the next time they’ll come with the same problem but for a different data set. They’ll know how to use that. So, it’s not so much the function – the function and the features are fine – it’s really what is it they want to see and that’s where we have to sit down with them and take them through that process [Daniel, Data Analyst, ID67].

To resolve this issue, Clark gave an account of a typical project in which he had two teams working together, one for developing the BI model and the other for communicating with decision-makers:

In terms of developing the model, which I suppose is much more of the business intelligence side, we took two approaches. One was that we just did the straight data crunching like cluster analysis etc., all those ranges of different approaches you can take, but then what we had is the business person sitting there trying to work out whether they knew what it meant [Clark, Operations Director, ID17].

Clark then identified the lack of proper interaction between data analysts and decision-makers as the main barrier to unskilled decision-makers using BI reports,

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as “these people do not talk the same language”. He then gave his experience of resolving this issue, by facilitating communication between the groups. Rachel further added to this view by highlighting the role of communication for data analysts, and the extent to which proper presentation of their work could assist decision-makers to understand underlying concepts and influence the efficacy of BI reports.

I've seen it both within this organisation and in other organisations, or other outside as well, which is we have some brilliant, absolutely brilliant analytic specialists who can build the amazing, amazing models but the communication of those, if you don't communicate that clearly, the managers will just turn off, and they will go with a method which is much less accurate, much less useful, just because they don't understand what is being presented to them [Rachel, Research and Analytics Director, ID31].

Rachel then captured the essence of analysts facing decision-makers who could not understand the reports they were presenting, as she talked about failing to explain her work in spite of the strong model she had developed:

My lowest moments in the organisation was [when] I developed, I think it was like a 27-dimensions cluster analysis of work-related expense compliance and then me trying to explain to the auditors why they should be using this model of non-compliance on why one individual was more non-compliant than another individual. I lost them within two minutes and that model was actually quite good but it was never, ever going to go anywhere because the way that I presented it was just so far out of my audience [understanding] that it just wasn't going to get up [Rachel, Research and Analytics Director, ID33].

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In summary, this exploration theme showed the view of study participants about engagement with BI outputs by end users. In the view of study participants, BI tools should be easy to use; however, BI end users should have a certain level of skill and expertise with which to explore BI outcomes. Providing that BI end users have the required capabilities to work with BI tools and the tools are designed to be used easily, self-service BI can assist decision-makers in exploring BI reports and generating their own reports.

5.10 Summary

This chapter presented the composite textural description of the study phenomena. Nine identified themes were explained from the point of view of study participants. The following identified codes in phenomenological reduction (see Section 4.3.1) were used to describe them.

1. BI evolution
2. Shared understanding
3. Problem identification
4. Collaboration
5. Business change
6. Business process
7. Data source
8. Company's history
9. External data
10. Business rules
11. BI budgeting
12. Copying BI solutions
13. BI adoption
14. On-time reports
15. Automated reports
16. Ad hoc queries
17. Ubiquitous reports
18. Insights
19. Details of reports
20. Storytelling
21. Personalisation
22. Information overload
23. Justifying decisions
24. Options in reports
25. Uncertainty
26. User's scepticism
27. User's resistance
28. Report validation
29. Ease of use
30. User's capability
31. Engagement

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Table 10 shows how the above final codes are used in different themes from the point of view of various study participants. In this table the numbers refer back to the final codes from the above list. Each row indicates the opinion of one study participant on the shown themes in the column.

Table 10: Summary of identified themes and their final codes

	Scope definition	Process alignment	Integrity	BI customisation	Turn into action	Data presentation	Intuition	Trust in data	Exploration
Hill	1	5,6	8,9	11,12,13	14				
Shaun	3,4		8,9	11	14	19,22	25		30
Emily	1, 2		8,9,10	11	14,15,16,18	22	25		
Jane			8			19,20,22			
Madison	1, 2		8		14,15,16,18	20		26,27	
Dale	1,2,3,4		8		16,18				
Matt		5	8		16,18	22		26,27	30
Jordan	4		8,10		18		25		
Shane	4		8,9,10		17	19,20	25		30
Scott	2,4	6	8						
Daniel	1,2,3		8,9,10					26,27,28	30,31
Myla	4		8		16	20			
Rachel	4		8	11	16	19,22	25	27,28	31
Nathan	1,2,3	5,6,7	8	13	18	19,22	23,24	26,27,28	
Sahil	4		8		18		25	28	
Alfred	2,3		8	11,13	14,15,17			27	
Chandler	1		8,10				23,24,25		
Ross	4		8		17	19,20	25	27	
Glenn	2,4	5	8	13	15,17				
Arnaldo	1		8		16		23,24	28	30
Clark	1,2,3,4		8,10	11,12,13			25		29,30,31
Ruofan	3	5,6	8,10	13	14		25		
Robert		5,7	8	11,12	15,17				
Roy		5,6	8				25	27,28	30
Ian	1,3		8	13			25	26	30
Andrew	1,3,4		8,9		16		23,24	26,28	
Jeffrey	1,3	5,6,7	8,10			21		28	

Table 10 shows that to develop BI scope with organisations, first, a shared understanding (code 2) between different BI stakeholders should be developed. To this aim, various BI stakeholders should collaborate (code 4) and employ an evolutionary (code 1) approach to identify the business problem (code 3) that can

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to be addressed by BI. While the interview with Clark and Sahil covered all common codes of scope definition, other study participants elaborated on the selected aspects of the common codes. This table shows that three common codes that are closely related to the business processes are mentioned by Nathan and Jeffery. They highlighted the importance of modifying business processes to achieve high-quality data source. Other study participants further elaborated on issues of business change (code 5), business process (code 6) and data sources (code 7) that should be considered in aligning BI with existing routines of organisations. Table 10 shows the emphasis of Hill and Clark on various aspects of customising BI tools based on the organisation's culture and strategies. To this aim, it is required to consider BI adoption (code 13), budgeting (code 11) and copying BI solutions (code 12). According to this table, Shane, Daniel and Emily draw our attention to the importance of designing BI systems that can provide a comprehensive coverage of the business environment. In their view, different sources of data should be integrated. More importantly, data rules should be in line with business rules (code 10). While other study participants elaborated on some of the characteristics of data sources in BI systems, Shane, Daniel and Emily emphasised the integration of business rule (code 10), external data (code 9) and company's history (code 8). Table 10 also indicates that several study participants spoke about taking actions and elaborated on the required characteristics of BI, such as providing insights (code 18), automated reports (code 15) and ad hoc queries (code 16). However, in Robert's point of view, on-time reports (code 14) for turning BI reports into action can be facilitated by ubiquitous BI reports (code 17).

While Hill, Dale, Scot, Alfred Glenn and Robert elaborated on some aspects of organisational requirements for using BI, namely customisation, scope

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definition, process alignment, integrity and turning into action, they did not talk about individual needs and characteristics for the use of BI. However, data presentation, intuition, trust in data and exploration were highlighted by other study participants. Jane provided a review of the main features of presented data which includes providing details (code 19), telling stories about data (code 20), personalising (code 21) and avoiding information overload (code 22). Study participants also noted that BI reports should provide BI end users with the opportunity to apply their own judgment while making a final decision. In this line Chandler mentioned that certain report options (code 24) and the level of their certainty (code 25) provide intuitive decision-makers with a tool to assist them in justifying (code 23) decisions. Table 10 shows that Daniel and Nathan elaborated on various aspects of trust in data, namely report validation (code 28), user's scepticism (code 26) and user's resistance (code 27). Finally, this table shows importance of exploring reports by BI end users, which as Clark pointed out, requires the need for direct user engagement (code 31), tools' ease of use (code 29) and an appropriate level of user's capabilities (30).

While the presented description elaborated on the use of BI for everyday decision-making and understanding of business environments, it does not show the relationship between the identified common codes and themes with the priorities of organisational sensemaking. The next chapter, therefore, will elaborate on these findings by presenting the views of the study participants on the use of BI for organisational and individual sensemaking. It will present the textural-structural description of BI-based sensemaking and will show the agreements and disagreements of study participants on each of the presented themes and their role in organisational sensemaking. It will discuss the identified themes from various

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views and, when necessary, the identified themes will be compared and contrasted with each other.

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This chapter undertakes imaginative variation of themes and codes derived from the interview narratives with a view to produce a textural-structural description (see Section 3.2.3) of the investigated phenomena. The knowledge gained after identifying the themes in phenomenological reduction phase (see Section 4.3) helped in exposing the thematic structure hidden in the stories shared by study participants. The identified themes in Chapter 5 will be used in this chapter and during imaginative variation to define properties of sensemaking in the context of BI and its decision processes. At the end of this chapter the challenges for using BI to address sensemaking properties will be identified. This chapter will show how the thematic analysis in Chapter 5 is used during imaginative variation. Finally all the insights from theme identification in Chapter 5 and imaginative variation in this chapter, will be used to describe the process of BI-based sensemaking in Chapter 7.

As highlighted in Section 3.2.3 and noted by Moustakas (1994, p. 97), during imaginative variation, the researcher seeks possible meanings through the “utilisation of imagination, varying the frames of reference, employing polarities and reversals, and approaching from divergent perspective, different positions, roles, or functions”. The extracted themes identified in Section 4.3 (see Figure 16), therefore, will be used to explain five properties of sensemaking that are directly supported in the literature of BI (see Section 2.3). In this process similarities and differences between study participants’ views and opinions will be explored with respect to the perceived strengths and weaknesses of BI technology (and its

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properties) in support of five properties of organisational sensemaking (see Section 2.3).

Moustakas also noted that “variation is targeted toward meanings and depends on intuition as a way of integrating structures into essence” (Moustakas, 1994, p. 98). In this line, in the next step of imaginative variation, the similarities and differences between study participants’ views and opinions that are uncovered in Section 6.1 will be used to describe identity creation and enactment and integrate the structure of BI-based sensemaking into essence (see Figure 16). As Moustakas advised, “the uncovering of essences, the focusing on pure possibilities, is central in the imaginative variation” (Moustakas, 1994, p. 98). Indeed, this chapter provides the foundation of the essence of this study, which will then be presented in Chapter 7.

The results are described in three subsections. First, the direct support of BI for five properties of sensemaking and the challenges faced by the sensemakers in using the technology will be presented (Section 6.1). It will be emphasised that BI in its current technological form is not able to directly support identity creation and enactment. The next two subsections (6.2 and 6.3) will discuss the importance of stakeholders’ abilities to enact on BI environments and to create their unique BI identity, so that they could use BI for sensemaking within their organisations.

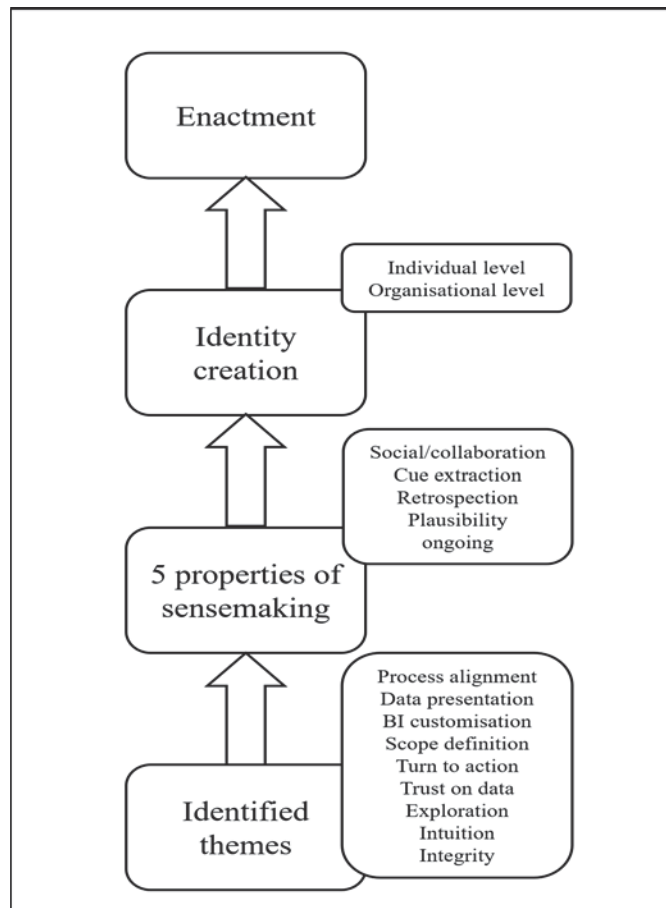


Figure 16: The process of imaginative variation

6.1 BI direct support for five properties of sensemaking

So far, the analysis of the collected interviews has resulted in the system of structured themes and codes describing the participants’ experience in using BI in their respective organisational settings (see Chapter 5). In the following sections, BI support for sensemaking is further explored, one sensemaking property at a time. Each property is reflected on and presented from the point of view of a decision-maker working in a modern large organisation – one that is commonly saturated with data and assisted by a range of sophisticated analytic tools. To elucidate the

connection between BI capabilities and sensemaking properties the properties are illustrated with statements of personal experience from the study participants.

6.1.1 Retrospection

There is a great amount of data around organisations in a variety of forms: structured or unstructured, historical or live, internal or external and small or big data. Organisations use transactional data, generate reports, make a decision or not, and ultimately leave data behind for further uses. In fact, that data would be beneficial if it were collected from different sources and compared. BI systems rely on huge volumes of business data, which represent past transactions, events and situations. Not surprising, all such historical accounts could facilitate integrated views of an organisation and may thus provide active support for sensemaking. The thematic analysis revealed an integrity theme, which is closely related to providing retrospective view of organisations. The final codes of this theme, “company’s history”, “business rules” and “external data” (see Section 5.3), explain how BI can assist in empowering retrospection in organisational sensemaking. Ruofan, for example, elaborated on the purpose of capturing past events for business and discussed customer data integration with BI predictive tools.

First of all you try to forecast, you’re trying to make a new product, and one way is to look at similar products and try to identify if there is a trend. That applies of course to any business in the world I believe, even those credit cards units, something similar that I’m making, or something that someone else is making, and there’s got to be the infrastructure that they could tap into

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that kind of data from elsewhere and bring it in there [Ruofan, Data Integration and Management Director, ID17].

To understand the organisation, decision-makers have to create an analytical identity for their organisation to think retrospectively. Probably the most common use of BI is in everyday operational decisions based on live data. Hill emphasised the importance of live data in process change [Hill, Managing Director, ID50]. However, Shaun, an Executive Director, criticised the case of real-time data analysis in hospitals and asserted that most of the organisations that monitor their process constantly, as a requirement for real-time BI, are retrospective. While the role of live data in current BI systems is crucial, historical data are in the heart of many BI systems. Organisations need to have almost a repository of information to use it for various applications such as trend analysis. Therefore, the main element of any BI system is a data warehouse, which stores large data and lots of history [Clark, Operations Director]. Emily, a Senior Delivery Analyst, explained the limitation of real-time data in her retail organisation, full of everyday transactions, and the need for historical data.

The ERP systems don't have history that much and don't have visibility across each other to show the data in such a way [Emily, ID35].

Robert, a Channel Technical Manager, spoke about the successful expansion of their business to other areas that they never had any experience in by modelling data and predicting customer behaviour. His company expanded its business to other areas by retrieving historical information and current information, and looking at patterns and algorithms to predict what their customers might do with a new line of their business [Robert, Channel Technical Manager, ID18]. Data quality

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is the primary BI element for retrospection. Without quality, the state of data is not good enough to have a retrospective view of an organisation. Hill, a Managing Director, mentions data quality as a measure for the health of data.

It [BI] is giving you a tap to access what we have in the water tank. Data quality is the quality of the water. That's one way of looking at it. But data quality is almost a measure; it's the health of your data [Hill, ID7].

Hill further noted that whereas the measurement of health is the “what” aspect, the activities for improving health, like master data management, are fundamentally the “how” aspect. Therefore, BI, in one respect, provides a view on the health of your data or informs if the data is reliable enough to make it into information that is executable. Nathan, a Director of Sales and Marketing, explained that data is captured for a particular purpose, such as CRM, and the data analyst wants to use that data for business analytics. He noted that if the system was designed for analytics perhaps this would be a more streamlined process.

Data integration is another critical element of BI for achieving a clear retrospective view. There can be several systems within organisations doing specific tasks without an aggregated view. Emily, a Senior Delivery Analyst, noted that the result of an integrated enterprise would be a single version of truth, which provides an entire outlook of the organisation, not just from a single point of view of a sector. She emphasised the importance of having an integrated view on all available data sources:

Sometimes to get to the bottom of your problems, you need to actually have [a] view from end to end. So very often the people had to log in to different systems to look at different pieces of data and try to bring it together on some

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Excel or something. So what we do is we bring all the data to one place and then try to show it together so they can see the whole picture [Emily, Senior Delivery Analyst, ID33].

The availability of “external data” was also found to be of great importance to several study participants, especially in terms of developing an organisational ability to expand a retrospective view into external business environments. For example, Sahil spoke about generating reports and models from external data:

We get data from the Australian Bureau of Statistics, we get data from other agencies, we modify that and we create it and it's presented both spatially as well as you know, the standard reports [Sahil, Manager of IT Strategy and Architecture, ID13].

Big data combined with a new generation of BI tools capable of extracting and analysing freely available data – such as unstructured and semi-structured data, whether from internal or external sources – provides new avenues for business.

The big data thing – the text out there thing – there's a lot of interest in that in the moment. We don't do the content collection ourselves, so you know, we'd need to partner with someone to get the data, or they would need to suggest where to find it or bring it, but there is a lot of looking at what's being said out there on the web. Sometimes it's a combination of internal and external and correlating them together and that can be interesting too [Jane, Senior Consultant, ID31].

Large volumes of data generally enhance retrospection and create new opportunities for organisational change and improvement, as well as facilitating

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trend predictions (Russom, 2011). However, as observed by Robert, to use BI as a lens on retrospective records, data quality needs to be considered as a fundamental aspect of the analytic system.

You can have the best BI solution in your organisation but if the data that's coming in there is rubbish it's going to produce rubbish business intelligence and it's not going to be intelligence, it's just going to be business data [Robert, Channel Technical Manager, ID6].

Nathan asserted that the commitment of time and effort in delivering quality insights into organisational processes is to do with preparation of data, which may not have been collected for specific analytic purposes [Nathan, Director of Sales and Marketing, ID30]. Madison added to this view by noting the risks to data quality when using data from multiple sources:

It may be of low-data quality – particularly in the warehouse, that they don't actually trust it – or it may not necessarily be in a form that allows them to do the analysis themselves. So it may be like ... and a lot of our work is across disparate databases and systems, so yes, they've got a warehouse but the data model doesn't allow the kind of analysis that needs to be done. That means you've got to go back to the source systems – maybe source A, source B and work with those sources to once again to try and – and again because it's a one-off, not necessarily a big item, just to solve that specific problem – you know, with the data that's needed for that challenge [Madison, Director of Enterprise Intelligence, ID34].

Ineffective data integration and poor data quality are the main barriers to effective management of retrospective records, whether generated from within or

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sourced externally. Overcoming these problems is the prime objective of BI technologists, whose ultimate aim is to provide a “single version of truth” for decision-makers. Alfred further suggested that the complexity of data cleansing increases significantly when integrating data from diverse systems:

But the complexity comes when you have more than one system, just trying to integrate them. You've got enough data quality issues with one system, let alone two [Alfred, Data Integration and Management Director, ID58].

Companies have to understand what customers are discussing in public forums such as Twitter and open forums in Facebook and other social media platforms, and accordingly take advantage of that situation. Dealing with unstructured data from social media, also called “social media analytics”, helps companies to understand customer sentiment and to predict which customers are likely to churn, and finally to design campaigns and offer products to the most appropriate customers from which to make the most profit. Organisations need to hear this because they need to collect this information and understand their customers' expectations, and the way that they communicate with each other.

These public forums or this social media is more important than ever. So you need to try and grab as much structured and unstructured data as you can in order for you to be successful in analysing your market, your customers, therefore your clients [Robert, Channel Technical Manager, ID30].

Apart from the use of internal data, organisations need to deal with external and big data as well. Madison, a Director of Enterprise Intelligence, spoke about the necessity of benchmarking by the use of BI. He noted that apart from what is known about their customers, they have to know about potential customers to be

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able to segment them. Therefore, access to open source information from other organisations and using them for benchmarking is another crucial function of BI, which is exactly what organisations should be aiming for.

I think that the ability to be able to tap that sort of information [external data] into your own systems and look at that is really where organisations will be heading [Shaun, Executive Director, ID98].

According to Weick, sensemaking is retrospective, meaning that the sensemaker looks back and reviews events or situations that make sense in respect of the current situation. After creating an analytical identity for the organisation, data analysts create a clear retrospective view of the organisation by data quality, data integration and predictive analytics.

6.1.2 Social aspects of sensemaking

The real power of analytics lies in the collaboration between BI users (Stoodley, 2012), especially when more information could be leveraged by more decision-makers or “communities” in the organisation (Hasan and Gould, 2001). This critical property of Weick’s model of sensemaking can be discussed from the identified themes in two ways; the use of BI tools to support collaboration between decision-makers and the advantage of collaboration between BI stakeholders for defining the scope of BI.

Several common codes in the identified theme for collaboration elaborates on how BI can potentially support social aspects of sensemaking; they are sharing and circulating BI reports and commenting on them. Sharing BI reports, as well as organisational reliance on decision-making partnerships, are a form of social

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engagement in an organisational framework. To support this assessment, Robert noted that BI support for face-to-face and virtual meetings, providing access to shared data, circulation of BI reports and their online discussion and annotation, are part of this engagement.

There's an icon that they click on that dashboard that says, I want to start collaboration on this. It could be an activity. It could be a blog. It could be a template where we attach files and, similar to Facebook, you can have messaging on top of messaging related to that dashboard, related to that graph or what have you [Robert, Channel Technical Manager, ID16].

Apart from traditional tools of BI in support of collocation, several study participants understood the new trends of BI such as visualisation and mobile BI in empowering collaboration between end users. Ross, for example, drew attention to two new BI enablers for collaborative decision-making. He mentioned the need for co-located BI collaboration and the use of large screens and interactive visualisations to support team interaction.

I can look at collaboration of the oblong minority report where both, you know multiple sets of hands or working on a big screen at once, right. I'll get to that but that's one set. There's collaboration which is I'm working on some data, and this is collaboration that exists already. I'm working on some data, previously what I'd have to do is I'd have to print, send it to you via email, call you in, have a meeting, we'd sit down around a screen and we'd stick our big fingers and hopefully not touch each other's screen too much, and that's how collaboration would be [Ross, Founder of the Data Visualisation Company, ID50].

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He also recognised the way that modern BI extends its collaborative functionality to the cloud, by cloud-based reporting and access to such reports via mobile devices. Ross further highlighted the trend of combining BI with collaboration systems via messages, emails and, most importantly, mobile phones and tablets.

I think the biggest thing for collaboration that has a realistic opportunity that's available now is the tablet ... it's easy to say "Hey have a look at mine", and you pass it over and there's an engagement [Ross, Founder of a Data Visualisation Company, ID51].

Roy emphasised the use of BI reports in portable devices from the cloud in order to take information into board meetings and make decisions based on live data. However, he noted that a great deal of effort should be done to make this user-friendly and encourage executives to engage with BI tools.

They [a Norwegian Oil Company] wanted the exec [executives] to be able to walk into the board meeting and there and then just swipe through it. It's becoming more and more of a popular thing for reports to be viewed in such a format [Roy, Software Sales Manager, ID22].

Ubiquity in BI reports and having the reports appear everywhere, whether in meetings or in a golf course [Robert, Channel Technical Manager], transmitting the reports to decision-makers, analysing the reports, making decisions based on those analyses and sending them back is a significant part of BI systems for enactment and consequently sensemaking. In other words, decision-makers could enact in their business environment by having active reports, and reading those reports on portable devices either online or offline, then interacting with them, creating

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comments and circulating and forwarding those reports to their colleagues [Robert, Channel Technical Manager].

Apart from BI facilitation of collaborative decision-making, some study participants noted the need for BI to actively support communication and experience sharing between data analysts and decision-makers [e.g. Clark, Operations Director]. This need is propelled by significant knowledge gaps in both business communities, where the majority of organisational decision-makers do not have sufficient technical skills to operate BI tools, and data analysts, who do not have enough understanding of the business environment.

6.1.3 Cue extraction

Identifying significant cues to unfolding business events buried in masses of rapidly changing business data is a challenge for every organisational decision-maker. Modern BI provides some answers to those challenges. The thematic analysis identified two themes that are closely tied to cue extraction; “turn into action” (see Section 5.5) and “data presentation” (see Section 5.6) show how cues could be extracted and used for understanding business environments and organisational sensemaking.

BI can monitor the flow of business data, alert users to important changes in their environment, and supply insights so that they could make sense of the evolving business situation. Thematic analysis identified several tools for extracting insights: dashboards, scorecards, real-time alerts, online KPIs and starred reports. Dashboards and scorecards have traditionally been part of BI systems (Lönnqvist and Pirttimäki, 2006), used to capture and signify critical

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business issues, summarise rich data surrounding business cues, and subsequently present information in simplified and interactive ways to allow exploration and eventual sensemaking by business users. Robert elaborated on the methods for embedding alerts in dashboards to facilitate cue extraction to support sensemaking:

Our event management system gives you alerts, gives you notifications and gives you the monitoring of your – for your KPIs. It could be your sales forecast numbers. It could be your budget's due or it could be that your predictive analytics has given you an alert that this is happening or it could happen. There are many types of event notifications that we have available [Robert, Channel Technical Manager, ID24].

Other study participants noted that BI-generated cues are not readily accepted by sceptical decision-makers, who often demand validation of obtained reports [e.g. Madison, Director of Enterprise Intelligence, ID76; Andrew, Manager of Diagnostic Imaging, ID33]. Daniel, however, remarked on some decision-makers using interactive self-service reports to drill into data in search of further decision support, clarity and certainty.

I [as a data analyst] want to anticipate what they want to see but also give them room to allow them to customise or to tailor their own graphs. And also – depending on who we're working with – because if they are someone who's working at a high level, the summary's fine [Daniel, Data Analyst, ID21].

The thematic analysis also identified “data presentation” (see Section 5.6) as an important element for providing busy decision-makers with cues that give meaning to what has happened to their organisation and its business environment (Weick et al., 2005). Presenting significant cues and unfolding business events

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buried in masses of business data is a challenge for every organisation. BI provides decision-makers with a unique opportunity to see extracted cues and monitor the flow of business data, alerting them to important changes in their environment. Drawing on his experience as a Manager of Business Intelligence, Matt cautioned BI adopters from saturating decision-makers with signals and alerts in busy organisational environments, where they may be subject to warnings constantly competing for their undivided attention, leading to disorientation rather than sensemaking.

Arnaldo, a Business Intelligence Developer, explained the willingness of executives to see just simple reports in their scorecards such as traffic lights and no more. Apart from simple reports, alerts as the major part of BI dashboards assist decision-makers in extracting cues and taking quick action. Alerts also could be sent by automatic emails to decision-makers if dashboards are not available.

[When it comes to the] scorecard, one of the ways that you can look at it is just by traffic lights, nothing else. It's just got agencies and traffic lights and it's only red. So she wants to see just red, no numbers [Arnaldo, Business Intelligence Developer, ID38].

Nathan, a Director of Sales and Marketing, noted that BI primarily focuses on presenting data rather than guiding people through making decisions [Nathan, ID62]. However, Ross, a Founder of a Data Visualisation Company, believes visualisations could be used either for presenting extracted cues, exploring a story around the data by end users or finding insights. It could provide the ability to engage and communicate with an audience and to convey the message to that specific audience. He believes that data is changing and BI end users need to have

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the proper tools for being able to manipulate data, explore and ultimately formulate the business problem.

One [one] side visualisations can be built to be exploratory tools for exploring the data yourself and to find insights and to gain understandings in that. That's got its own stream of how we go about dealing with that. That's really built around the concept that there's a large set of data that is changing. You need to be able to have the tools and be able to manipulate and explore that possibility space yourself, in some way visually. On the other side of the coin is the ability to engage and communicate with an audience and to convey your message to that particular audience [Ross, ID2].

6.1.4 Plausibility

“Intuition” and “trust in data” are two themes that elaborate on the plausibility for making sense of organisations (see sections 5.7 and 5.8). However, while intuition discusses how BI can support plausible thinking of intuitive decision-makers, “trust in data” casts doubt on some BI tools and their acceptance by decision-makers.

A large part of BI analytics involves considering different business scenarios, understanding existing and potential risks, and making predictions for situations, markets, demands, trends and business events. Such predictions and modellings can assist managers to better understand a spectrum of business predictions, and are capable of providing support for making important strategic decisions, with potentially tremendous impacts on company performance [e.g. Sahil, Manager of IT Strategy and Architecture, ID13]. The challenge, however, is to eliminate

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fuzziness in BI reports, which is often the unwanted consequence of low-quality data. Even though plausibility over accuracy is an important aspect in Weick's (1995) sensemaking model, the inexact nature of business situations described by BI systems often escapes the attention (and moreover comprehension) of many BI end users. Chandler underscored this issue and, from the vantage point of his position as a Director of Financial Governance and Planning, discussed the significance of educating business decision-makers about the mere plausibility of outcomes predicted by BI systems:

We have to give them the story that they were sold, but we also have to open their eyes to the fact that the story that they were sold was based on the perfect world and we don't live in the perfect world [Chandler, Director of Financial Governance and Planning, ID96].

Nevertheless, the experience of study participants indicates that modern business executives become increasingly more BI savvy and open to the fuzzy nature of a future projected by BI tools. As Sahil noted:

Not all reports have to be 100 per cent confident; you can still have a report which you can say there's only 30 per cent confidence and that's good enough, than nothing at all [Sahil, Manager of IT Strategy and Architecture, ID14].

To further support this assessment, Robert provided examples of companies that readily embraced predictive analytics to give them significant leverage over their competition:

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That new line of business did open up with this company. That new line of business is now a successful line of business. It's actually outperforming the other areas of line of business. Purely because they were able to model it; they were able to look at patterns and trends to be able to put some algorithms in there, predict – do some predictive analytics and combined with the historical analytics and put the two together and they were able to do something quite new [Robert, Channel Technical Manager, ID18].

As Robert further explained, plausible BI modelling can assist managers to understand current and future business states, and consequently provide support for making important strategic decisions, with potentially tremendous impacts on company performance.

6.1.5 Ongoing

BI systems commonly acquire and monitor new business data in a continuous cycle of information growth and improvement. As highlighted by the study participants, this creates opportunities for ongoing sensemaking and generation of insights [Jordan, Senior Data Analyst, ID38–39; Jeffrey, National Manager for Financial Reporting and Analysis, ID43; Matt, BI Manager, ID47–48]. BI decision-makers are thus equipped with continuous access to up-to-date information capable of supporting the ongoing development of new understandings and fresh insights into their organisation. Madison jokingly contrasted BI with other traditional decision-support and reporting systems by stating that BI is just a continuous reporting.

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When I think of BI I think it's a little bit more continuous reporting [Madison, Director of Enterprise Intelligence, ID17].

Continuity of data monitoring and reporting is an integral part of the growing trend to provide decision-makers with analytic ubiquity. BI systems must not only provide uninterrupted business status reports and advice – quickly, efficiently and as needed – but also deliver such reports and advice to decision-makers wherever they are.

A lot of it now for decision-making at an executive level has to be done much quicker, more effective, online, offline, it has to cater for both. The idea of the executive having a mini iPad on the golf course and getting a report sent to them, making – analysing that report, making some decision on that report, sending it back is very real today [Robert, Channel Technical Manager, ID17].

Ubiquitous decision support is especially high on the agenda for those executives who operate in dynamic and volatile business environments, with multiple information channels and several feedback loops. Such environments change at a pace that no longer permits analytics to take place in the backroom of BI departments, or allows reports to be digested at the leisure of a boardroom meeting. Clark, however, elaborated on another aspect of ongoing sensemaking by highlighting the role of continuity in defining the scope of BI and creating a shared understanding:

It is a constantly evolving thing. It's not static, ever. Because if it is – my experience, and a lot of this is that models age quite quickly, particularly in environments where you've got feedback [Clark, Operations Director, ID28].

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As noted by Rouibah and Ould-ali (2002), the modern conceptual framework of BI demands underlying processes to be highly iterative, and designed to sense environmental signs that need to be translated into actionable information for strategic decision-making. BI is increasingly an evolutionary process (Foody, 2009; Hallikainen et al., 2012).

6.2 The need for BI identity

While the study participants explained the capabilities of BI to support five properties of Weick's model of sensemaking (1995) – namely, retrospection, social engagement, cue extraction, plausibility and the ongoing nature of the sensemaking process – they also highlighted the need for organisations and individuals to create the capacity for sustained use of analytical tools to support management decisions; namely, identity creation. Nathan, with his experience in supporting sales and marketing, elaborated on the role of BI identity by contrasting BI and other IT systems and highlighting the need for the culture of discovery:

If you put in a CRM system that's new and it requires some business process change, there's going to be some resistance so you need to convince people about the new business process but once you've embedded the process, it's there. Whereas, you know, BI and analytics is probably a more open business process. There are some tied up processes that exist in BI but then, you know, there's a culture of discovery and justifying your position based on evidence which is probably a bit harder than just teaching someone how to generate an invoice differently [Nathan, Director of Sales and Marketing, ID51].

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In the context of BI, therefore, to make sense of the larger business environment, organisations need to create BI identity at individual and organisational levels. In both cases the objectives are the same. Creating BI identity at the personal level results in individuals gaining the ability to understand organisational complexity by supporting their decisions with data-driven processes, which consequently lead to more effective actions as performed by that individual in the organisation and its environment. Creating BI identity at the organisational level, on the other hand, is about capacity building and modifying organisational elements, resulting in organisations where BI is reflected in structure, processes, culture, policies and procedures.

As demonstrated in the following subsections, the importance of BI identity emerges strongly in the interviews with study participants, who claim the need for both types of BI identity and their enactment within an organisation, with impact on the five discussed properties of sensemaking.

6.2.1 Organisational level

The thematic analysis of collected data identified four principal themes that are closely related to BI identity in organisations; namely, scope definition, process alignment, integrity and BI customisation. The discussions revealed that the clarity of BI scope is one of the first requirements of a BI identity to achieve a shared understanding of analytic reports (see Section 5.1), which commonly stems from the fact that business information is often valued and analysed differently across different functional contexts (Davenport, 2010). The thematic analysis also identified the implication of process alignment with BI systems (see Section 5.2).

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Scott, for instance, cautioned on designing business processes to use BI within an organisation:

Technology, in my mind, isn't particularly good unless you have a reason for using it and a way of using it, and in that case [BI] organisational process is the most important part. The enabler is the second one. So you need to have your process mapped out and correct first. Then you need someone to automate and enable it to make sure you get a level of rigidity around what the process is supposed to do [Scott, General and Development Manager, ID37].

BI identity could be manifested in business rules that integrate with data rules to achieve a “single version of truth” within the organisation (see Section 5.3). Daniel referred to situations where a lack of such integration led to decision-makers' scepticism in BI reports and the associated data analysis [Daniel, Data Analyst, ID36]. He also experienced working with members of the same organisation relying on a single data source to produce distinct (and conflicting) calculations and results due to the use of different business rules [Daniel, Data Analyst, ID36].

To deal with such situations, Roy, a Software Sales Manager, suggested using consistent data rules across the organisation, but customising BI for the use of certain groups of decision-makers, to assist them in solving their particular issues and provide them with the levels of detail sufficient to understand underlying business problems. At the same time, as a Director of Enterprise Intelligence, Madison expressed his concern about an overly casual approach to analytics for

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problem-solving rather than using the technology as a sustainable approach to managing an organisation:

Most of our work is not that established. Some people run it on a continuous basis. Most of our clients really want us to solve or resolve a particular issue, a particular pain point that they've got at the time, rather than necessarily building something sustainable and lasting [Madison, Director of Enterprise Intelligence, ID18].

This approach may, however, incur prohibitive time and cost to organisations implementing their BI, in which case their management commonly decides on the adoption of vendor best practice, with a generic “proven” BI solution, which may result in a reduction of costs and sharing of domain experience, but also in copying failures and risks across the entire sector [Hill, Managing Director, ID30].

6.2.2 Individual level

Organisations need to educate individuals and enable them to think and behave in ways that let them make sense of their organisation with BI. The thematic analysis revealed several themes that are related to an individual's BI identity; namely, data presentation (see Section 5.6), intuition (see Section 5.7), trust in data (see Section 5.8) and exploration (see Section 5.9). While some of these themes explain how BI should be used based on the identity of decision-makers, others elaborate on the characteristics of BI ends users for utilising BI outcomes. Nathan considered BI as a core competency for modern organisations, which should not be outsourced; therefore, in his organisation, instead of undertaking analytic work on

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behalf of internal clients, he created an environment where clients could carry out the majority of analytic tasks on their own.

We don't tend to do a lot of analytics on behalf of clients. We create an environment where they can do analytics. If it comes to advanced analytics, then obviously there's, you know, some areas where clients might not have the skills but typically it's a core competency of a company to have some analytical capability. I'm not so sure that you can outsource your analytics. You can outsource your, or get help with your data logistics, but outsourcing your analytics doesn't quite make sense to me. That's what I would have thought is, you know, one of the key things that you would want to keep in-house, it's your differentiator, it's like outsourcing your strategy, "We're just going to produce widgets and get someone else to do the strategy", it doesn't quite make sense. Because analytics is so tied to strategy [Nathan, Director of Sales and Marketing, ID19].

In his recent experience, Robert worked with one of his company's partners to investigate the organisational requirements for adopting a BI solution. He noted that he ought to attend some steering committee or stakeholder committee to assure them that the organisation has enough capabilities, and management support is sufficient for adopting a BI solution that can improve their current process. He added to this view by stating that organisational capacity for using BI effectively includes every aspect of his organisation, from its structure to the way people think and make decisions.

My mantra in the last seven years has been; understand where you are today as a business; understand where you want to go as in where your competitors

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are, where your benchmark is. Then my job as an ASP [his company] person is to help you get there. That's where it could be products, it could be change management, it could be the culture, it could be the organisational restructure, it could be what's needed to happen in your organisation for you to be ready for something new [Robert, Channel Technical Manager, ID32].

According to study participants, however, there are some situations that prevent individuals from using BI effectively, including imposition of time constraints (see Section 5.6), the need to justify decisions and actions (see Section 5.7), scepticism towards BI (see Section 5.8) and involvement of unskilled users (see Section 5.9). All such individual characteristics, which promote or hinder the use of BI, are the fundamental constituents of BI identity at the individual level.

Decision-makers who often face a severe lack of time are unwilling to labour through tables and charts of data or perform complicated data manipulation. During his career, Jeffrey has realised that there are two types of decision-makers – “those who are numerically savvy and want tables and data to be able to manipulate information whereas the other group is not interested in diving into the data and they would rather to see the options” [Jeffrey, National Manager of Financial Reporting and Analysis, ID37]. Justifying decisions and actions is one of the reasons why some decision-makers use BI reports (LaValle et al., 2011). In such situations, extensive reports are not effective, as decision-makers are looking for specific numbers or patterns that they already have in mind [Chandler, Director of Financial Governance and Planning, ID43], and BI systems simply provide decision-makers with tools to support what they already know are the possible options (see Section 5.7).

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The identity of decision-makers could also be reflected through their management style of either trusting data for making fact-based decisions or relying on intuition for making gut-based decisions (MacKrell and van den Boogaard, 2012; Stoodley, 2012). Scepticism toward BI reports hinders intuitive decision-makers from using BI (see Section 5.8). In the view of the study participants, sceptical decision-makers either feel they may lose their independence (and ultimately their power) or they may simply not trust the reports. Madison stated that this issue is even more likely to happen for recommendations models:

You wouldn't make a recommendation without running it past the client first because every client, even if they have the standard implementation, they are going to do their own things to it and they've got their own quirks about why they do things. So they'll always be a point of validation [Madison, Director of Enterprise Intelligence, ID76].

The analytical skills of individuals seem to play an important role in their interactions with BI systems and subsequently impact the effectiveness of BI systems in helping decision-makers understand their organisation (Glancy and Yadav, 2011; Shanks and Bekmamedova, 2012). Shane strongly encouraged development of skills sufficient to use and manipulate BI reports [Shane, Technology Strategist, ID22]. Ian, responsible for running business operations in his organisation, described situations where lack of skill impeded decision-makers even from articulating the right questions [Ian, Operations Manager, ID54]. At the same time, Dale cautioned on the use of self-service analytics by unskilled managers acting on BI reports without the presence of an analyst, such as himself, capable of explaining the results and their meanings, as well as how such results should be used in action [Dale, Enterprise Intelligence Data Analyst, ID49].

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The discussion so far has illustrated the necessity of BI identity creation at organisational and individual levels. It has emphasised that creating BI identity will result in a BI-based organisation with clear BI scope, aligned processes, integrated BI and business rules and customised BI. More importantly, in such organisations, either the culture of discovery already exists between individuals, or there is a way to deal even with scepticism, lack of time and skill and the tendency to justify while using BI reports. The next part of the chapter will elaborate on the crucial role of enactment on BI environments by decision-makers in order to achieve the desired BI identity at individual and organisational levels.

6.3 Enactment on BI environment

When people enact they bring new events into their environment (Weick, 1995). Enactment is an important element of sensemaking theory, as it shapes a new environment, which then includes the basic elements for BI-based sensemaking and consequently decision-making. Enactment influences both individual and organisational identity. To enact on BI environments, decision-makers need to either rely on self-service BI or communicate with data analysts to create capacity for sustained use of BI tools in support of all aspects of sensemaking. Scott observed that there exist few sizeable organisations with people capable of taking an end-to-end view of BI, from data, through its analysis, to decisions and actions. To assist such a process to take hold in an organisation, he also emphasised the necessity of rich and regular communication between decision-makers and data analysts [Scott, General and Development Manager, ID26]. Other study participants also commented on this issue and described situations where

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clear communication between BI stakeholders was needed to define expectations for BI functionality [e.g. Rachel, Research and Analytics Director, ID40].

The thematic analysis revealed two themes that are strongly associated with enactment; exploration (see Section 5.9) and collaboration in the process of BI scope definition (see Section 5.1). The following sections elaborate on the role of collaboration between decision-makers and data analysts, as well as decision-makers' interactions with BI reports. It shows the impacts of enacting on a BI environment, and its effectiveness on BI in an organisation moving toward organisational sensemaking. It subsequently discusses how enactment can address the existing barriers and challenges for creating BI identity.

6.3.1 Collaboration between BI end users and data analysts

The analytical skills of individuals influence their interactions with BI systems and subsequently impact the effectiveness of BI systems in assisting decision-makers to understand their organisation [Shane, Technology Strategist, ID22; Ian, Operations Manager, ID45; Dale, Enterprise Intelligence Data Analyst, ID49; Daniel, Data Analyst, ID67]. Madison stated that in spite of his interest in involving decision-makers in exploring reports, BI users still need considerable assistance:

All the ones [reports] I showed you – generally they'd be able to work them out, but it doesn't mean you can give them to somebody cold. It's not like ... We want to try and get to that place like we're a web page where it opens and it's intuitive and you know what to do straight way, but many individual

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clients are probably necessarily at that kind of point – they still need a bit of hand-holding. It depends what you're trying to do without visualisation as well. So some of the ones I showed you, some are explorative [Madison, Director of Enterprise Intelligence, ID53].

Dale also cautioned on managers' skills in acting on reports without the presence of an analyst to explain meanings and how they should be used in action [Dale, Enterprise Intelligence Data Analyst, ID49]. And yet, Clark identified the lack of proper interaction between data analysts and decision-makers as the main barrier to unskilled decision-makers using BI reports, as “these people do not talk the same language” [Clark, Operations Director, ID41]. Madison further highlighted the need for communication with data analysts, and the extent to which proper presentation of their work could assist decision-makers in understanding underlying concepts and influence the efficacy of BI reports [Madison, ID49].

Good communication plays an important role not only for decision-makers learning from data analysts how to interact with reports, but also for data analysts learning from decision-makers about the business environment. The benefit of this conversation between the two parties is twofold. First, it educates decision-makers on using and interacting with BI and promoting fact-based decision-making processes – the main requirement for BI identity creation at an individual level.

It's a three year or four year journey for them [clinicians], to turn from clinicians into managers and all that – don't want to be data driven either but to be able to use all the tools at their disposal I think is critical. And because they're not, they haven't been through business degrees and everything else. It takes time to get them to a level and coach them the way you want them to

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be, because it's very hard otherwise. But you just can't expect people to use the stuff, they've got to see the benefit in it for themselves [Ian, Operations Manager, ID86].

Second, data analysts can engage in the process of discovering business rules [Ruofan, Data Integration and Management Director, ID19] and their integration with the available data [Rachel, Research and Analytics Director, ID12]. To emphasise the need for communication between data analysts and decision-makers or BI end users, Ruofan compared and contrasted their approach toward data and their understanding of business:

The data analyst normally would think [about] data in this way. [That] is to say, "Is the data regular? Is the data clean? How do we ensure the data will come through reliably?" When the business users (look at data, they) will say, "I understand relational database design ... I understand this field linked to that field, foreign key, but I'm more interested in each week's total transaction amount and where the customer spends the money. Was it retail? Is it food?" And then I can project it... [Ruofan, Data Integration and Management Director, ID19].

In this line, Rachel explained that routine data analyst tasks don't require comprehensive understanding of the business environment; she gave examples of generating SQL queries by data analysts. However, she noted that a communication between business people and data analysts is required to develop analytical models. This communication further leverages data analysts' understanding of the business environment that can result in efficient models:

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They'll go and speak to an SQL data analyst and that data analyst would build SQL code to pick up, to identify cases based on expert knowledge. So it's an expert – so it's using the expert knowledge and it's just SQL. So there's no adaptability of it, it's not learning from its analysis, it's just, "This is a SQL rule and if you hit his rule, yes. If you don't hit this rule, no", unlike other models where it's a supervised learning model. So they're learning every day to be better and better at what they actually do. That's what I class as an analytical model rather than a business rule models [Rachel, Research and Analytics Director, ID12].

Both of abovementioned aims focus on developing a shared understanding between business and technical collaborators [Alfred, Data Integration and Management Director, ID27], as well as defining the scope for BI use in an organisation [Shaun, Executive Director, ID20]. Indeed as Daniel, an experienced Data Analyst, stated, whenever the communication between these two groups happens the business rules will ultimately be shaped:

There's always some communication with the client and then the next step is to understand, because that conversation creates your business rules [Daniel, Data Analyst, ID17].

The communication between decision-makers and data analysts should take into consideration the needs of BI users, their prioritisation, and then the validation and verification of those needs.

Identifying needs: One of the very first issues of a complex business environment with BI is that decision-makers and BI end users are not aware of BI needs. Daniel understood this issue and suggested that many people simply do not

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know what can be achieved with the use of BI systems, as if such people were “fixed on what they only want to see” [Daniel, Data Analyst, ID24]. In Emily’s practice as a Senior Delivery Analyst, since BI users are not aware of BI capabilities, she provides opportunities for them to slowly explore their BI facilities by staged prototyping of BI solutions.

We try to do prototypes. We refer to something that we’ve developed in the past. Or we try to develop a prototype and say okay, you want a bit of trend, a bit of future, a bit of this, cut by that and different selectors. So the developer, the front end developer with experience, they can say okay I designed this report for you, because I think that’s a nice presentation. What do you think? And when the users look at that and say okay that’s good, but I would like this trend to be longer and maybe next to it I need some more information about suppliers as well. And so we basically, this is collaboration and we come up to the, common understanding [Emily, Senior Delivery Analyst, ID77].

Other study participants such as Ross, an expert in data visualisation, used visualisation systems for exploring both data and needs. In Ross’ view, the purpose of visualisation is to provide BI-generated insights in the earliest stages of data and problem exploration, well before more traditional BI reporting is deployed [Ross, Founder of a Data Visualisation Company, ID34]. Daniel also emphasised the role of visuals in exploring business data:

When the stakeholders are looking at their [visualised] data, they’ll see they’re standard but then “Oh, this is new. Let’s have a look at this” or “I want to focus on this particular thing” [Daniel, Data Analyst, ID29].

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Prioritising needs: Insufficient understanding of BI capabilities can also result in inefficient reports. Several study participants, therefore, suggested negotiating requirements to prioritise needs. Emily described several situations where BI-related tasks, such as running reports automatically, could not be delivered or understood unless negotiation with decision-makers took place [Emily, Senior Delivery Analyst, ID28]. She further stated:

When you really look into it you figure out that part of it is never used. So I try not to waste my time and my peoples' development time and the company's money. So we always try to get to the bottom of it. What do you actually need for your work? Not what you had and please replace with that. What you think you want [Emily, Senior Delivery Analyst, ID30].

Emily noted that prioritisation is needed to determine the most critical pieces of information [Emily, ID78]. She noted that in her organisation they try to find out what the most critical pieces of information are, as from business-side people, “everything seems to be important”. However, during her experience she has understood that not all requests are critical and they should be negotiated to identify high-priority information. In her view, BI requirement analysis should happen with an evolutionary approach.

They [the replenishment department] have a little IT department for a while, working just for them. So that works well with the agile approach, because one of the agile principles is that you can, you know, negotiate over requirements and they're not fixed for the whole duration of the project. Business can change priorities and they can even change requirements to remove some requirements and add some others. As long as it fits within the

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project duration. So they are very happy about that [Emily, Senior Delivery Analyst, ID81].

Validation and verification of needs: Rachel, a Director of Research and Analytics, elaborated on the need to differentiate between problem statements and stakeholder expectations. She mentioned that quite often when BI stakeholders define a problem, their expectations of BI are completely different [Rachel, ID15; Shaun, Executive Director, ID61].

Our methodology is very, very – it's the same across all the clients but it's a real challenge when you deliver something and it's not where they thought they should be. But I think that's almost like the same as delivering a solution to a client – that's not what we thought we were going to get. That can't ever happen, you would never be in a position where you'd give a client an IT solution or a system and then they go "Oh, I didn't know that". That's got to be resolved before you get to that point [Shaun, Executive Director, ID61].

In consequence, she routinely undertakes an initial interview with BI users to establish their expectation, which is captured in a business understanding report, where the aims and intent of the business are clearly identified. Subsequently, the report is translated by data miners into a BI model.

It [the communication between analysts and decision-makers] wants to show exactly what the aims and intent of the business is and the aims and intent of what a model will deliver, because business aims and intent are different to a model aims and intent. A model is very specific; it will give you a specific outcome, where business will come and say, "We just want to understand the level of compliance" [Rachel, Research and Analytics Director, ID18].

6.3.2 Exploration

Once decision-makers start interacting with and validating BI-generated reports they also start developing trust in such reports [Roy, Software Sales Manager, ID18]. Consequently, they are likely to undertake more data-driven actions. As a data analyst working closely with BI clients, Daniel added to this view by noting his willingness to anticipate decision-makers' needs and provide them with opportunities to customise and tailor their reports. Shaun further suggested that interaction with BI is a very constructive way to gain data insights. He indicated that decision-makers should find the opportunity to directly interact with reports and answer their own questions, since they are the only ones who could actually tell the business story behind the data.

Self-service is a feature of BI that enables decision-makers to access and work with corporate information without the IT department's involvement. While in a typical BI system, decision-makers have a list of reports that have been created for them, with self-service BI they can drag the reports onto their window and make their own analysis, therefore they are able to modify and personalise those existing reports according to their needs. They can change dimensions or the actual financial measure, or add a calculation, or do some traffic-lighting on those types of reports. They start with pre-created reports, which they can bring into their workspace and modify until they are satisfied with the final report [Robert, Channel Technical Manager]. In new BI systems, BI developers don't tend to do a lot of analytics on behalf of their clients; they create an environment where their clients could apply analytics, except advanced ones or some areas where clients might not carry the required skills.

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However, the study participants had different experience in providing decision-makers with self-service BI. While in Ruofan's company some decision-makers even use Teradata to write SQL on their own [Ruofan, Senior Business Analyst], Alfred found it difficult to make decision-makers to play with reports and "they generally like just something dumped in their inbox" [Alfred, Director of Data Integration and Management]. Daniel highlighted various reactions of decision-makers toward self-service BI:

Some people just say "Oh, just do it. We don't really care" but some people say "We want to take a bit of ownership. We want to understand a bit more" and that's fine but "Let us know how you did it to begin with" [Daniel, Data Analyst, ID39].

Also, Shaun, an Executive Director, noted that a great number of decision-makers and BI end users lose their confidence when they are being asked to generate their own reports:

I think less people are more confident with interactive. You've still got clients who ask for graphs in PowerPoint. Despite the fact that we've got a tool that can interrogate it and show [Shaun, ID71].

The study participants elaborated on the consequence of interaction and exploration on the effectiveness of BI through personalisation and validation of reports.

Personalisation: Rachel explained that there are different types of audiences for BI reports, therefore unless she maintains close communication with them, she would not be in the position to prepare and present such reports to their respective

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clients [Rachel, ID8]. She further cautioned on creating reports for decision-makers without first identifying and considering their needs and personalities. She strongly asserted that insufficient communication with BI users is the primary cause of not utilising BI reports to support important business decisions [Rachel, Research and Analytics Director, ID37]. In support of this view, Emily elaborated on her approach to delivering BI reporting, by closely collaborating with decision-makers in the design process to establish their data and presentation preferences:

We work with them [decision-makers] and we discuss which way they want the data presented. So in the end, we work in such a way that they understand because that's what they, they are part of the selection process [Emily, Senior Delivery Analyst, ID64].

Report validation: In the view of the study participants, scepticism toward BI reports hinders intuitive decision-makers from using BI [Madison, Director of Enterprise Intelligence, ID76; Rachel, Research and Analytics Director, ID32; Andrew, Manager of Diagnostic Imaging, ID33].

We'd obviously look at a few levels – you know, there's a financial statement accuracy level, so you know, how is the processor forming that? So, have all the purchase orders been approved – because then we've got a financial commitment if you like and then ... because that will flow down to liabilities. Then you might look at the internal control environment as well. You know – are there cases where the person who requested to buy something is also the same person that approved the purchase of their goods – that's the control issue. And then you can look at the same sort of data. You can look at the performance and how they could optimise the processor and what are your

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payment terms on these things? Okay, so some people you pay within 30 days, some you pay within 7 days – you know, like you can optimise that and push everybody back to 30 days and improve your working capital position [Madison, Director of Enterprise Intelligence, ID74].

To counter this trend, Shaun suggested the need for report validation by encouraging report users, especially those who are not committed to data-driven decision processes, to actively engage with the reported data via BI-interactive facilities, before understanding sets in and ensuing actions are taken:

It's already needing to be validated further on down and by the time it's there all the questions are out of the way, it's either a yes or no we're going to do it. So if you give something to somebody that you believe – some information to make a decision, that's never going to be it. It's always got to go up or it's got to go down, and then what you're relying on the way is those stakeholders to be engaged and understand it [Shaun, Executive Director, ID39].

As can be seen from the results presented so far, this study extends Weick's sensemaking theory (1995) in the context of BI by emphasising enactment of individual and organisational BI identity in a BI environment. To this end a number of activities need to be undertaken by data analysts and decision-makers to include exploration and identification of need for data, analytics and reports within the enterprise; prioritisation, verification and review of such needs; increasing the level of integration between business rules and data rules across business functions to create a “single version of truth”; fostering decision-makers' trust toward BI and its outcomes; development of decision-makers' skills in self-service BI to directly engage with BI-generated insights; and personalisation of BI to support

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management decisions and actions based on BI-generated data. Communication between decision-makers and data analysts was deemed indispensable in developing shared understanding of business and data insights, and the dissemination of such insights within an organisation.

6.4 Other insights

The conceptualisation of the framework for BI-based sensemaking was changed in the process of publication in 2 conferences and a journal; namely International Conference of Information Systems (ICIS2014), Communications of the Association for Information Systems (CAIS), Business Analytics Congress (BAC2015). In a hermeneutic cycle, these publications were developed in a sequence and each followed a number of revisions; ICIS2014 with 2 reviews, CAIS with 6 reviews, and BAC2015 with 2 reviews (see Appendix 1).

Development of the framework for BI-based sensemaking started from the Weick (1995) model (see Figure 1 and Section 2.1). In the first submission to CAIS, this model was re-conceptualised as two separate frameworks, one for individual and one for organisational sensemaking. However, in response to feedbacks received at the ICIS2014 (Namvar and Cybulski, 2014) and in the process of revisions to the CAIS, the model was transformed to an integrated model which shows both individual and organisational identity. The published version of framework (Namvar et al., 2016) will appear in the synthesis (Section 7.1). This framework was also presented in the BAC congress (Namvar, 2015) in a more concise form to reflect the future trends in BI and analytics, which is not presented in this thesis.

6.5 Summary

This chapter determined the essential structure of the phenomena. In this process, frames of reference were varied, conflicting views among the study participants, as well as reversals, were looked at and the structured invariants of their shared experience was achieved (Moustakas, 1994). The identified themes in Section 4.3 were compared against the properties of organisational sensemaking to explain the lived experience of the study participants in dealing with BI technology within their organisations from the perspective of Weick's model of sensemaking (1995). The findings clarify that BI can indeed support five out of seven properties of sensemaking. BI-captured data allows decision-makers to continuously engage with environmental cues via interactive reports, dashboards and scorecards and, as a result, gain business insights and share them with other decision-makers in the organisation so that they can make and enact decisions. However, in the process of imaginative variation several conflicts and polarities for addressing sensemaking properties using BI were uncovered. Table 11 summarises BI's strengths and weaknesses in addressing the sensemaking properties, which are listed in the table's first column. The second column shows the tools and services provided by BI that also display various properties of sensemaking, as inferred from the literature on BI or from the conducted interviews. The third column, drawn primarily from study participants' viewpoints, highlights the challenges for using BI in support of sensemaking.

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Table 11: BI and its challenges for supporting sensemaking properties

Sensemaking property	BI tools and services for supporting sensemaking	Challenges identified by study participants
Retrospection	Wide range of data sources and possible reports	Data is not produced for BI purposes
Social engagement / Collaboration	Facilitation for collaborative decision-making by sharing, commenting, and circulating reports and the availability of reports on mobile devices and large screens	Data analysts and decision-makers need to interact
Cue Extraction	Dashboards, KPIs and alerts	Information overload should be avoided and also there is a need for self-service BI
Plausibility	Plausibility of prediction models is the necessary consequence of uncertainty in business environments	Fuzzy data often results from its low quality, which decision-makers do find to be acceptable
Ongoing access	Continuous reporting, ubiquity and availability of reports on mobile devices	The scope of BI and shared understanding should be leveraged in a continuous cycle of growth and improvement
Identity creation	There is no direct support from BI tools	Organisations should create capacity for using BI for not only everyday operational decision but also strategic decisions. Also, individuals should deploy an evidence-based approach to decisions making
Enactment	There is no direct support from BI tools	Communication between BI stakeholders and interacting with BI reports by end BI users is needed to enact on BI environment

Table 11 shows that although BI aims at providing a retrospective view of organisational environments, it should deal with data that is not usually produced for BI purposes. It explains that modern BI systems provide an infrastructure for collaboration between BI end users and facilitate collaborative decision-making by

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sharing, commenting and circulating reports and the availability of reports on mobile devices and large screens. However, the social aspects of BI do not directly support collaboration between BI end users and data analysts. Indeed, interaction between data analysts and decision-makers is needed to create a clear scope for BI in order to generate the required reports.

Table 11 indicates that even though BI provides several tools such as dashboards, KPIs and alerts for cue extraction, BI end users may be overwhelmed with information. Also, BI end users may not trust automated reports and ask for self-service BI to generate their own reports. The table shows that uncertainty in business environments and its plausible nature can be demonstrated by prediction models, which are at the heart of BI systems; however, fuzziness of BI reports, which often results from low-quality data, leads to scepticism toward BI systems by decision-makers. Finally, the table elaborates on continuous BI reports that are available ubiquitously on mobile devices and which can facilitate ongoing access to changes in the organisational environment. However, it emphasises that the scope of BI and shared understanding also should be leveraged in a continuous cycle of growth and improvement.

Considering the limitations and challenges of BI for addressing sensemaking properties, sections 2.3.6 and 2.3.7 varied the frames of reference and aimed at addressing the conflicting views in Section 6.1, presented in Table 11. These sections explained the relationship between BI and the two remaining properties of sensemaking – identity creation and enactment – which are not well supported by BI technology.

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Section 2.3.6 clarified the role of BI identify for addressing the conflicting issues for using BI for sensemaking. Section 2.3.7 further explained how communication between BI end users and data analysis and interaction of BI end users with BI systems can assist in creating BI identity at organisational and individual levels. Figure 17 illustrates the relationship between various sensemaking properties in the context of BI and highlights the importance of identity creation and enactment to the sensemaking process.

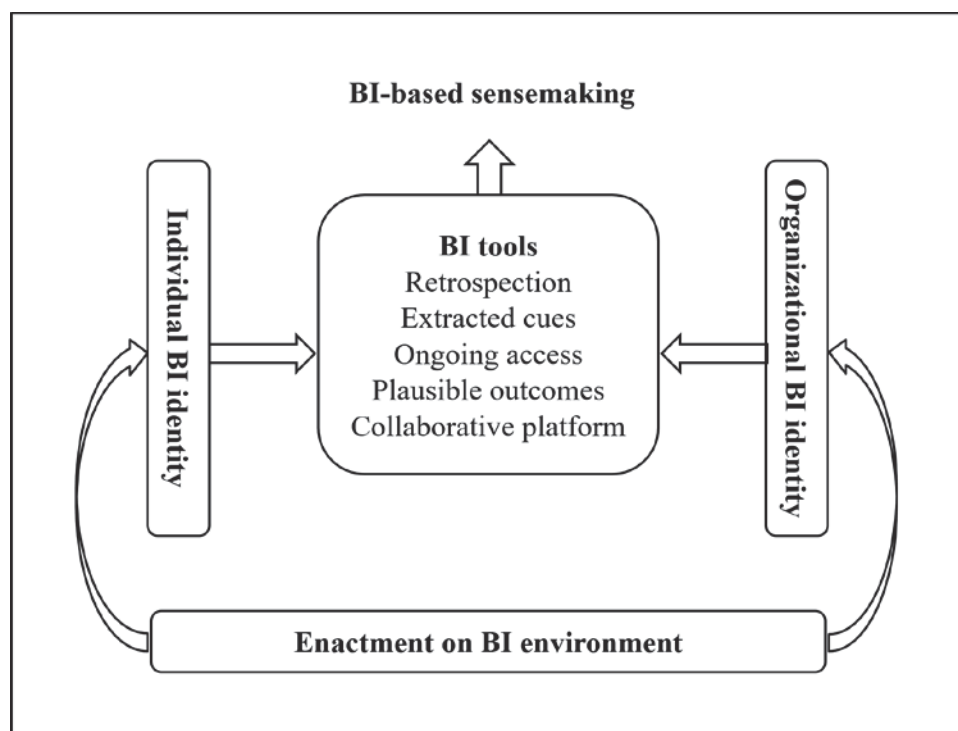


Figure 17: BI and sensemaking properties

In this figure, enactment on the BI environment by decision-makers is considered the basis of BI-based sensemaking. Enactment can improve both individual and organisational identity. Once BI-identity is enhanced, individuals and the organisation can use BI tools to assist retrospection, cue extraction, ongoing access, plausible outcomes and collaborative platform, which are required for BI-based sensemaking.

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The next chapter will present the synthesis of findings along with the essence statement of this study. It extends Figure 17 and proposes a framework for BI-based sensemaking.

7 Synthesis, essence and evaluation

This chapter will use the composite textural-structural description presented in Chapter 6 to synthesise the knowledge gained through the analysis of interviews focused on using BI for sensemaking in organisations. As a result, a synthesis and visualisation of all the insights previously presented and evaluated through the cycles of hermeneutic phenomenological analysis will be proposed and when necessary, compared and contrasted with the literature of sensemaking (see Section 2.1) and BI (see Section 2.2). The chapter will subsequently discuss how the proposed model of BI-based sensemaking fits into the existing body of knowledge and presents the essence statement of this study. Finally, it will review the evaluation criteria and the completeness of this study.

7.1 Synthesis: BI-based sensemaking

Organisational sensemaking provides a framework for understanding organisations and their structure, processes, people, resources, relationships and interactions. It implies a continuous identity construction along with enactment of roles in organisational settings (Jensen and Kjaergaard, 2010). Changes in the organisational environment are captured by sensemakers in an ongoing manner. Sensemakers enact on organisational environments after encountering confounding situations, and they reduce the number of possible meanings in the process of selection (Weick, 1995) (see Figure 1). The introduction of BI into this context alters the process of sensemaking and recognises the primacy of BI identity for individuals and their organisations (see Section 6.2 and Figure 17). Figure 18 shows how different elements of organisational sensemaking (discussed in Section 2.1 and

illustrated in Figure 1) are inter-related as revealed by the composite textural-structural representation of participants' experience (discussed in Chapter 6 and illustrated in Figure 17) derived from the conducted interviews. It presents a process model for BI-based sensemaking that shows the process of enactment and the relationship between enactment, identity and sensemaking. It extends Weick's (1995) model of sensemaking in the context of BI and presents a process model for BI-based sensemaking that shows the process of enactment and the relationship between enactment, identity and sensemaking.

The collaboration of BI stakeholders (see Section 6.3.1) and their interaction with BI tools (see Section 6.3.2) ultimately lead to the evolution of BI identity at individual and organisational levels, to support retention of shared knowledge and individual experience (as discussed in Section 2.1.1 and illustrated in Figure 1). This is shown by the loop between "identity", "enactment" and "selection" in Figure 18. In fact, as presented in Figure 17, BI end users will leverage their understanding of BI and analytics and how to use BI outcomes by enacting on BI environments. This enhanced identity at both individual and organisational level is what remains during and after the process of BI-based sensemaking which can improve further decisions. Two boxes for individual and organisational identity in the proposed model represent "retention" of original model by Weick (1995) (see Figure 1) in the context of BI-based sensemaking. The loop in Figure 18 starts with enactment that can occur in various forms, including BI end users' communication and collaboration with data analysts and their interaction with BI reports (see Section 6.3). Then, BI end users will use reports to act on their business environment. The enhanced business environment eventually grows new capabilities for using BI tools more effectively, in an evolutionary and iterative

process. This new business environment is likely to better fulfil the requirements of the organisational BI-based identity.

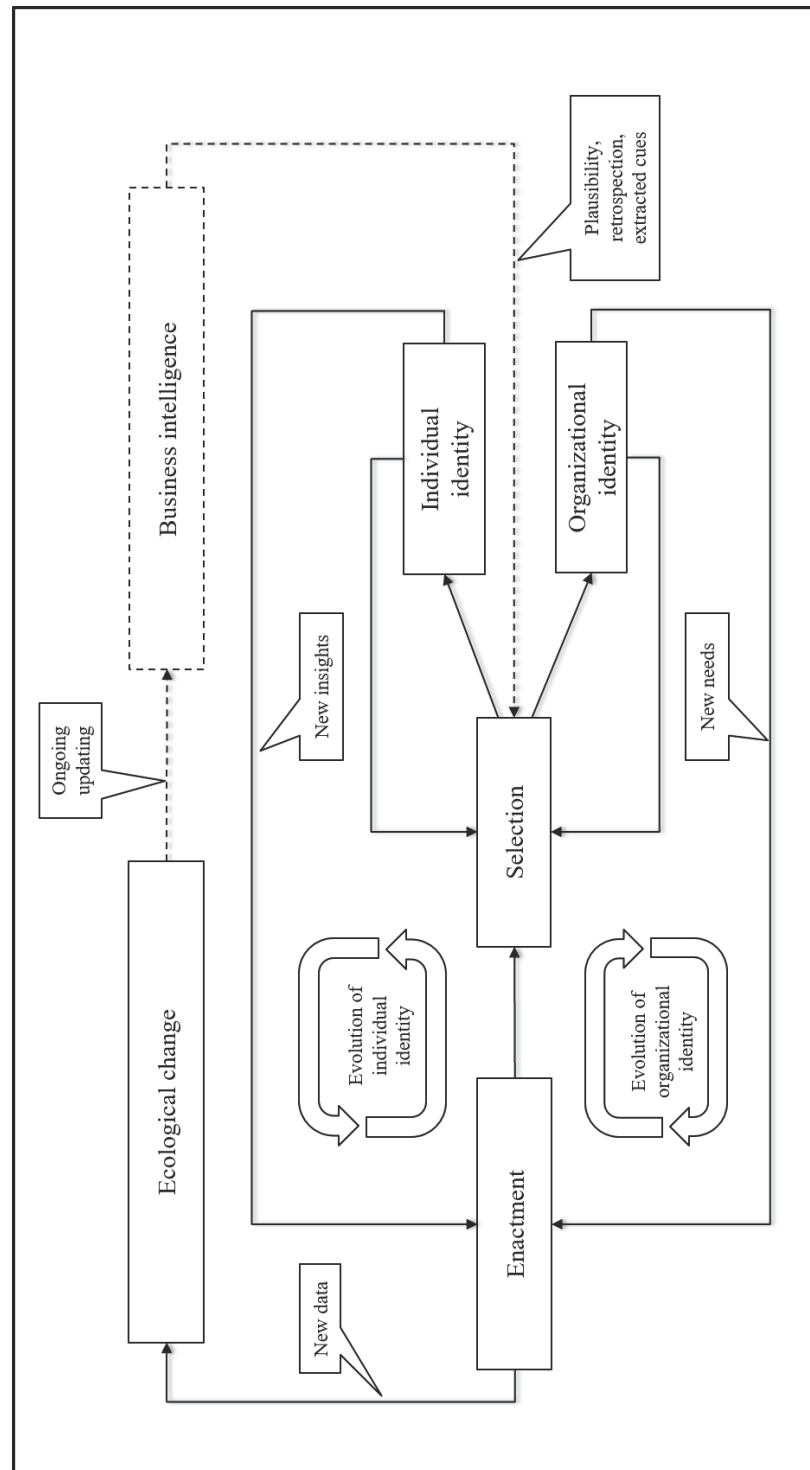


Figure 18: Framework for BI-based sensemaking

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Through shared knowledge and individual experience, BI can improve decision-making processes and indirectly assist enactment of business objectives (feedback from “identity” to “enactment” in Figure 18) on external business environments. While in this figure sensemaking is an ongoing process, decisions are made occasionally either by enacting on the BI environment, or initiating changes to their business environment by using BI reports or analytical models. While enactment on the BI environment includes manipulating data sources and contributing to BI scope definition, enactment on the business environment includes any action taken based on BI outcomes. It can be a new product purchase or decision to recruit new staff. In fact, enacting on a BI environment (see Section 2.2.2) is mainly a prerequisite for using BI (see the arrow from “enactment” to “selection” in Figure 18), whereas enacting on a business environment using BI (see the feedback from “enactment” to “ecological change” in Figure 18) occurs after BI is implemented and its scope is defined.

In the modern digital environment, ecological change is instigated by the creation of new data, as well as by initiating new business activities. At the same time, enactment starts the reflective process of meaning creation (“selection” in Figure 18), which feeds back into improving and strengthening BI identity (depicted in Figure 17 and discussed in Section 6.2). Indeed, in the modern organisations BI is being used to improve the process of sensemaking by facilitating the effort of sensemaking “whenever the current state of the world is perceived to be different from the expected state of the world” (Weick et al., 2005, p. 414). As shown in the input from BI to selection, BI is able of discovering ecological change through three capabilities: retrospection (see Section 6.1.1), plausibility (see Section 6.1.4) and cue extraction (see Section 6.1.3). BI thus equips end users with

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tools to identify crucial sources of ecological change for the process of organisational sensemaking, which may include changes due to breakdown of processes (Patriotta, 2003), surprise of unexpected events (Louis, 1980), creation of opportunities (Weick, 2012) and interruption of work patterns (Dervin and Foreman-Wernet, 2012).

As discussed in Section 6.2.1, at the organisational level, the strengthening of BI identity can be associated with business process improvement, and in particular the development of new requirements for improved BI-related processes (“new needs” in Figure 18). Organisational BI identity helps develop workplace practices and culture (Wixom and Watson, 2010). It further leads to refinement of the scope for BI utilisation, alignment of business processes with BI requirements (Marjanovic, 2010), customisation of BI tools based on the needs and expectations of the organisation (Nemati et al., 2010), as well as integration of data definition with business rules (“evolution of organisational identity” in Figure 18).

At the individual level, as discussed in Section 6.2.2, personalised interaction with BI provides opportunities to gain experience, knowledge, attitudes and skills (Foody, 2009) that will eventually define an individual’s role in the organisation (“evolution of individual identity” in Figure 18). By means of BI self-service, end users of modern BI environments, such as executive decision-makers, are able to interact with high-level business reports rather than rely on specialist data analysts to provide the service (Foody, 2009; Nemati et al., 2010; Watson, 2008). More personalised reports can be generated at a level relevant to end users, and enable them to view and explore data directly and immediately, and then eventually to generate new insights and turn them into actions effectively and efficiently (Foody,

2009; Hallikainen et al., 2012; Smietana, 2010; Steiger, 2010) (see “new insights” in Figure 18).

Much decision makers’ activities in organizations is, however, concerned with “collective efforts to make sense” (Maitlis and Christianson, 2014, p. 78), and decision-makers need to establish clear communication within their teams and with data analysts (Imhoff and White, 2010), who may have better understanding of data and its underlying concepts (e.g. its statistical and mathematical grounding). These conversations not only leverage decision-makers’ BI identity, but also educate data analysts about business rules and lead gradually to a shared understanding of business needs and expectations of BI. They may also help to define the scope of BI within an organisation (see Table 11 and Section 6.1.2).

Upon turning fact-based decisions into action, organisations are able to better select data for its collection and provide their BI systems with higher quality data (“ongoing updating” in Figure 18), which assist in updating data sources and preparing appropriate data for analytics. Thanks to data-driven meaning creation (link between “BI” and “selection” in Figure 18), as well as leveraging of growing experience (link between “identity” and “selection” in Figure 18), decision-makers are able to rely on extracted environmental cues and plausible outcomes to develop retrospective and prospective views of the organisation. BI systems that incorporate data for ongoing ecological change allow their users to review and reflect on the past events, and filter data influx to extract cues via summary reports, KPI charts and alerts for busy decision-makers or for those willing to justify their actions (see Table 11). Prediction models and self-service BI have the potential to motivate sceptical decision-makers to interact with the presented information, and form and articulate insights that should eventually yield better decisions. Finally, a

collaborative BI platform assists decision-makers to share BI reported insights and in this way learn from each other (see the interaction of all feedback loops in Figure 18).

The findings of this study confirmed the previous works on the use of BI within organisations. In particular, it approved the necessity of alignment between BI and business process (Marjanovic, 2010), clear scope of BI (Watson and Wixom, 2007), collaboration between various BI stakeholders (Imhoff and White, 2010; Yeoh and Koronios, 2010), using various data sources (Negash, 2004), insights in BI reports (Elbashir et al., 2008; Negash and Gray, 2008a; Rouibah and Ould-ali, 2002) and continuous use of BI (Foody, 2009; Smietana, 2010). It, then, integrated all these insights in a framework to extend the sensemaking theory by Weick (1995) in the context of BI.

The proposed framework in Figure 18 for BI-based sensemaking demonstrates how the two distinct areas of business and technology, BI and sensemaking, can be put together to enhance understanding of business environments. It uses modern data-driven tools and techniques to extend sensemaking theory. It also shows what BI and analytics can do before decision-making and actions occur, and how modern tools such as BI can assist decision-makers in making sense of ongoing changes in the business environment.

7.2 The essence statement

After the synthesis of the research findings, with the gained understanding of BI-based sensemaking, it was possible to explore new ways of improving business decision-making with the use of BI capabilities (present and future) to incorporate and enhance organisational sensemaking (see research question in Section 1.2), which is succinctly described in the following essence statement:

A modern data-driven firm and its workers act on the organisational environment primarily by means of digital communication and by creation of new data. By relying on data resources and modern analytic technology decision-makers could use BI beyond simple reporting to better support organisational sensemaking, thus, providing management with methods and tools to continuously generate insights leading to quality and actionable decisions.

The key to effective use of BI for organisational sensemaking is the creation and consistent utilisation of BI identity at both organisational and individual levels. At the organisational level there is a need for clear BI scope, alignment of business and BI processes, integration of BI with business rules and customisation of BI tools. Individuals also need to develop BI proficiency so that they can deploy an evidence-based approach to decision-making, use BI tools to justify their decisions and actions, be less sceptical of data-driven management and less reliant on intuition.

Organisational sensemaking using BI proceeds in a continuous process of capturing the ecological change, identity creation and enactment on BI

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environment, all leading to the creation of new data and new requirements for the shape and operation of the organisation, resulting in refined business structures, processes and data, and ultimately better decision-making.

Enactment can shape a business environment to support BI-based sensemaking and consequently foster quality decisions and actions. However, decision-makers need to be self-reliant with the use of BI technology and interact with BI tools and use BI-generated insights to enact their own identity and their organisational identity, which is reflected in business structures, processes and data. To achieve this, strategies should be developed to overcome situations that prevent individuals from using BI effectively, such as time constraints, the need to justify decisions and actions, scepticism toward BI and the involvement of unskilled users.

BI is able to assist not just decision-making but also sensemaking. In fact, bridging BI and sensemaking is vital to helping decision-makers understand that BI has deeper implications for business than just reporting on status. BI technology offers ample support for business sensemaking, whether individual or organisational, thus providing management with methods and tools to continuously generate business insights leading to quality and actionable decisions. While BI vendors, analysts, developers and end users seem to be well aware of BI features and functionality for reporting and decision support, BI-based sensemaking could provide opportunities for business decision-makers to better use the tools currently in their possession in order to resolve the challenges around BI and ultimately help businesses transform into BI-based organisations.

The analysis of insights collected from the study participants provides benefits to organizations planning to implement BI systems to support their

business decision-makers. And yet, decision-makers still need to investigate how enactment on external business environments might be undertaken to create new data sources for organisational sensemaking using BI. Also, they should more effectively identify prediction models to select plausible meanings in the sensemaking process.

7.3 Evaluation and theoretical saturation

This research represented the opinions, beliefs and perceptions of BI stakeholders for using BI in the process of organisational sensemaking. The adopted research inquiry of this study, hermeneutic phenomenology, relied on continuous reflection on and evaluation of insights derived from the cycles of data collection, analysis and understanding (Klein and Myers, 1999). This study fully recognised the principle of hermeneutic cycles and went through several rounds of hermeneutic. Ultimately, it formed the research findings by relying on iterative acquisition of partial insights and fusing them together (Klein and Myers, 1999). The understanding of these partial insights was also deeply influenced by growing understanding of the investigated phenomena.

In the continuous epoché process (see Section 4.3), my own biases and prejudices also were given consideration during various steps of this research to comprehend their influence on the research process and its deliverables. I entered the hermeneutic cycle with my own insights and pre-understandings into the BI and sensemaking concepts, processes and models, and the subsequent interviews provided new insights from BI stakeholders to revise my growing understanding iteratively. As the BI-based sensemaking framework gained maturity (see Section

0), in many instances to ensure consistency and completeness, reinterpretation of the previously collected and analysed partial insights was required. By reflecting on each cycle, it was possible to fuse the horizons of understanding for all study participants and for me as a hermeneutic investigator. Hermeneutics was explicitly and rigorously applied throughout various steps of this research (see Figure 12), including:

- Assessment of any prior prejudices and biases held by all parties involved in this study;
- Theoretical framing and gaining understanding of the domain in focus;
- Data collection and understanding;
- The refinement of the framework for BI-based sensemaking.

All such reflections are considered an indispensable part of hermeneutics and its evaluation strategy. The following sections demonstrate how credibility, confirmability, transferability and dependability were considered throughout this research (see Section 3.3). Then, Section 7.3.4 discusses how the saturation of knowledge and themes has occurred to the point of completeness.

7.3.1 Credibility and confirmability

Credibility of this study is related to my ability to know where the data came from, how to collect it and how to use it (Shank, 2006). It is also related to the process of formulating the emerging “truth” between myself and the study participants, to determine that the inquiry was conducted in a way, which ensures the precise description of the investigated phenomena (see credibility Section 3.3). Confirmability of this study is related to how the research findings were supported

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by the collected data and can be concerned with critical examination by other inquirers (see confirmability in Section 3.3). It required the establishment of consistent research practices by studying the collected data during the original inquiry (Guba and Lincoln, 1989). To increase the likelihood that credible and confirmable findings and interpretations are produced various strategies were employed, which I turn to next.

This study relied on my intimate involvement in the research process. I needed to critically reflect on how data is socially constructed through the interaction with study participant (Klein and Myers, 1999). This implied my close interaction with the subjects in order to construct shared understanding of the investigated phenomena (see Section 3.1.1). I recognised and moderated my biases by adherence to the phenomenological process of epoché (see epoché in Section 4.3). I was also fully aware of the importance and challenges of my interaction with study participants. To reduce my influence on the process of data collection, study participants were encouraged to talk freely during the interviews, on any issues that was essential in their mind for using BI to its fullest in their organizations. Additional questions were asked when further explanations were required. Open-ended questions were predominantly used (see Section 4.2) in order to obtain detailed explanations and to extend the depth of understanding of investigated phenomena.

This approach for data collection allowed my understanding of the study participants' experience to be gradually constructed, verified and improved. This process was recorded, transcribed and analysed in the further hermeneutic cycles. Study participants verified transcripts after they were produced to ensure the transcripts are a correct representation of what they said. Moreover, after the

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transcription of long interview experiences into text files, the verbatim transcript of experience were applied (see Chapter 4). In addition, Chapters 5 and 6 cited direct quotes from study participants.

External peers were involved in discussions, findings, conclusions and analysis (Guba and Lincoln, 1989) through submission of findings to a journal and two conferences (see Section 6.4 and Appendix 1). Consequently, two articles resulting from this research were presented and published at international conferences including International Conference of Information Systems (ICIS2014) and one article was published in Communications of Association for Information Systems. All feedback received in this process was incorporated in the analysis and the subsequent synthesis of findings.

By employing continued engagement and persistent analysis (Lincoln & Guba 1985), the real context of the phenomena was explored and accurate interpretations of the study participants' experiences were facilitated. This required critical reflection of the background of the research setting (Klein and Myers, 1999). Thus, in the interviews, I captured all contextual information that had any influence on the study participants' experience.

Finally, in line with the principle of "multiple interpretation" (Klein and Myers, 1999), triangulation of participant views and opinions was incorporated in this study (Lincoln and Guba, 1985). I was sensitive to possible differences in interpretations among the study participants, and looked at the investigated phenomena from various aspects of empirical reality to triangulate and compare the results. Triangulation is closely related to the hermeneutic approach, as I constantly

evaluated the findings throughout the reflective fusion of horizons of understanding (Lukaitis, 2010) and explored the views of various study participants.

The interpretation was also assisted by considering possible biases in the narratives (principle of suspicious in Klein and Myers, 1999). It required assessing collected data more critically and analysing it in the context of the social worlds of study participants. As a requirement of hermeneutic inquiry, I continuously reflected on the insights derived from the cycles of data collection, analysis and understanding in each conducted hermeneutic cycle. I understood that opinions and beliefs shared by the study participants were filled with some degree of bias, and individual experiences could have a strong impact on the way the study phenomena is described, as well as what issues are emphasised as significant. Thus, I did not use any individual view to directly represent domain knowledge, while instead, I only considered views that emerged as shared by several study participants in the domain (see Table 10). I further recognised that coding and interpretations of transcripts could also be biased; therefore, I applied iterative data collection and analysis to identify and subsequently minimise any such misinterpretation.

7.3.2 Transferability

Transferability of this study is related to the extent that the result could be applied to another context for a similar result. As explained in Section 3.3, and further explicated by Lincoln and Guba (1985), providing a transferable study to other context is not the responsibility of constructivist researchers. Nevertheless, a “thick” description of this research was provided for critical readers so that they could judge when and how the findings transfer to other contexts (Creswell, 1994,

p. 252). The described details include those of the study participants and their organisational settings (Klein and Myers, 1999).

Chapter 4 and Chapter 5 provided thick description, while writing about a theme or describing a case. Such extensive descriptions of the identified themes, appearing throughout the textural-structural descriptions, were designed to facilitate transferability of this research to future readers. Appendices 3 and 4 also provided additional information about the profile of the study participants and the identified themes.

As study participants were chosen from a broad range of industries and business roles (see Table 7 and Appendix 3), I provided details about their organisations and the relevant issues to help readers make sense of the meaning of the context. In the meanwhile, I applied a detailed and rigorous process that can be retraced by other researchers. The research process included the hermeneutic cycles through which the collected data was coded and analysed for commonalities and similarities, both of which were fundamental in finding common issues and concerns shared by practitioners across the domain (see Chapters 4 and 5 and Appendix 4). As a result, the readers can reflect on all presented findings in relation to their own specific circumstances.

As this research followed an interpretivist methodology, it is not possible to claim generalisation of the synthesised knowledge beyond the studied domain, and yet, the comprehensive description of data, analysis and findings facilitate transferability of all derived observations and judgements. It is the reader who ultimately decides “when and how the claims might ‘transfer’ to their own situations” (Lindlof and Taylor, 2002, p. 240).

7.3.3 Dependability

Dependability of this study is related to the stability of research methods and the accumulated data and findings over the study duration (Lincoln and Guba, 1985, p. 242) (see dependability in Section 3.3). In the context of this project, the project also required sensitivity to possible contradictions between the “theoretical preconception guiding the research design and actual findings with subsequent cycles of revision” (Klein and Myers 1999).

As a minimum requirement in this process, I first identified what type of interpretivism is selected as the preferred research approach. For this research hermeneutic phenomenology was selected as the primary research approach (see Section 3.1.1), and the likelihood of dependability was increased by remaining intact through the strict adhesion (see Section 3.2) to the hermeneutic phenomenological steps proposed by Moustakas (1994, p. 85).

The methodological framework as proposed by Moustakas (Moustakas, 1994), based on Van Kaam’s (1966) work, was stable throughout the research. However, as my understanding of the studied phenomena changed over time, my coding scheme was continuing growing in response to insights achieved by continuous assessment of the research process. Various coding in this study had been used previously by information system researchers for making sense of large volumes of data, and therefore was deemed considerably suitable for this research (see listing and preliminary grouping in Section 3.2.2). This made the process of understanding explicit, and allowed creation of derivative text that were further analysed in the study. Finally, by presenting statements regarding my position, the

selection of informants and my biases and values, the dependability of this study was enhanced.

7.3.4 Theoretical saturation

The research was determined to meet its success criteria upon the arrival at a consensus of all involved project participants (see success criteria in Section 1.2), as defined by the theoretical saturation of participant perceptions (see theoretical saturation in Section 3.3). Theoretical saturation of data and themes was reached during the hermeneutic phenomenological process of clustering and thematic analysis, nearing towards the completion of the last 3 interviews, with Ian Andrew and Jeffrey (see Table 7), as no new common codes (see Table 8) or themes (see Table 9) were identified.

By the completion of the 23 textural descriptions, a large number of study participants had reaffirmed the identified themes (see Table 9 and Appendix 3). At this stage, it was no longer effective to add any more study participants as the consensus was deemed reached and an exceptional number of overlaps in study participants' perception had actually occurred (see Table 8). The consensus spanned a range of codes and themes, which were considered relevant to the research question and its sub-questions, and which verified the accomplishment of theoretical saturation.

The theoretical saturation of consistent interpretation over the conceptual space of notions related to the proposed model of BI-driven sensemaking was achieved in the course of this study, namely thematic analysis, composite textural description and imaginative variation. The analysis revealed that all study

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participants had similar views as to the role of data for creating retrospective view of organisation (see company's history in Table 8) and they agreed on its weaknesses and strengths of this process (see Table 12). Thus, the consensus of study participants occurred during thematic analysis, and the associated themes and their coding system fully described retrospection in the context of BI (see scope definition and integrity in Table 9).

Table 12: Saturation on properties of BI-based sensemaking

Sensemaking property	Relevant themes	Study participants	Saturation point
Retrospection	Scope definition and integrity	All of the sturdy participants	Thematic analysis
Extracted cues	Turn into action and data presentation	All of the sturdy participants except Scott, Daniel, Chandler and Roy	Composite textural description
Social	Scope definition and integrity	All of the sturdy participants except Emily, Jane, Madison, Matt, Chandler, Ruofan and Ian	Composite textural description
Ongoing updating	Scope definition and turn into action	All of the sturdy participants except Jane, Matt and Roy	Composite textural description
Plausibility	Intuition and trust in data	All of the sturdy participants except Jane, Scott, Myla, Glenn and Robert	Composite textural description
Individual identity	All of the themes	Nathan, Robert, Jeffrey, Chandler, Madison, Ian and Dale	Imaginative variation
Organisational identity	All of the themes	Nathan, Scott, Daniel and Madison	Imaginative variation
Enactment	Scope definition, process alignment, integrity, BI customisation, turn into action and exploration	Scott, Rachel, Madison, Clark, Ian, Ruofan, Alfred, Shaun, Daniel, Emily, Ross and Roy	Imaginative variation

During composite textural description, the thematic analysis (see Table 9) was identified themes that describe four properties of sensemaking, namely extracted cues, social, ongoing updating and plausibility as well as their relationships (see Chapter 5). At this stage, only those views that emerged as shared

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by several study participants in the domain were considered for further interpretation. Consequently, the consensus over these properties of sensemaking was achieved by a number of the study participants. For example, opinion and beliefs of Scott, Daniel, Chandler and Roy were not used in describing extracted cues and its relationship with other properties of sensemaking (also see Table 10).

Theoretical saturation of establishing the relationship between identity creation and enactment occurred during imaginative variation (see Sections 6.2 and 6.3). All of the identified themes were used to construct the relationship between individual and organisational identity with other properties of sensemaking. In the process of reconciling their analysed views, Nathan, Robert, Jeffrey, Chandler, Madison, Ian and Dale were viewed as reaching the consensus as to the role of individual BI identity, and Nathan, Scott, Daniel and Madison agreed on the element of organisational BI identity. This resulted in constructing the final framework of BI-based sensemaking (see their quotes in Section 6.2).

Also, several themes, namely scope definition, process alignment, integrity, BI customisation, turn into action and exploration were applied to describe enactment in the process of BI-based sensemaking. The consensus of views held by Scott, Rachel, Madison, Clark, Ian, Ruofan, Alfred, Shaun, Daniel, Emily, Ross and Roy established the relationship between enactment, identity creation and other properties of sensemaking, leading to the creation of the framework presented earlier in this chapter. At this point the theoretical saturation was achieved and the research deemed completed.

7.4 Summary

This chapter presented the synthesis and evaluation of this study, which is the final step in the hermeneutic phenomenological process. It integrated and fused the insights representing multiple viewpoints and developed the essence of the study participants' shared experience. It further compared and contrasted such shared views with the extant literature on BI and sensemaking. In the process, the thematic structures that emerged from the hermeneutic phenomenological analysis of participants' lived experience revealed the alignments between BI and sensemaking.

The model of BI-based sensemaking was delivered, which clarified and explained the role of enactment and the process of sensemaking. The statement of the essence of BI-based sensemaking was presented to show how the proposed framework fits into the existing body of knowledge in the sensemaking and BI domains. The next chapter will conclude the findings and presents the limitations of this study, along with opportunities for future research.

8 Conclusion

This chapter first elaborates on the research questions of this study and how they are answered. Then, it presents theoretical and practical contributions of this research. Finally, it describes the limitations of the current study and suggestions for future research.

8.1 Revisiting the research questions

This study aimed to explore how BI technologies could assist decision-makers to engage in a continuous process of sensemaking with a view to gaining insight into their business environment and ultimately improving their decisions (see Section 1.2). The main research question was:

How can BI improve the process of organisational sensemaking necessary for making decisions?

By referring back to the essence statement (see section 7.2, also Sections 6.2, 6.3, and Figure 17), a brief answer to the main research question is that:

BI is able to assist in the process of organisational sensemaking when BI identity could be created at organisational and individual levels. This identity can be developed through the continuous process of enactment on the BI environment by the BI end users. Enactment results in a clear definition of BI scope within organisations and the understanding of business data by the end users. To enact on the BI environment, BI end users need to collaborate with various BI stakeholders, including data analysts, and to directly interact with BI tools to explore and act on the relevant BI reports.

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A detailed answer to the main research question is presented by elaboration of its sub-questions (see Section 1.2).

The first sub-question focussed on what organisational sensemaking is and how it helps making decisions. To answer this sub-question, sensemaking theories, which are designed for understanding organisations and their environment to make better decisions, were reviewed in Chapter 2. Table 1 compared and contrasted six models of sensemaking and explained the strength and weakness of each model for describing the requirement of organisational sensemaking (see Section 2.1.2). Then, it was explained that organisational sensemaking occurs in an ongoing process of creating retrospective views of the organisational environment. Through enactment on the business environment, sensemakers adopt various identities and collaborate with other individuals in an organisation with a view to extract cues about ecological changes and to give plausible meaning to them.

The second sub-question explored what BI is and how it helps decision-making. The answer to this sub-question necessitated conducting an in-depth literature survey (see Section 2.2), which was subsequently complemented with a study of views, opinions and experiences of BI users and business analysts (see Chapters 4 and 5). The thematic analysis of interviews with these BI stakeholders identified a number of issues, which BI-based organisations needed to address to improve the process of decision-making (see Table 10). These included: effective definition of BI scope to support fact-based business operation, aligning BI and business processes, customising BI based on the structure and strategy of organisations, integrating BI and business rules and tuning BI outcomes into action. The identified themes also revealed those attributes of BI reports that are likely to enhance decision-making, which included: report personalisation based on the

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characteristics and needs of BI end user, accuracy of reported results that is likely to increase trust of BI end users in data, inclusion of plausible results that broadens the range of reported results and aids the selection of decision options, and report interactivity supporting exploration of BI outcomes by BI end users (see Chapter 5). These themes are important to determine the BI functionality necessary to collect business data and subsequently generate information capable of assisting decision-makers.

The third sub-question investigated how decision-makers currently use BI to make sense of their organisation. Sections 2.3 and 6.1 clarified the direct support of BI for five sensemaking properties: (1) BI in its current form is used to provide a retrospective view of business environments; (2) BI have functionality to capture ongoing changes in the environment; (3) various tools such as dashboards and scorecards can be used to extract cues and insights from the business environment; (4) BI provide analytic models supporting prediction and forecasting to assist end users making plausible decisions; finally, (5) BI tools can be used to engage BI stakeholders in the collaborative construction and use of various business reports.

By answering all of the three sub-questions, it was possible to define a conceptual framework explaining the process followed by those decision-makers who currently use BI effectively to support their organisational sensemaking. The framework formalises the answer to the main research question (see Section 1.2). Sections 6.2 and 6.3 explained that to improve the process of organisational sensemaking BI identity should be created at individual and organisational levels. To this aim, BI end users need to enact on BI environments by maintaining active communication with data analysts and other BI stakeholders, and by developing skills to directly interact with BI tools. Section 07.1 further presented a framework

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for BI-based sensemaking that illustrates the process of organisational sensemaking, its seven properties and their relationship in the context of BI.

The proposed framework identified the role of BI for improving the process of sensemaking. This framework extends the original model of sensemaking by Weick (see Figure 1) by focusing on BI technology as the facilitator of capturing environmental changes and presenting various outcomes. In this framework, while sensemaking is a continuous process, decision-making occurs sporadically. In fact, BI end users can either improve the process of sensemaking by making decisions and enacting on BI environment or they can make enhanced decisions by better understanding equivocal situations during the process of sensemaking. The proposed framework does not contradict the existing sensemaking frameworks; instead it shows how BI and analytics, as emerging technologies, can improve the existing processes of organisational sensemaking.

Table 8 and Table 9 showed that nearing the completion of the last 3 interviews, during the phenomenological process of clustering and thematic analysis, theoretical saturation was achieved as no new common code or theme were identified. Most of the study participants agreed on the presented challenges of the five properties in Table 11 (i.e. retrospection, cure extraction, social, plausibility and ongoing). They also agreed how these challenges can be addressed to improve the process of organisational sensemaking (see also Table 8 and Table 10). Thus, according to the success criteria (see Section 1.2), this research is complete and the research question has been answered.

8.2 Contribution of the study

This thesis provided ample evidence for the impact of the completed research on the theory and practice of organisational sensemaking and its technological support (past and future).

8.2.1 Implication for theory

The research reported in this thesis brought two distinct theoretical fields together, sensemaking (see Section 2.1) and BI (see Section 2.2), and demonstrated how the approaches advocated by these two fields can be put into practice with applications for BI and analytics.

From the sensemaking point of view, the results of this study extend Weick's sensemaking theory (1995) by firmly setting it in a modern data-driven organisational environment, where tools such as BI can assist decision-makers in making sense of ongoing changes in the business environment (see Section 6.3). The explanation of sensemaking properties in the context of BI revealed the strength and limitation of BI for addressing organisational sensemaking and provided insights for further investigation into how intuitive decision-makers can make sense of data-driven organisations.

Most significantly, the thesis advanced a process framework of continuous organisational sensemaking through the incorporation of BI technologies with a particular emphasis placed on the creation of individual and organisational identity. It described the relationship between various properties of sensemaking and the feedback loops between enactment and identity creation in the process of

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organisational sensemaking (see Section 0). The novel process proposed for describing sensemaking provided insights about individuals and their collectives, as they make sense of environmental changes to achieve an organisational level of sensemaking.

Finally, the study made a contribution to the literature of BI and analytics by investigating what BI and analytics can do before decision-making and actions occur. This addressed the shortcoming in the previously reported BI literature (see Section 2.2) where decisions were predominantly investigated as the objective of BI processes, placing far less priority on the understanding and making sense of organisational environment.

8.2.2 Implication for practice

This study clarified that BI can assist not only decision-making but also sensemaking. In fact, bridging BI and sensemaking is vital to helping decision-makers understand that BI has deeper implications for business than just reporting on its status. BI technology offers ample support for business sensemaking, whether individual or organisational, and thus provides management with methods and tools to continuously generate business insights leading to quality and actionable decisions. While BI vendors, analysts, developers and end users seem to be well aware of BI features and functionality for reporting and decision support, BI-based sensemaking could create significantly more opportunities.

This study identified those BI elements needed for the sensemaking process to succeed in organisational settings. The synthesis of the thesis insights represents the views and experience of BI practitioners and thus could be of value to the BI

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community. This study guides organisations on how to use BI effectively with a view to gain insights into their business environment. The study results have the potential to assist BI stakeholders in creating and consistently using BI identity at organisational and individual levels (see Section 6.2).

This study provided guidelines for creating BI identity at the organisational level; including: how to define a clear BI scope, align business and BI processes, integrate BI with business rules, and customise BI tools (see Section 6.2.1). It also indicated how individuals also need to behave in the ways that enable them to make sense of their organisation with BI (see Section 6.2.2). This understanding will help organisations developing strategies to overcome situations that prevent individuals from using BI effectively, such as time constraints, the need to justify decisions and actions, scepticism toward BI, and the involvement of unskilled users.

This study assists decision-makers in understanding how to enact on business environment to support BI-based sensemaking and, consequently, foster quality decisions. It guides decision-makers how to independently interact with BI tools and use BI-generated insights to enact their own identity in the process of refining business structures, processes and data (see Section 6.3.2). It also articulates guidelines for communication between decision-makers and data analysts which can result in identifying, prioritising, validation and verification of needs (see Section 6.3.1).

Finally, the proposed framework for BI-based sensemaking (see Section 0), which was derived from the wisdom and experience of BI end users, has the potential to assist decision-makers to better use BI tools currently in their

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possession and to resolve the BI challenges currently facing them; ultimately, helping businesses transform into BI-based organisations.

8.3 Limitation of the study

There are several limitations in this study that need to be addressed. First, in line with the research question of this research (see Section 1.2) the study participants were chosen from BI stakeholders who are already familiar with the principles of data management and with BI tools. They believed in the usefulness of BI for decision-making and understanding business environments. They were, thus, able to elaborate on the aspects of BI that can *improve* the process of organisational sensemaking. The study, however, did not include those decision-makers who were not familiar with data-driven decision-making. This limitation, however, was necessary from the point of view of the research design, as pertinent to the process of data collection and analysis, and a later imaginative variation (see Chapter 6) and synthesis (see Chapter 7).

Second, this study selected its participants mainly from the industries that are strongly driven by data; including, IT, finance, health care and retail. Other industries, such as building and construction that are less reliant on data and analytics were not included in this study. Again, by talking with practitioners from those data-driven industries, the study had a better chance to identify insights of relevance to its research question (see Section 1.2).

Third, by adopting hermeneutic phenomenology as the primary research methodology (see Section 3.1.1), this study focused on the lived experience of BI stakeholders. Other sources of data within organisations, such as documents and

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charts, were not analysed directly in this research. At the same time, the study participants discussed various issues related to the creation and use of such business documents in the interviews.

8.3.1 Future work

The analysis of insights collected from BI practitioners provides benefits to organisations planning to implement BI systems to support their business decision-makers. Yet, several suggestions for the future work can be made.

First, this study revealed the role of enactment on the *internal* BI environment for improving the process of organisational sensemaking. This enactment occurs primarily through communication between various BI stakeholders (see Section 6.3.1) and through exploration of BI reports by the BI ends users (see Section 6.3.2). Future work is, thus, needed to investigate how enactment on *external* business environments might be taken. Such a study could potentially reveal how organisations act on their external environment with BI and how they collect new data sources for capturing environmental events, to further improve organisational sensemaking.

Second, this study showed the importance of predictive models in providing plausible outcomes for decision-makers (see Section 6.1.4). However, as the research investigated the role of BI and analytics in general (see Section 1.2), it did not examine various approach of BI end users in using predictive models specifically. Other researchers, therefore, could investigate how one could use prediction models to select plausible meanings in the sensemaking process. They

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could also reveal the risks associated with using predictive models by data analysts when encountering skeptical decision-makers.

Third, this research identified the crucial importance of collaboration between data analysts and BI end users while creating BI identity at organisational (see Section 6.2.1) and individual (see Section 6.2.2) levels. Future work in this area needs to be undertaken to further investigate new ways of collaboration between co-located and remote decision-makers to enhance their joint efforts and to determine when and how decision-makers need to interact with BI tools in a highly personalised way. These studies could reveal capabilities of modern BI systems that have the potential to improve social aspects of organisational sensemaking.

Fourth, some other research can be conducted to investigate the negative aspects of BI technologies on organisational sensemaking. They could investigate if providing decision-makers with more data makes the process of sensemaking even more complicated.

Finally, because this study was conducted across different industry sectors and functional areas, more work is needed to investigate the work patterns and best practices that could emerge for specific industries. This might focus not only on the investigation of lived experience of study participants but could include analysis of documents and observation of practices within their organisations.

8.4 Summary

In a competitive business landscape, organisations need to monitor changes in the business environment and turn them to their advantage. BI, with its analytical

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power, uses vast amounts of data to create one type of competitive advantage. With the growing amount of data around organisations, BI has changed from being a useful tool to a necessity for survival in rapidly fluctuating business environments. Previous studies on the business value of BI confirmed that in order to master environmental change and take advantage of big data, organisations need to alter the way they operate and move toward using BI not only for decision-making but also for making sense of business environments.

To identify the requirements for using BI within organisations, many studies have been conducted on critical factors needed for implementing and adopting BI. However, in spite of efforts to use BI at strategic levels, most of its use is limited to day-to-day operational decisions. Therefore, there was a need to use decision-making theories to explore the underlying factors in how firms move toward information-based decision-making. In a similar fashion, this study relied on the theory of sensemaking to investigate how BI could be used to better understand the organisation, with a view to assist business decision-making, and eventually turn the organisation into a BI-based one. This thesis identified new ways of using BI more effectively, provided insights into development of future BI technology and the ways of growing organisational sensemaking to support actionable decisions and created opportunities for further research.

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Appendix 1: Publications

The publications based on the findings of this study are outlined in below:

- Namvar M., Cybulski J., Perera, L. (2015) “Using business intelligence to support the process of organizational sensemaking”, Communications of Association for Information Systems, Vol. 18, pp. 330-352.
- Namvar M. and Cybulski J. (2014) “BI-based Organizations: A Sensemaking Perspective”, International Conference on Information Systems (ICIS2014), Auckland.
- Namvar M. (2015) “Making Sense of Organisations by Analytics’ Emerging Trends”, Business Analytics Congress (BAC2015), Fort Worth.

Appendix 2: Plain language statement and consent form



DEAKIN UNIVERSITY PLAIN LANGUAGE STATEMENT AND CONSENT FORM

TO: [Full name]

Plain Language Statement	
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Date:	XX XXXX 2012
Full Project Title:	Understanding Business Intelligence Driven Organisations
Principal Researcher:	A/Prof Jacob Cybulski
Associate Researcher(s):	Mr Morteza Namvar Dr Yee Ling Boo Mr Luckmika Perera

You are invited to take part in this research project. Your participation is voluntary. If you do not wish to take part you are not obliged to. Deciding not to participate will not affect your relationship with the researchers or to Deakin University. Once you have read this form and agree to participate, please sign the attached consent form. You may keep this copy of the Plain Language Statement.

The main aim of this study is to investigate how Business Intelligence and Business Analytics are used by organisations to assist and justify management decisions.

The concepts of Business Intelligence (BI), Business Analytics (BA) and 'Big data' are gaining prominence for the modern businesses. While these concepts are loosely defined, they are commonly associated with collections of methods and technologies that enable executives to analyse large volumes of business data with a view of improving quality of their decisions. The ultimate objective of BI/BA tools, such as IBM Cognos or Microsoft PowerPivot, is to optimise operational

performance and to influence an organisation's strategic positioning against its competitors.

As BI/BA tools are becoming more affordable and widely available, the analytic capabilities of BI/BA systems increase, management must also rapidly adapt their practices to take advantage of this technology and in the process display a lot of innovative thinking. This study therefore aims at understanding the emerging BI/BA practice, which may include the way BI/BA enable business objectives and processes, allow justifying decisions or enacting action plans.

The outcome of this study will be twofold. In the first instance, the collected insights will allow us to create a comprehensive theoretical framework that explains the role of business intelligence/business analytics in a modern organisation. The second objective is to inform the design of Information Systems curriculum, to cover the skills and knowledge so that university graduates would be well prepared for the techno-organisational challenges of using BI/BA systems in their future practice.

You have been selected to take part in this project because of your considerable experience in using BI/BA in decision-making. With your consent, your participation in the project will involve a focus group and/or an interview, each of approximately one to two hours. You may of course decide to stop participating in your session at any point. Up to the time of publication, you may also ask that any information collected at your interview be altered or destroyed and not used for the research. This will not be possible with the records of a focus group session, which would include multiple participants.

Indicative interview and focus group questions include (the terms "BI" and "BA" are here used interchangeably):

- *Could you briefly describe your role in the organisation?*
- *Please describe how you use business intelligence in your day-to-day practice.*
- *Explain how BI could assist in understanding business operation and strategy planning.*
- *Explain how BI could assist in making executive decisions.*

- *Explain how BI could assist in developing and justifying action plans.*
- *Could you describe what skills and knowledge are required for you to learn and use BI tools?*
- *Could you discuss what combination of business and IS subject would you recommend to be taken by undergraduate and graduate students to allow them proficiency in the use of BI?*

We will voice record the focus groups and interviews. You may also wish to provide the interviewers with samples of your work to better illustrate your tasks and the use of BI in conducting these tasks.

All voice recordings will be transcribed and you will be invited to correct and amend the transcripts. The corrected transcripts, our notes and any other documents that you may give to us would then be analysed for research purposes and curriculum development. Note that the transcripts will be anonymised so that your identity and the identity of your organisation would not be disclosed in any of the publications resulting from this project.

To comply with the government requirements all research data will be stored securely for a period of a minimum of 6 years after the final publication. It will then be destroyed.

Approval to undertake this research project has been given by the Human Research Ethics Committee of Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Office of Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au.

If you require further information or if you have any problems concerning this project, you can contact either of the principal researchers – please quote the project number BL-EC 46-12. The contact details of the principal researcher responsible for this project are:

A/Prof Jacob Cybulski

School of Information Systems
Deakin University

221 Burwood Highway
Burwood VIC 3125
Australia

Phone: 0412 853 383
Email: jacob.cybulski@deakin.edu.au

**DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM**

TO: [Full name]



Consent To Participate in Research

Date:

Full Project Title: Understanding Business Intelligence Driven Organisations

I have read, or have had read to me and I understand the attached Plain Language Statement.

I freely agree to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of the Plain Language Statement and Consent Form to keep.

Participant's Name (printed)

Signature Date

Please send this form to:

A/Prof Jacob Cybulski

School of Information Systems
Deakin University

221 Burwood Highway
Burwood VIC 3125
Australia

Phone: 0412 853 383
Email: jacob.cybulski@deakin.edu.au

**DEAKIN UNIVERSITY
PLAIN LANGUAGE STATEMENT AND CONSENT FORM**

TO: [Full name]



Revocation of Consent to Participate in Research

(To be used for participants who wish to withdraw from the project)

Date:

Full Project Title: Understanding Business Intelligence Driven Organisations

I hereby wish to WITHDRAW my consent to participate in the above research project and understand that such withdrawal WILL NOT jeopardise my relationship with Deakin University and the researchers involved in this project.

Participant's Name (printed)

Signature Date

.....

Please send this form to:

A/Prof Jacob Cybulski

School of Information Systems
Deakin University

221 Burwood Highway
Burwood VIC 3125
Australia

Phone: 0412 853 383
Email: jacob.cybulski@deakin.edu.au

Appendix 3: Profile of study participants

Hill is a Managing Director of an international consulting company, where they focus on various aspects of information management from master data management to BI, with a focus of better managing an organisation's information asset. Their BI solutions cover structured and unstructured information management. His company was initiated in Europe in late 1998, and then expanded to various countries around the world. Hill's jurisdiction covers some parts of Asia, in which he and his team assist companies to better manage their information and also understand and exploit how to gain business value using BI.

Shaun is an Executive Director of a benchmarking company that was set up in Europe more than 20 years ago. Her company offers various services including price benchmarking, process benchmarking, spend analytics and enterprise support decision-making. Shaun holds a bachelor's degree in education and a master's degree in business from an Australian university. She has worked with her company in Australia from the start and originally came from a business process outsourcing organisation. She has been in charge of operations and business development, and basically the operations of the business. Her company collaborates with various sectors.

Emily is a Senior Delivery Analyst at an Australian retail company. In her company there are two data warehouses; the customer and business warehouses. Emily works in the business area and her role is coordinating product managers and designers. She has a team of ten people who basically develop reporting tools for the business, specifically about replenishment, which is one major issue for their

business. Recently, they had a transformation project in their IT department and they introduced new reporting systems. They are currently trying to remove manual and unreliable reporting tools and replace them with new sources of reports designed for strategic decisions.

Jane is a Senior Consultant in a small start-up software company, which sells text analytics software. She has been with them since late 2005 and started as a trainer; she then assisted with many other tasks such as sales demonstrations, technical support and consulting. Although she is not a developer, she listens to development dialogue and follows the details. Their software, initially developed in an Australian university, uses statistical algorithms to analyse text documents and produce summary reports. Some of the reports are visual whereas others are quantitative. Their algorithms, developed in academia, have been stable for years; however, their interface has had a few iterations to become more user-friendly and commercial. They have pushed out into the commercial and government sectors, as well as the academic sector.

Madison is a Director in Enterprise Intelligence in a company; she sits in the advisory part of the organisation and does mainly consultancy tasks. They offer enterprise intelligence solutions, which incorporate links to BI and analytics. They look at data governance and its standards and then predictive analytics and data visualisation. In their company also there are other skill sets such as information architecture and IT architecture. Even though they are a consultancy firm, they provide support to audit work by using analytics.

Dale is a Senior Manager in the same area as Madison and works on projects that Madison directs. He manages day-to-day tasks while Madison has a strategic

focus on projects. In his daily work, Madison analyses data and tries to achieve a certain objective, or works with organisations to understand what data they require to reach their objectives. Then, he works with them to convert their data into insights. Recently he has been utilising visualisation to summarise and represent reports.

Matt is a Manager of BI in a university. He studied a Bachelor of Commerce and did a triple major in marketing, economics and IT, and then did his honours in economics. Initially, he did not intend to work in IT, but later on, he found himself getting more and more involved in working with data and found an opportunity to work with a data warehouse team. He has been working in BI for the last 12 years. He has been in two organisations and performed functional and management roles. He believes his business background has been very helpful, rather than his IT skills, as BI is more about the business rather than technology.

Jordan is a Senior Data Analyst. He holds a PhD in analytics from an Australian university and started his job at a university right after his graduation. Initially, he worked as a data analyst and then was promoted to a senior data analyst. His role covers a broad ranges of responsibilities, including forecasting and modelling of student loads.

Scott became a General Manager in one of the leading IT companies in the world six months before the interview. Prior to that, he spent 18 months in running an operational database administration team and provided consulting to a utilities, strategy and architecture team, around relational data and BI strategy. He also worked for seven years in a bank, where he engaged with data and its use within the organisation.

Shane is a Technology Strategist in the same company that Scott works for. Although he is a BI end user, his various roles at his company have exposed him to a variety of BI and analytics tools. His role has recently changed to the technology side of BI and he is now a technology strategist assigned to one their biggest clients. Prior to that, he was in the partner channel that investigated selling performance, and its impact on their business.

Daniel is a Data Analyst in a BI consulting firm. He holds a double degree in accounting and IT from an Australian university. He worked in several large Australian organisations. He mainly deals with clients to find out their needs for BI and analytics systems and assists them to engage with BI tools. He receives data from their clients, analyses them, and after integrating business and data rules uses analytics and visualisation to report on them. As he tries to discover client demands, he continuously interacts with them to see if they want to see something new.

Myla is a Data Analyst in the same company that Daniel works for. She holds a bachelor's degree in social science, started her job as a market researcher and then became familiar with various data analysis tools. Thus, she has been doing quantitative and qualitative analysis for the last eight years. She is always curious about what is hidden under data, and what patterns and relationships can be discovered among the data.

Rachel is a Director of Research and Analytics in one of Australia's government sectors. Her background is psychology and she has been interested in the statistics side of this. She is not doing data analysis herself, but as her strength is statistics, she can understand the models discovered by data miners. In fact, she is a translator between BI end users and data miners, and manages analytics

projects. She understands business requirements and guides data miners on how to generate their models.

Nathan is a Director of Sales and Marketing in a company focused on delivery rather than sales and marketing. They are specialised in a number of services across information management and BI. They run marketing programs to educate organisations on different ways of using BI or leveraging their existing BI tools to enable them to make better fact-based decisions. Their services cover the whole life cycle of information management, including financial budgeting and planning, setting targets for organisations, data management and integration, analytics and strategy, portals and collaboration. Nathan's role is to effectively generate demand for their services and software.

Sahil is a Manager for Information Technology Strategy and Architecture and is also the program director delivering information management strategy projects within the Department of Business and Innovation in one of the government sectors. He holds a bachelor's degree in electronics and communication, a masters' degree in biomedical and electrical engineering and a PhD in computer science from an Australian university, where he was an associate professor for nearly ten years. He has been working on many areas, initially in computer architecture and parallel computing. Then, he moved into information management, in which he has been working for the last ten years in variety of government and industry sectors. He has a broad understanding of the needs, requirements and changing demands of data and information analytics and their use in industry.

Alfred is a Director of Data Integration and Management in the company that Nathan works for. Prior to that, he worked in consulting firms for around five years in various roles, including software development database management and BI. Since being in his current role, he has taken more of a solution architect role and directed projects primarily in the BI space. He currently manages a number of BI projects with several staff and clients.

Chandler is a Director of Financial Governance and Planning in the same company that Nathan and Alfred work for. Prior to that, he worked in various aspects of financial planning, including budgeting and forecasting in Europe and US. He holds a bachelor's degree in finance from an Australian university. He started his professional career as a tax investigator and then designed investigations for a chartered accounting firm. In his current role, he is responsible for financial governance, and also managing data at the corporate governance level. He tries to insure that outcomes of BI and analytics applications provide a more consistent basis for decisions.

Ross is a Founder of a data visualisation company. He has been working in the IT field for more than 15 years. He initially started an IT degree at an Australian university, but left it and worked at a consulting firm overseas for more than five years, where he undertook a variety of tasks, including software development and business consulting in telecommunications and internet projects. In late 1990, with his colleagues, he founded a company that develops recommendation systems for enterprises, mainly online store fronts, using data mining and predictive analytics.

Glenn is a Manager of Data Analysis in an organisation that manages dental hospitals in Australia and also funds community dental clinics that predominantly

service concession card holders. Glenn's role is basically monitoring the performance, reporting and evaluation of the public dental services that his company funds. He is a dentist and does not have any BI and analytics qualifications. However, in spite of lack of knowledge in BI and data warehousing, having that clinical background where a lot of information is being reported around the clinical activity and knowing the business, is the reason he is in his current role.

Arnaldo is a Senior Data Analyst who works in Glenn's BI team. He has a programming background and knows how to run reports in databases. While Glenn is clinical and knows the business and how hospitals run, Arnaldo is the technical person in the team, who develops the reports. Together, Glenn and Arnaldo develop reports for executives to enable them to monitor patient numbers, wait lists and clinical data.

Clark is a Director of Operations in a government sector. For about two years, he has been working on a project focused on reviewing the design of a BI solution for his firm. Prior to that, for the several years, he was a Director of Risk and Intelligence in a number of business areas. In those roles, he had experience with using large data warehouses for data analysis and delivering decisions with BI tools. He has been dealing with an Australian large company and a large warehouse since early 1995. In his career, he has progressed from doing very quantitative and technical work into translating data into the business to create intelligent reports. He has experience in interpreting BI reports and applying them in a business sense to develop practical solutions that integrate BI outputs and everyday business decisions. In his role, he is more concerned about building the capability in people who can understand BI and interact with self-service BI tools. He has tried to use

the functionality that his organisation has to turn business information into useful reports that assist in making decisions from the strategic level to the tactical level.

Ruofan is a senior business analyst in one of the Australia's major banks. He holds an information systems degree from an Australian university and he also acquired a certified practice accountant qualification. He started working as an accountant, but then he realised that he is facing mainly information issues rather than accounting issues. His company couldn't work out how much to pay the contractors and couldn't balance certain accounts; therefore, he used various technologies to balance certain accounts. He progressed from there and was offered work with a much bigger multinational company, for which he had the opportunity to work in the US and Asia on big projects. From there his work has always related to data in the sense to help business make decisions.

Robert is a Channel Technical Manager for a leading IT company that offers various BI and analytics solutions. He has education background in accounting and IT. He started his professional career in accounting, and then moved to systems accounting, and finally the hybrid of accounting and IT. During last six years within his company, he has been supporting their business partners on the best way to implement BI solutions. He has not been contributing to the physical implementation of software, but he has tried to insure that their clients are ready for implementation and that they offer the right solution for the right problem. He is also working and coordinating with universities to see how they can bring their students into an educational lab with business analytics.

Roy is a Software Sales Manager for business analytics in a leading company. During the last three years he has been managing a team of software sellers in

Europe selling their software portfolio capability. He moved to Australia a couple of months before the interview as he wanted to focus on business analytics and work in the software group. He has a team of salesmen who are supported by pre-sales technical people, and they are spread all over Australia.

Ian is an Operations Manager for diagnostic imaging in the health sector. He is a medical imaging technologist and has a Diploma in Diagnostic Radiography, a degree in medical radiation and a Postgraduate Diploma in Health Services Management. He holds a master's degree of business focused on entrepreneurship and innovation from an Australian University and is currently doing a PhD. He interacts with generated reports from the data warehouse to monitor and track business activity, to make sure his company is achieving budgets and targets.

Andrew is a Manager and the Chief Radiographer for the diagnostic imaging department in a hospital. He has an operational role, but he is also responsible for reporting on performance against activity and financial targets. He is involved in the process of building budgets for the year, hearing business cases for projects, and major equipment purchases. He has an assistant who analyses data and assists in monitoring progress and forecasting performance. This analysis is mainly used to see if they are on track and whether they need to establish new targets.

Jeffrey is a National Manager of Financial Reporting and Analysis for one of the largest infrastructure projects in Australia's history. He holds a bachelor's degree in finance accounting. His professional career started at chartered accounting firms and then he moved into the commerce world. As he progressed he was intrigued by information and started to dive into reporting, analytics and its

presentation for making decisions. Currently, he is looking after reporting and analytics for the entire construction of a huge infrastructure project.

Appendix 4: Final codes and their statements

In the following the final codes from the point of view of various study participants will be presented. Note that each table refer to a final code (see Section 4.3.2) and its related statements from the point of view of various study participants.

BI evolution	
Hill, ID13	What is the point of “installing a tap to put on the water tank” if the water is going to be dirty? The outcome is drinking clean water. So if you’re selling me a tap, is the tap a form of purification as well? Because then I’m interested. But you’re actually asking me for more than a tap. You’re asking for the tap with clean water and that’s information management as opposed to business intelligence. Which brings me to the point of the definition of business intelligence and how that’s evolved over time.
Shaun, ID2	One of the big challenges we find is that vendors rarely see the product of the data or the outputs of the data they’re giving. So in the case of – even in the higher ed [education] sector, but for government in particular, they might require their vendors to give large amounts of transaction reporting and information based on what they’ve spent or the processes and things like that. They then use that for the purposes of analysis and decision-making and the vendor sits there thinking well, what happened with that? Did anything come back from that? So one of the things we talk about with our clients is if you are going to put in place with your vendors fairly complex regular, repeatable reporting, they get something back from that.
Shaun, ID3	Whether that’s a summary of the data they’ve sent or a couple of insights into the market or into the client, it’s still important, otherwise it’s like anything, even I’m sure in the faculty, you provide reports – if nobody’s coming back to you with any questions those reports become more and more redundant. So that sits a little bit with what we do with vendors in that we are working on behalf of the client but we often talk to clients about making sure that for that large piece of data or that ongoing data you’re going to receive – then vendor requires something back to create the carrot for them to keep providing it.
Matt, ID54	If you understand 60 per cent of the requirements up front that’s good, that’s great. Then you start building and you start delivering and then you get feedback early and then you iterate and you go through and then you eventually break the work up into bits, deliver as much as you can as time goes on.
Daniel, ID28	If we’re starting with a client that has no idea about what they’re doing or the data that they have, then it’s really about “Okay, here’s a summary of your business and each month we’re going to focus on a particular area”. So this month – we’ll still have your three or four standard views, for example, or reports – now, this month we’re going to focus on this particular area. And then two months later, we’ll focus on this particular area.

Shared understanding	
Hill, ID13	What is the point of “installing a tap to put on the water tank” if the water is going to be dirty? The outcome is drinking clean water. So if you’re selling me a tap, is the tap a form of purification as well? Because then I’m interested. But you’re actually asking me for more than a tap. You’re asking for the tap with clean water and that’s information management as opposed to business intelligence. Which brings me to the point of the definition of business intelligence and how that’s evolved over time.
Hill, ID90	The fact that I have four credit cards, does that mean I’m four customers or is that one customer? Now a different – two GMs might be saying, no, no, that’s one customer because I get remunerated for you having a credit card. I don’t get remunerated for you having a loan. So you’re two customers from a bank perspective, or from my perspective as a GM. But on the outside, when marketing look at you they say, you’re one person. We look at you as one customer. When the definitions aren’t clear, the state of your data is not good enough to make decisions and your business processes will help dictate the state of data or let’s call them the definitions, clear definitions that are owned.
Shaun, ID15	A really good example of that was where they’ve engaged an Oracle or a SAP but they haven’t enabled a spend analytics module or reporting modules or trained anybody in it. So it’s the scope and then it’s articulating what they believe the deliverables will be from that.
Shaun, ID4	There’s an example at the moment with South Australia Health, they’ve had an Oracle – it was in the papers – an Oracle implementation, it’s cost a fortune, it’s taken two years. Why would people be surprised? It’s crazy. That’s often the case, because that pre-engagement work has not been through enough, and I think that – you’ve seen it with SAP and all the other big ones, there’s always this oh, it didn’t meet our expectations; well, you didn’t set your expectation, you didn’t articulate them, you didn’t articulate the problem. But now I think IT is likely to take much longer than it used to because the risk and the dollar risk associated with it is well known.
Emily, ID77	We try to do prototypes. We refer to something that we’ve developed in the past. Or we try to develop a prototype and say okay, you want a bit of trend, a bit of future, a bit of this, cut by that and different selectors. So the developer, the front end developer with experience, they can say okay I designed this report for you, because I think that’s a nice presentation. What do you think? And when the users look at that and say okay that’s good, but I would like this trend to be longer and maybe next to it I need some more information about suppliers as well. And so we basically, this is collaboration and we come up to the, common understanding.
Alfred, ID18	BI, a lot of the time, what we find is that people don’t actually understand what they want until they see it. So even if – you might have the best laid out designs and plans, and we attempt to not do too much designing and planning around that. More try and surface the data up to a couple of key users that intricately know the business and let them play around and get them to help us define the requirements a bit better after they’ve seen their data. Then move forward.
Ruofan, ID19	The data analyst normally would think [about] data in this way. [That] is to say, “Is the data regular? Is the data clean? How do we ensure the data will come through reliably?” When the business users (look at data, they) will say, ”I understand relational database design ... I understand this field linked to that field, foreign key, but I’m more interested in each week’s total transaction amount and where the customer spends the money. Was it retail? Is it food?” And then I can project it...
Ian, ID86	It’s a three year or four year journey for them [clinicians], to turn from clinicians into managers and all that – don’t want to be data driven either but to be able to use all the tools at their disposal I think is critical. And because they’re not, they haven’t been through business degrees and everything else. It takes time to get them to a level and coach them the way you want them to be, because it’s very hard otherwise. But you just can’t expect people to use the stuff, they’ve got to see the benefit in it for themselves.

Collaboration	
Emily, ID28	Sometimes you have to negotiate a bit and see, to identify, what actually, what are the important things they need, not what they want, but what they need.
Emily, ID78	We try to find out also what are the most critical pieces of information. Because if you had a list of things that you want to see on my report in a business sense, at first glance it looks like everything is as important as the next thing. So, but when, from experience, we know that it's not. So we say okay, these are the things you can have. This one. Do you really need that? Because it's just getting too complicated, the report. Or we need to bring it out of some other system. So if you really want to do it we can do it but it's going to take us another month to do it. So the business can decide whether they really need that or not? Is it just wishful thinking or just sort of, yeah, it would be nice to have. So we try to categorise things we must have, and wishful thinking.
Madison, ID74	We'd obviously look at a few levels – you know, there's a financial statement accuracy level, so you know, how is the processor forming that? So, have all the purchase orders been approved – because then we've got a financial commitment if you like and then ... because that will flow down to liabilities. Then you might look at the internal control environment as well. You know – are there cases where the person who requested to buy something is also the same person that approved the purchase of their goods – that's the control issue. And then you can look at the same sort of data. You can look at the performance and how they could optimise the processor and what are your payment terms on these things? Okay, so some people you pay within 30 days, some you pay within 7 days – you know, like you can optimise that and push everybody back to 30 days and improve your working capital position.
Daniel, ID17	There's always some communication with the client and then the next step is to understand, because that conversation creates your business rules.
Daniel, ID52	In that scenario [reporting for two different departments within an organisation] you will have two separate people. So one person will be focused on finance and they'll have their reports for their stakeholders, then we have one for purchasing. They might have the same stakeholders, but when we're talking to that person in finance – it'll be completely – or not completely different – but they'll both have different focuses anyway. So we'd never have one person that focuses on three or four different things.

Problem identification	
Hill, ID28	I think that the main point of value is the business expectation. If you've been digging a hole for the last 15 years, you're not going to cover that hole in the next six months or 12 months. It might take you just as long, even longer to recover that. Now that is something that businesses cannot comprehend. It's a bit like being in government, "I've got two years to prove myself." So now you're starting to see terms like agile BI. "We're going to quickly fill up the little holes that matter the most" is the promise, it's not that easy, but explaining that to an executive is probably the toughest part.
Shaun, ID14	So first of all it's the problem identification, which a client usually has and we just need to verify. Then there is the challenge of articulating the scope of what they want. So whilst they know they've got a problem, they're not necessarily thinking about the scope.
Shaun, ID14	Once we've got that well-articulated it's then a case of just building a relationship through that pathway of assessment and proposal and bid. To be honest, from a Exquisite Teck marketing perspective we want that to take as long as possible. I don't know, I'm sure this is the same for most companies, the longer it takes the more accurate the final proposal or delivery will be but also the stronger the relationship will be.
Shaun, ID16	Once we've got that well-articulated it's then a case of just building a relationship through that pathway of assessment and proposal and bid. To be honest, from a Exquisite Teck marketing perspective we want that to take as long as possible. I don't know, I'm sure this is the same for most companies, the longer it takes the more accurate the final proposal or delivery will be but also the stronger the relationship will be.
Shaun, ID44	If the problem is still not clear by the time you've got to the end or the decision-making phase, then again it's been a failed process, almost.
Emily, ID81	They [the replenishment department] have a little IT department for a while, working just for them. So that works well with the agile approach, because one of the agile principles is that you can, you know, negotiate over requirements and they're not fixed for the whole duration of the project. Business can change priorities and they can even change requirements to remove some requirements and add some others. As long as it fits within the project duration. So they are very happy about that.
Rachel, ID15	The first thing is defining the problem, and I'm a particular stickler for this, is making sure that when speaking to the client, is making sure that the problem is very clearly defined and the expectations of the analysis are very clearly defined, so I know – and those are actually two different things. Because quite often people very clearly define a problem but what they expect from the analysis is completely different to answering the problem that they've just posed.
Ruofan, ID17	First of all you try to forecast, you're trying to make a new product, and one way is to look at similar products and try to identify if there is a trend. That applies of course to any business in the world I believe, even those credit cards units, something similar that I'm making, or something that someone else is making, and there's got to be the infrastructure that they could tap into that kind of data from elsewhere and bring it in there.

Business change and business process	
Hill, ID89	Companies just don't have their data in a good state to be able to do those [analytics and visualisation]. If their data was good and their processes were good, they would get a lot of value out of the analytics, but the two fundamentals are does your process exist? If you can tell me an organisation, does that exist, then move to the next stage. If your process exists, you're right. What is the state?
Shaun, ID97	That's normally poor decision-making, yeah, and that always – that sort of behaviour I guess is what stymies it for the – being I guess a bit more risky. It's a small market, we see people who have burnt themselves down that path. You can also see the benefits of being able to be nimble and take advantage. I think the other piece of them being removed from it is – and how often do we see that an organisation might be tasked – an organisation might have a particular agenda, a business proposal that they need to make a decision on and then something comes in that completely swamps that because of an environmental influence or something like that's happened. They basically refocus.
Jeffrey, ID60	[We] looked at the processes in isolation through the stages and kind of explain to people what their responsibility was in that process and what it impacted on for the next stages, so they could get a context of that. So then we came back and mapped out who should do what, when it should be done, and how it should be done and how it should be communicated up the line to allow for this end result to be accurate.
Hill, ID83	So you have to be very clear on the scope that you're providing. So I guess what I'm suggesting that the successful way to execute this is to understand the definition of success. If I'm going to improve my customer on-boarding process as a bank executive, what are the key success criteria? What happens today? What do I expect to see tomorrow or in three months' time? Therefore in between what does halfway look like?
Hill, ID101	Where we see people trying to analyse it [data] in real time so that they can do something or catch it through another process. I mean you spoke about the concepts of big data. How does big data fit into this? I mean what was it yesterday that didn't exist, it was just data. So lots of it means we're having more transactions coming through our processes, that's what it means.
Shaun, ID91	If you think about if we're doing something here and it takes us maybe a month to get it all right, put them in a report, it's not necessarily that they [BI end users]'re going to action that in a month. Nobody works that nimbly in the big organisations.
Shaun, ID95	Typically you don't look at organisations that are Australian and go wow, you know, like Apple. They are nimble, they are - I guess it's more marketing but they look to be probably fairly nimble...
Scott, ID37	Technology, in my mind, isn't particularly good unless you have a reason for using it and a way of using it, and in that case [BI] organisational process is the most important part. The enabler is the second one. So you need to have your process mapped out and correct first. Then you need someone to automate and enable it to make sure you get a level of rigidity around what the process is supposed to do.
Scott, ID107	The process is more important than the actual platform in this case, so the platform just happens to really be very, very good at making sure the process works well.

Data source	
Hill, ID7	Imagine you were a manager and you're making a critical business decision on 70 per cent of the actual facts because the other 30 per cent is not healthy enough to be able to make a decision. That could be the difference between a success and a failure. So that's where data quality comes into it. One is, it's 30 per cent, it's not good enough to make a decision on, so we'll put it in the unknown bucket. But then if you manage that, get the master data management, so the proper information management around that other 30 per cent, then that forms part of the bigger picture and business intelligence is the availability of that information to make a decision.
Shaun, ID13	We don't actually say that to the client, like have you got your problem right, but we know from experience that they might be in the market for some reporting and analytic software, but actually the problem is that the data they're extracting from their other source system is not being extracted correctly. They haven't asked for the extent of it and in fact the data that's being fed into that system isn't being fed in properly, so it might be an issue further down or back in the workflow.
Nathan, ID30	The difficulty is that, data was captured for a particular purpose, now we want to do something else with it. What's the gap between the two? Because the data wasn't captured for the purposes of analytics typically. If the system was designed with analytics in mind, then perhaps that would be a lot more of a streamlined process but typically you have a GIS [Geographical Information Systems], you'll have a CRM [Customer Relationship Management] system, a few other systems, and you're trying to optimise certain business processes and then companies want to differentiate in terms of how they bring that together to get some understanding of opportunity.
Robert, ID4	The customer didn't know what they wanted before I got there. They thought that it was just a BI issue but when we did a whiteboard and started looking at their existing environment, starting to look at where they wanted to be, how they wanted to get there was not the best practice way. That was my role just to guide the customer that an understanding of where they are and the existing infrastructure, the existing environment, the existing executive support and an understanding on how to get that best practice situation. So the BI implementation happened after the warehousing. So that garbage in, garbage out thing happened after the data was cleansed, after the data was mined in the proper data warehousing, which made the BI look good.
Jeffrey, ID61	Every day we deal with it and people say it's wrong. And that's part of our job to explain why it's not reflecting what they think it should reflect and is it the process that's broken down or is it the source system that's not accurate and updated. And more often than not it's the source system issue. And some people understand that and that's great. But that's probably one of the biggest roadblocks and challenges in a BI solution is – my view is people understanding it, everything comes back to the root of the raw data. The processes are mapped in terms of how the data is pushed out to a BI platform and the business rules are written, and it will only pull what's in the source system.
Shane, ID14	So first of all it's the problem identification, which a client usually has and we just need to verify. Then there is the challenge of articulating the scope of what they want. So whilst they know they've got a problem, they're not necessarily thinking about the scope.
Daniel, ID36	This is pencils just for the pencil guy – butchers just for the butcher guy. But as long as my formulas, or my methodology's exactly the same, then I'm happy with that. You don't want the same data source and then different types of people manipulating or changing because you'll have "Oh, we spent 50 million dollars. Oh no, we've got 48" – then you're totally not going to trust the data. And ultimately that's what gives people, particularly the stakeholders, the ability not to take action because if they don't trust the data, they're not going to do anything but if everyone's on the same page, everyone's got the same type of report and everyone understands how the data's produced, then they can be more confident in creating those actions.

Company's history	
Shaun, ID51	One of the good things about that is they are realising that the data has more applications than just that point in time, which is kind of shooting ourselves in the foot a bit. But quite often organisations will collect data with a particular purpose. They use it, they generate a report, they make a decision or not, and then they leave the data. But that data actually would be useful on an ongoing basis for something else, always is. Maybe it's trend analysis, maybe it's looking for baskets – whatever it is. We say you need to have almost like a repository of that information because it will be used for other things.
Shaun, ID98	I see the use of the word big data now and it really, for me, doesn't quite do it. It's not about – as I put in the article, it's not about quantity, it's about quality. But I think that the access to open source information, so information on other organisations, whether that be in effect, benchmarking, anonymised, un-attributable, is gold. To have that insight is really what organisations should be aiming for, whether that's through a formal mechanism – which is preferred, obviously, because it's been through a more rigorous checking. I think that the ability to be able to tap that sort of information into your own systems and look at that is really where organisations will be heading.
Emily, ID33	Sometimes to get to the bottom of your problems, you need to actually have [a] view from end to end. So very often the people had to log in to different systems to look at different pieces of data and try to bring it together on some Excel or something. So what we do is we bring all the data to one place and then try to show it together so they can see the whole picture.
Emily, ID35	The ERP systems don't have history that much and don't have visibility across each other to show the data in such a way.
Alfred, ID58	But the complexity comes when you have more than one system, just trying to integrate them. You've got enough data quality issues with one system, let alone two.
Robert, ID6	Big organisations like Coles or Woolworths have very large data stores, but the complexity is quite low, and so it's quite easy for them to work out, you know develop models for understanding how things are performing, etc. The data in SLT [his organisation] is quite complex so it is very different problem than those simpler data problems. So it took us quite some time, but we are now at the stage where there is integration between our transactional systems and our knowledge decision-support type systems. So what happens is that the returns come in, into our transactional systems, and then push straight into here, and we run our models and we then push information back etc.

External data	
Shaun, ID120	It may be that some of them haven't been engaged through the process, so for example we recently did some benchmarking for financial services companies and on the delivery of the report – so most of the time we were working with procurement and finance; at the end of the report we were working with marketing.
Jane, ID31	Generally, because it's information, I haven't seen as much of a change management problem as I have with application development where it can change the way people behave and operate with the system. This is they need some information. It's a month-end process or whatever it is. This is the portal they go to, then run the reports.
Robert, ID18	What you'll see with self-service comes usability and trying to make the tools as intuitive and user-friendly as possible. I know now that some of our work in the labs, and indeed some of the work even with our business partners, is about – it's now not just about what is actually the numbers that are presented on the iPad. An awful lot of the – an awful lot of execs want to carry around an iPad and take the information into board meetings and use it live. A lot of the work is going into how to make that as user-friendly to operate and get round for exec as possible.
Robert, ID30	These public forums or this social media is more important than ever. So you need to try and grab as much structured and unstructured data as you can in order for you to be successful in analysing your market, your customers, therefore your clients.
Andrew, ID10	Sometimes when we're putting forward a new service we'll use some ABS data, in terms of the demographics of the local population and trying to estimate what the demand might be for the service. In the past I've used information from Medicare, so that's looking at usage patterns of health and trying to apply those patterns to our local catchment to try and forecast what the demand might be. It's not very accurate but it can be helpful, because we can at least get a guide, even though it might not be accurate we can still use it as a guide as to what the demand might be if we were going to introduce a new service.
Andrew, ID29	A good example was adult orthopaedic surgery, they took it out of LA Hospital and put it all here, so all the adult orthopaedic work, or the majority of it, is done here at MA hospital. But in the process of doing that they didn't estimate the impact of making that change. They knew that there would be some impact, because obviously people who break bones need to have X-rays done so there's going to be some more imaging done, but the modelling didn't take into account what the real effect was going to be, which was substantial.

Business rules	
Shaun, ID20	We were at a meeting this morning and much to my frustration 18 people, 45 minutes, I walk out and I'm like – and David [her colleague] said to me, “You know, our main business is to get people in a room to talk to one other in an organisation”. So half of that meeting was a debate that they were having amongst themselves about what they – and we were just drawing out. So that's an ongoing challenge; we're bringing people in the same organisation together to have a conversation. That can be typically what it looks like. The organisations, most of them will say and articulate they're looking for savings, whatever they understand that to be.
Shaun, ID17	In the meeting this morning, our aim, clearly that we didn't realise, was to get those people in the same room to talk to each other. It's phenomenal how many meetings we have like that where we say have you met – have you met Jim from IT, this is Steve from finance, and they're “Hi, how are you, I haven't seen you for ages”, and I'm like “How's it going?” I'm sitting there and David like this is what we do, we go to meetings and we put people together to talk about things and then we walk out a bit confused.
Shaun, ID18	We've got two clients there, one in procurement, one in finance. The finance guy is superior, unbelievably smart data analytics. He's working on the same sets of data as the analyst in procurement. Do they ever get together? He could do what she's trying to do in five minutes and then go on with his work and do, and they could have this same baseline. Together they would be a powerful team. So when they come here they meet – yeah, “How are you, haven't seen you since the last time you came here”.
Shaun, ID121	They [marketing department] are actually buying this or they're interacting with this information. More often than not that's a really good outcome for us because they then say you could measure this, and we go, yes, that's what we do. Then they say can you measure this? So for us that becomes a really good dialogue, but it is that bringing of stakeholders together.
Scott, ID26	You want the data scientist, who understands the business and understands the data sources to be able to mash them up, aggregate them together and provide a stream of information, and then you'll want the person who needs to use the information in a business context to be able to visualise and explain what they are deriving from an outcome point of view. And yes, there are some places where they are the same person because they have that end-to-end view, but there are a lot of places where they don't and obviously there is some blurring and those people need to communicate very well when there's two different people.
Rachel, ID12	They'll go and speak to an SQL data analyst and that data analyst would build SQL code to pick up, to identify cases based on expert knowledge. So it's an expert – so it's using the expert knowledge and it's just SQL. So there's no adaptability of it, it's not learning from its analysis, it's just, “This is a SQL rule and if you hit his rule, yes. If you don't hit this rule, no”, unlike other models where it's a supervised learning model. So they're learning every day to be better and better at what they actually do. That's what I class as an analytical model rather than a business rule models.
Ruofan, ID9	Any activities the bank does with the customer– do we stop other activities with the customer, what should we do? So that's why I think the enterprise should have a [enterprise] view of customers. Not individual business units viewing the customer [their way].

BI budgeting and copying BI solutions	
Hill, ID23	I think 80 per cent of initiatives are technology led, and it comes down to how organisations are structured. People get an IT budget. The CIO or whoever it may be will go and ask the business stakeholders, “I need \$X to transform the ...” or “\$X to go and manage your Business-As-Usual IT requirements”. So technology requirements typically have budget allocated from my observations. And the budget typically sits in IT – I mean it’s a common thread.
Hill, ID26	Unfortunately I’m probably going to say, nine out of ten instances they will get an inexperienced project manager. Very experienced at project management but very but inexperienced at business cases, or they appoint a business analyst or someone who is not quite qualified to manage and propose a very, very strong business case.
Hill, ID27	But even if they get beyond that point, the expectations created out of the business case are so great that it’s actually set the project up for failure right at the start. So a common thing that happens and you can go and interview the largest telco in Australia and ask them how much money they’ve spent on transformation projects.
Matt, ID19	We’ve presented to the senior executive, we’ve spoken to her about these things. They like the idea, it sounds fine to them, but if you ask them to put any money up for some of this sort of stuff then they tend to go on to say well, maybe things aren’t so bad the way they are, I think we can get by with what we currently have. It’s a cultural thing.
Hill, ID30	There are some companies, very few, who start from the beginning. NBN is a great example, where that’s happening, where they’re starting a brand new company from scratch. But in the process they try to copy the other companies. Now in the process of copying the other companies or following an approach, you also run the risk of copying failures.

BI adoption	
Hill, ID10	Information management is not limited to the technologies and how to implement them, it extends to how the people behave, how the processes exist, everything around change management, organisational structures and actually putting into place the right structures – this is partly a HR initiative – to be able to capture information and manage the asset across the organisation.
Hill, ID11	So we typically have a few perspectives that we cover; one is what is your business strategy and what's the corresponding strategy for information management related to the business strategy. What are the right architectures, and structures that will help facilitate this? What are the right technology characteristics? What are the organisational structures and finally, what type of policies and governance do we have in place to ensure that people aren't going to break the laws.
Hill, ID25	If you can manage that “unknown” percentage of data in the proper way, you know, there's a lot of opportunity. But that's what happens and there's a business pain or a driver, which is “Go and fix this, because it's affecting us in more ways than one, there's inefficiencies in our ability to make decisions”.
Alfred, ID31	Generally, because it's information, I haven't seen as much of a change management problem as I have with application development where it can change the way people behave and operate with the system. This is they need some information. It's a month-end process or whatever it is. This is the portal they go to, then run the reports.
Ruoofan, ID22	People would come up with new ideas, actually I can use this for other things, and then there are new requirements. Now whether or not the tool that we already signed the contract to be – to acquire, would deliver that or that would be another add on future improvement, or a lot of times they become ideas for the vendor to develop in a certain direction. I heard of stories that some vendors are willing to develop a new functionality for basically they partner with this organisation and come up with a new functionality or a new software, a new program. Knowing that in the market there were other users, other organisations that are willing to pay for it.
Robert, ID32	My mantra in the last seven years has been; understand where you are today as a business; understand where you want to go as in where your competitors are, where your benchmark is. Then my job as an ASP [his company] person is to help you get there. That's where it could be products, it could be change management, it could be the culture, it could be the organisational restructure, it could be what's needed to happen in your organisation for you to be ready for something new.
Robert, ID36	All companies are different. All businesses within the same industry are different. All businesses within the same functionality are different. We have a team at ASP [his company] and we have a team in our business partners that sit with the customer through the process we design. They have various forms of documentation, various forms of experience and various forms of expertise to guide them through that. There is no one silver bullet to help them with the redesign. It has to be a guidance and an expert analysis review for them to be successful at it.

On-time reports	
Hill, ID50	If you take the concepts of a process being “data in motion”, right, then your process is your data. Data is a dead event. It’s like looking at the graveyard. Why should we go and look at the graveyard to understand what’s going on in our business and look at three months of death when we can watch the people who are sick. Why wait till the end when they’re dead, watch them as they’re sick and then we can respond and do things, that’s where business intelligence [is].
Shaun, ID49	Our reports are actually about the marketplace, they’re extremely time dependent. So we know once we deliver a report we’ve got to get the client to move fairly quickly because six months later that might be what we call aged in the market.
Shaun, ID50	We often get calls from clients who are looking at a report from 12 months ago, and I'm like why are they using that, it's old.
Shaun, ID88	There's organisations that do have that constant monitoring and that requirement for real time, but most of the clients are retrospective, even things like hospitals, you'd think they would be real time - hospital beds, people coming in, but they're real time for that amount of their organisation, they're not real time for the whole - so that's kind of where they're just not there yet with regards to it.
Shaun, ID94	I think that timing for some decisions is extremely critical. So a case of that is if New South Wales are going to go out for – New South Wales government, say, have gone out for a new catalogue solution for their whole of government buying. No other state is going to move until they’ve made a decision; why would you? Why would you not wait and see what they do and then maybe pick up the vendors that lost out and see whether there’s an opportunity. So I think timing with regards to competition is definitely an influence. Again, the banks are another one. You can guarantee that one of the banks will move and then the others will follow. They’re waiting to see what each other does.
Ruofan, ID28	This process – if you’re lucky it will be six months. The business is not going to wait for a new piece of alert data that some vendor data supplier can now provide in order to say I can give you this data if you sign the contract with me, and there’s – by the way technology, and how long would it take for you to bring this data in that I can then include it into my – whatever – analytic tools. That is the issue, I’m not sure am I the only one or we’re the only organisation facing this because the business want to basically respond within the week.

Automated reports	
Shaun, ID86	In Australia we have very few clients who are looking real time, and real time we mean immediate. The only really - the solution that we've got that does that is the catalogue solution, which is just such a rich set of data and the accuracy in it is just fabulous for that real time immediate reporting and decision-making around what's being bought within the organisation.
Shaun, ID89	We try to say, you know, you've got a data set, it might be three months old, but you've got three years back, you can still look at some trend analysis and do some what if. I think the other reason we're not doing a great deal of real time is because the decision-making is not as nimble.
Emily, ID30	When you really look into it you figure out that part of it is never used. So I try not to waste my time and my peoples' development time and the company's money. So we always try to get to the bottom of it. What do you actually need for your work? Not what you had and please replace with that. What you think you want.
Emily, ID70	You have probably, you have both ways of reporting. Being able to show alerts. But at the same time, alerts is not everything. That's a higher level of alerting, that's great. But you need to have also to be able to look at data on the lower level, because you don't always just want to look at the alerts. You want to look at the data as well and see other trends and other projections.
Alfred, ID74	They [the hospitals with which he works] also have near real time. So within five second updates for a suite of data integrity checks. So they [staff] enter data into the front end in their core patient management system and then they can go and look at these integrity checks and make sure that all the data they've entered for that client and any others are all correct. So it replicates back – not back and forwards, but into that report within five seconds. They look. If there's any red on the screen then they go back into the system, fix it up. By the time they've gone and hit refresh of the button, it's gone to green.
Robert, ID27	The activities that are created or are part of the existing BI they've got the ability to - for other people to create notifications and alerts. It goes into your email system. It goes into your - whatever type of collaboration solution you may have in your organisation. They are using it at the moment as a database of knowledge. So for example they see a scorecard or a KPI report and one of the managers has an issue with it. So they look at the collaboration solution, were there any activities created on this when they had this issue last time? So they're able to look at the activities and see how they resolved it last time and have that database of knowledge and rather than setting up a new activity they can just refer to the resources and go, "Okay, this is where you need to go. This is how you're going to solve the problem. This is how they did it last time. It looks pretty much the same as this time. Maybe we go down that path again." But as far as - that question again is pushing towards that smarter analytics play and the business intelligence solution is getting there. It's almost there but it's not there yet. The collaboration solution helps.
Andrew, ID42	Operational reporting is done on a monthly basis and it's retrospective. We report in the third week of the month following. Although, I can access activity data, in almost real time, so that changes once a day, in terms of the real data.

Ad hoc queries	
Madison, ID18	Most of our work is not that established. Some people run it on a continuous basis. Most of our clients really want us to solve or resolve a particular issue, a particular pain point that they've got at the time, rather than necessarily building something sustainable and lasting.
Rachel, ID27	You've got a request that is more complicated than that and you need a different level of information, then you need to put a request in to a data analyst and they'll do an ad hoc query, which is a specialised request, for you that can't be done through just the slice and dice tools. Then you've got the – and that's just – with that it's just either raw data, it will just be data set that they pull for you, or you're asking a specific question like, "What's the average salary and wage amount for mechanics in 2007?" So it's a very specific request that you can ask them. And then the next level is the analytical tools which run directly off the data warehouse. So it's those models which are running on different levels and different bases to give that kind of added value and to really build that information, not just that raw 'you have to think of the question and ask it'; it is designed to pop up questions.
Arnaldo, ID44	Usually, it [a request for BI report] depends where it is coming from and depends what measure and it could be that one of the managers here – say they want to look at a particular target or measure. We'll get a request through IT. It will come through to our area. We'll assess it and then we may do initially data extractions for them. If we keep getting, it's an ongoing thing – it usually comes through as an ad hoc request. I want to see this, can we look at this or can we look at it in this way.
Madison, ID17	When I think of BI I think it's a little bit more continuous reporting.

Ubiquitous reports	
Shane, ID93	All the data and the underlying analysis, the talk tracks, the PowerPoints that go with it, should be rendered inside the tablet.
Shane, ID94	Everyone's got their view. So you've got the people who sit on that side of the table who've basically got their access to that cubes or other cubes, and then you've got your presentation. So theoretically they're all sitting around using digital devices now, but they all ultimately manifest themselves into these things.
Ross, ID51	I think the biggest thing for collaboration that has a realistic opportunity that's available now is the tablet ... it's easy to say "Hey have a look at mine", and you pass it over and there's an engagement.
Robert, ID17	A lot of it now for decision-making at an executive level has to be done much quicker, more effective, online, offline, it has to cater for both. The idea of the executive having a mini iPad on the golf course and getting a report sent to them, making – analysing that report, making some decision on that report, sending it back is very real today.
Roy, ID22	They [a Norwegian Oil Company] wanted the exec [executives] to be able to walk into the board meeting and there and then just swipe through it. It's becoming more and more of a popular thing for reports to be viewed in such a format.

Insights	
Hill, ID86	Those KPIs are seldom defined. That's what I'm seeing. So when the KPIs aren't defined you're not really sure what you're solving. If we could define those KPIs of what success looks like and we're doing that, there's a water utility we're working with right now who said, "Look, success looks like this. We need to be able to go and bill our customers that we haven't got all the information on." Now, just collecting an ABN or collecting a BSB number means we can go and transact with them. That \$7 million has been sitting there for the last three months, we haven't billed it, we should be billing it.
Shaun, ID27	So what you see in all of our reports and our dashboards that come out of the solution are always three actions. There might be six recommendations and 17 key findings, but there's always three actions and they sit there at the top of any report that we provide a client. That is our biggest challenge is to get the clients to then action those.
Shaun, ID28	Some of them are extremely prescriptive; they will say in this item in your organisation if you reduced your price by three per cent you would achieve \$20,000. It can be that specific. We always have three at the front of every report.
Shaun, ID55	They're getting information that is succinct, it's very pointy. It's above or below the line, so to speak, and I think whilst they recognise it's an unsettled environment and there's always, if you like, changes going on and external factors, it's a cliché but they see the big picture in that. But they're often getting very, very pointy information. It's not greyed, if you like, by - it's drilled down already.
Dale, ID37	They've [the users within the government sector] actually come out and said, we need some facts behind this. So data is actually the core solution really to show what's going on, so we're responding to the request to actually bring in data to come up with a solution – whereas some of the other broader strategic type activities find where we can, I don't know, enter a market or identify cost reduction opportunities. Data is kind of like used as a vehicle to get that solution, whereas the project that I'm referring to before really the actual answer is, here's the data and this is the insight from the data.
Dale, ID38	I would use data to answer questions, but that's no longer seen as valuable – I mean that's the real baseline type stuff. So if I'm looking at payroll for example, sure I can answer the questions by taking the data for the full population and running analytics on it and saying, well this is what's happening, but clients are finding it more valuable for us to be able to show them, even interactively, to be able to say, this is what you're paying your employees, now let's slice and dice it for you to give you some insight about, you know, which types of employees are driving which types of pay types – you know, which months tend to create spikes here and there, what's causing that.
Madison, ID75	If it's procurement it's like, you know, ordering the right goods at the right time – so there's a number of multiple objectives that they want from it that you can use the data to assess whether those objectives are being met or not. But then you've got them tied up to other things as well. So buying at the right time – well, what does my inventory look like? You know, with those kind of things too.

Insights - Continued	
Nathan, ID22	A lot of people talk about Operational BI but you've got to think realistically about what is Operational BI, it's not really producing KPI reports. Because people at the front office end, they're making, they don't have time for reflection. They're not going to sit there dragging and dropping and lassoing, it's not what they do, they need to, they'll get lots of information about a case very quickly and need to make a decision, an optimal decision.
Sahil, ID24	For example, let's say a finance project, I'd be so operationalised to doing the books and the financial operation reporting, it's of value as an efficiency driver but it's not much value in terms of meeting the department's key performance indicators, which is our promise to the government to deliver something. So in my opinion the focus should be on where we put our time and energy to look at the KPIs. We've got two big KPIs, big ones, more investment dollars in Victoria and more jobs in Victoria. They are not easy in this environment to create. The department is working hard to do both of those.
Robert, ID11	Our dash-boarding solution is high level because we go on this theory that you can be an executive person, come into your office on the day, have a look at your monitor, have a look at maybe the trends in sales or the trends in profits or how your products are going, how your region's going, and notice what needs to be - what attention needs to be focussed on today. You can do that on a desk top, on a laptop, on a Blackberry, on an iPhone, an iPad, a Samsung Tablet, what have you; Windows CE phone. You can have a look at your analytics at a high level on a daily basis and it's aimed at the - those dashboard solutions are aimed at the executive line, middle line management that can make decisions on what needs to be activated today. That's very important. Not only that, it's not something that's created for them. The ability for an executive to see a report or a dashboard and then realise that you could actually - he or she may need other types of information.
Robert, ID24	Our event management system gives you alerts, gives you notifications and gives you the monitoring of your – for your KPIs. It could be your sales forecast numbers. It could be your budget's due or it could be that your predictive analytics has given you an alert that this is happening or it could happen. There are many types of event notifications that we have available.
Roy, ID34	It [actions by BI reports] is governed by business rules and businesses have an insight into what the business process flow is. But influencing that business process flow is analytics in terms of what we know about the customer and what step to take next. So it is a business process. But it's a business process that is informed through the use of advanced analytics.

Details of reports	
Shaun, ID38	My experience of the top level is they're not necessarily going to be interested in the detail that sits behind that recommendation or that information that allows the action. They are relying on it (a) to be 100 per cent correct and (b) for somebody to explain it to them if they need to be. They're not going to be wasting time sitting there trying to understand why the graph is going down when they think it should be going up. I think that in some cases when you're dealing with the top level, the C level, you are not going to have the time to explain that.
Ross, ID33	Data visualisation helps you find questions that you didn't know you wanted to ask. Whereas business intelligence, and this is a great quote from someone, is like driving your car while looking in the rear-view mirror. And that really absolutely defines how we see the two fields separating. So at a less facetious point, data visualisation is about a way of exploring data and finding what are some of those insights or points that you then want to feed into a more regular business intelligence system that you wanted and have monitored that then feed into a reporting system that says here are the things that I want to be able to track and monitor and which attributes we want to be looking at. So that's how I sort of separate those two out of there. And they cross, they interact, but visualisation is not business intelligence and business intelligence can use data visualisation but tends – that's just our view on that type of thing.
Rachel, ID31	Generally, because it's information, I haven't seen as much of a change management problem as I have with application development where it can change the way people behave and operate with the system. This is they need some information. It's a month-end process or whatever it is. This is the portal they go to, then run the reports.
Nathan, ID21	I think senior executives would delegate some of the lower level substantiation of a good decision to their direct reports. So, I don't see that there's necessarily a, it's divorced. I would be quite suspicious of a CEO that spends all of his time in spreadsheets and, in fact, I probably have seen some CEOs that would prefer to spend their time in spreadsheets rather than tackling big decisions and I don't think that that's necessarily a good use of their time.
Daniel, ID29	When the stakeholders are looking at their [visualised] data, they'll see they're standard but then "Oh, this is new. Let's have a look at this" or "I want to focus on this particular thing".

Storytelling	
Shaun, ID39	It's already needing to be validated further on down and by the time it's there all the questions are out of the way, it's either a yes or no we're going to do it. So if you give something to somebody that you believe – some information to make a decision, that's never going to be it. It's always got to go up or it's got to go down, and then what you're relying on the way is those stakeholders to be engaged and understand it.
Madison, ID54	So we're not actually telling a story with the data. We're giving the client a way to work and explore through the data themselves in their own time and discover what they want to discover out of it. And other ones are more explanatory - so we're actually trying to tell a story, so we've analysed the data - we've decided what the key things the data is telling us and we're actually trying to tell them - these are the things that are most relevant, so it depends on you know, again, what the client's expecting which will dictate a little bit about what you might deliver or not.
Rachel, ID40	If it's a good report it should be self-explanatory. It really should. And I find it a personal failing if people look at a report of mine and they don't understand what it is that I'm trying to say. Because that probably comes back to my position as a, what I look on as my position, as a translator. I translate from the business to analytics and analytics back to the business. So if either of those parties aren't understanding what's being presented, I'm not doing my job properly. But again, if there's a report that's going to be regular, a monthly or quarterly report, and it's a bit more complicated to read, then yes, we'd sit down and make sure the people understood what's being presented to them.
Ross, ID02	One [one] side visualisations can be built to be exploratory tools for exploring the data yourself and to find insights and to gain understandings in that. That's got its own stream of how we go about dealing with that. That's really built around the concept that there's a large set of data that is changing. You need to be able to have the tools and be able to manipulate and explore that possibility space yourself, in some way visually. On the other side of the coin is the ability to engage and communicate with an audience and to convey your message to that particular audience.
Ross, ID34	We had a project, the ones where there is – the projects that have been much more metric decision focused or outcome focused in terms of I want to be able to visualise these particular data points so I can find them and I know what I'm trying to look for, they are the ones that we end up implementing much more as a “dashboard” because the dimensions are better understood and how they go because someone's already known what they're looking for. So that's the class of one's where we tend to fit into that.
Myla, ID12	My style is to make all the argument self-explanatory, so if I want to say a certain relationship is one that you really need to examine, I would put a few charts that gives the readers, or the clients, a story. So I think that making it visual instead of having me interpret it for them makes it easier for them.
Shane, ID88	As part of the story, you could interact with this information and answer questions. And then you've got rather a tabular view; we also have a view around this way of presenting.

Personalisation	
Shaun, I15	Our analysts are 100 per cent with the data, the moving around of the information with the data analyst, but the benefit is that they can go out and sit with a client and the clients like them sitting with them, and they can talk about the information, and they can say can you see that this data shows you this? Would it be better if you actually had this as what we call a heat map, that just has two colours on it, and it says this is compliant and this isn't. So they can articulate that with the client.
Shane, ID62	We were all building custom web interfaces to things like that and this web interface was sort of trying to integrate data between two stores and so on. So we're eliminating that and we're saying, yes, of course these things will have their own web interfaces but you're only seeing one small view. You've really got to be going to these big cubes here, it is starting to become B-Cube now – where these operational systems are feeding into.
Rachel, ID18	It [the communication between analysts and decision-makers] wants to show exactly what the aims and intent of the business is and the aims and intent of what a model will deliver, because business aims and intent are different to a model aims and intent. A model is very specific; it will give you a specific outcome, where business will come and say, "We just want to understand the level of compliance".
Rachel, ID33	My lowest moments in the organisation was [when] I developed, I think it was like a 27-dimensions cluster analysis of work-related expense compliance and then me trying to explain to the auditors why they should be using this model of non-compliance on why one individual was more non-compliant than another individual. I lost them within two minutes and that model was actually quite good but it was never, ever going to go anywhere because the way that I presented it was just so far out of my audience [understanding] that it just wasn't going to get up.
Sahil, ID49	I believe there is more than one personality of a decision-maker in a single person. It's like multiple personalities; you've got multiple decision-makers and one individual. That's what I believe and I'm one of them and you're probably one of them too. So depending on the kind of decision and the data that's available to you, you form a judgement and make a decision.
Ross, ID17	It's not unsurprising that we're using bar charts a lot in this data. In other pieces where we're trying to represent that data we won't use bar charts because that's not necessarily the right mechanism for who the audience is going to be. So we take into consideration the style of audience, the background their coming from, what the corporation is that we're dealing, well the client that we're dealing with.
Jeffrey, ID37	In terms of any reporting we do outside of BI or whatever, we try to appeal to both so that we don't have to do multiple reports. But our BI solution is certainly tailored so that there are graphs when we can but a supporting dataset that goes with the graph, and then the users can then export that if they need to do their own analysis.
Matt, ID47	Our most numerous users are really those that just consume standard reports but then we've got that next level of user, there's 55 or so of them around the university, who can do ad hoc querying.
Daniel, ID39	Some people just say "Oh, just do it. We don't really care" but some people say "We want to take a bit of ownership. We want to understand a bit more" and that's fine but "Let us know how you did it to begin with".
Arnaldo, D38	[When it comes to the] scorecard, one of the ways that you can look at it is just by traffic lights, nothing else. It's just got agencies and traffic lights and it's only red. So she wants to see just red, no numbers...

Information overload	
Rachel, ID37	They've [the users within the government sector] actually come out and said, we need some facts behind this. So data is actually the core solution really to show what's going on, so we're responding to the request to actually bring in data to come up with a solution – whereas some of the other broader strategic type activities find where we can, I don't know, enter a market or identify cost reduction opportunities. Data is kind of like used as a vehicle to get that solution, whereas the project that I'm referring to before really the actual answer is, here's the data and this is the insight from the data.
Roy, ID32	Equally to [high-level decision-makers], the operator in the call centre who's inter – who's engaging with your customer, you want them to also make the best action – the best decision based on the information that you have. So you've got strategic decision, you've got operational decision; both of those can be driven by analytics.
Matt, ID26	So people might get information from the data warehouse, put it in a paper, publish that as a PDF to everybody and then if it was a starred item they'd review it, otherwise it wouldn't even get read by people.

Justifying decisions and options in reports	
Chandler, ID43	There's normally a number in somebody's head. That's person sitting at the top of the food chain. So a lot of the planning and budgeting exercise is actually getting to that number, then feeding that down through the operational plans. So we have built some models that do statistical analysis of historical data and give you the best modelling outcome and the likely modelling outcome. But we actually found that not many people were actually typically that interested in those because it wasn't actually flexible enough for them to get to that number. It gave them a number, but it was not necessarily the number that the senior management had in their head. That's the number that you have to get to, at the end of the day.
Shaun, ID123	If you're going to implement a big system like that, or any system, where is the bit at the front that is saying what are we going to get out of this? Are we going to tick the box on knowing that we can pay an invoice with minimum touch? Most solutions will do that, but what else are we going to drive at it? What will we get from our data; what will our data tell us about our behaviour as an organisation?
Andrew, D37	What we've got in place now helps us to build strategy and to justify and support our proposals in what we predict. Before we had the tools that we've got now, it was much harder to do that and very time consuming, very, very, time consuming.
Daniel, ID24	Some people just may not know what's out there and they're just fixed on what they only want to see.
Andrew, ID28	The manager clinicians are interested in those numbers, but most of the clinicians per se are not that interested. They'll probably have a bit of an interest if they feel that they're getting busier, you know, why are we getting busier or those sorts of things, but they're not that interested in the analysis side of things and the data. It seems to be the way that they are. They're a bit more focused on other things. They focus more on just the clinical side of things, rather than worrying about what might be happening data wise.
Shaun, ID21	Few say we're looking for a tool that will enable us to do decision-making; to be honest, I rarely hear that language, which is really what they are looking for.

Uncertainty	
Shaun, ID23	I think they [BI end users]’re looking for a specific outcome and sometimes they’re not even clear on the method of how they’re going to get there. They might think it was going to be enabled by BI but they’re not exactly sure how that’s going to work. So again, the key is in that scoping, that articulating – and also the output of what they’re going to do.
Shaun, ID54	Whilst accuracy might mean this is the most likely outcome, it means most likely not the definite. So in that we know there’s a grey area or a percentage of variants in that, but I’m not sure that people would necessarily know that unless they’re told those assumptions within the information.
Rachel, ID29	The predictive models are not necessarily used just to predict what’s going to happen in the future. The predictive models are often used also to predict what a [customer’s] behaviour should be. So it’s not predicting – and that might be for current year. So knowing what we know about that [customer], or the environment, or what’s going on, that models what a [customer] should be doing in the current year. So it’s not so much looking into the future, it’s just trying to validate what they’re currently reporting against what we expect they should be reporting. So it’s not future, it’s just kind of a validation tool.
Sahil, ID13	We get data from the Australian Bureau of Statistics, we get data from other agencies, we modify that and we create it and it’s presented both spatially as well as you know, the standard reports.
Sahil, ID14	Not all reports have to be 100 per cent confident; you can still have a report which you can say there’s only 30 per cent confidence and that’s good enough, than nothing at all.
Sahil, ID19	If I got some data and interpolated data, extrapolated data for the next three years, that data set itself changes very, very quickly. So how do we go about predicting the change to the data? Then we had to keep creating new predicted data sets in the future and then use that data set to predict the future. So it's not just using today's data set and extrapolating and predicting something that just won't work. Just predict your family budget for the next two years and see if you're going to stick to it; no way. Electricity bills have gone to what, 200 per cent on what it used to be.
Robert, ID19	I started the presentation with three questions. How much did you pay for last week's newspapers? Everyone say hardly anything. How much did you pay for today's newspaper? You guys probably said whatever it's work, 50 cents, \$1 I don't know. I look online anyway. But then as soon as I asked the question, how much would you pay for next week's newspaper alarm bells started ringing. "Hello, I'll pay anything especially if it's got lotto numbers on it or something like that." But that's how businesses are thinking as well. We need to know how our business is doing. We need to know why our business is doing like that. We need to understand what we can do about it going forward. Do we need to budget and plan better? Do we need to understand our business better going forward? Do we need to predict what our customers might do? It's all together.

Uncertainty – Continued

Andrew, ID24	<p>You know, we can look ahead and say, ‘Well this is what we think is going to happen.’ and then plan for it. Obviously there are things that we can’t plan for because we don’t know that they’re going to occur and it then helps us to then predict financially as well, what position we’re going to be in, because we can work around things like revenue, because that’s very activity based. We can work around things like what the overtime might be, you know, what some of the consumable costs might be, whether they’re expensive items. So we might say, ‘Well we think we’ll do this many of this type of test and that test might cost us \$2,000 dollars to do or \$20,000 dollars to do,’ whatever it might be, but at least we can predict that.</p>
Ian, ID21	<p>From a strategic perspective, you usually have a look at a bit of hindsight over what’s been happening because part of the risks that we manage is the increase in public demand versus our private patient work and one pushes out the other. So you can forecast out that you’re going to be doing X number of private patients but if the public patients go up by a percentage, they push the privates down.</p>
Roy, ID17	<p>[Companies] are using operational analytics to understand the mix of their products in particular marketplaces or the split of people that are buying their products and when they're buying them. That's where this is going to - eventually that's where we'll get to where as you come into the store they know about you and they'll be able to predict what you might be about to buy and make you an offer on that. In terms of the kind of slicing and dicing and what not, that tends to be, as I said, more in office of finance.</p>
Chandler, ID96	<p>We have to give them the story that they were sold, but we also have to open their eyes to the fact that the story that they were sold was based on the perfect world and we don’t live in the perfect world.</p>
Chandler, ID44	<p>I understand that using statistical modelling will give you a predictable outcome, but even using those sorts of predictive models, you have to treat it with a hell of a lot of caution in business environments.</p>

User's scepticism	
Andrew, ID26	<p>It [predictive model]'s mostly used at the management level across the sites and I think that it's been useful, everyone's accepted, and that they see it's being used to set a target about what we estimate the activity is going to be and what you can be expected to do, and people work to that. So they say, well this is where I need to get to, if they're not getting there. Look, I think it's been useful, particularly, people who run a subservice or they might be managers like me at the site where they have the big picture, but also those who are further down who might just run a little part of that, is to say, 'Then this is what we think you're going to do.' and if they're well under, well we need to know what's going on that they're well under, or if they're well over, what's changed to take them well over. And it helps us to also understand where the demands are, instead of just rolling with it, and it's better for planning and particularly for resources.</p>
Shaun, ID61	<p>Our methodology is very, very – it's the same across all the clients but it's a real challenge when you deliver something and it's not where they thought they should be. But I think that's almost like the same as delivering a solution to a client – that's not what we thought we were going to get. That can't ever happen, you would never be in a position where you'd give a client an IT solution or a system and then they go "Oh, I didn't know that". That's got to be resolved before you get to that point.</p>
Shaun, ID75	<p>If you're not confident in what you might be asked and you might have to then explain or you can't articulate it, then you're not going to show it.</p>

User's resistance	
Madison, ID34	It may be of low-data quality – particularly in the warehouse, that they don't actually trust it – or it may not necessarily be in a form that allows them to do the analysis themselves. So it may be like ... and a lot of our work is across disparate databases and systems, so yes, they've got a warehouse but the data model doesn't allow the kind of analysis that needs to be done. That means you've got to go back to the source systems – maybe source A, source B and work with those sources to once again to try and – and again because it's a one-off, not necessarily a big item, just to solve that specific problem – you know, with the data that's needed for that challenge.
Madison, ID58	A client will say, well we hired you to solve our problem, now you've given me... what do you recommend? You know, basically making... And if you're at that very final meeting with the decision-maker you know, you'll probably work your way up through different levels to say, you know like, this is what this is looking like, what does that mean, then you've got a contrary thing happening here. Generally they'll want you to - if it's like a business case - you know, you should demonstrate that you've considered options and then a recommendation on the basis of that recommendation.....
Rachel, ID32	It's a very, very long-term organisation, so you've got a lot of people with a lot of experience, so use of analytics and the presentation of analytics has to either, rightly or wrongly, it needs to be aware of people who have got some very strong opinions and beliefs about what is actually going on. And if you're going to be developing a model which is contrary to these positions, or long-held standing positions, you have to present your results in a very plausible and easy-to-understand [way].
Nathan, ID51	If you put in a CRM system that's new and it requires some business process change, there's going to be some resistance so you need to convince people about the new business process but once you've embedded the process, it's there. Whereas, you know, BI and analytics is probably a more open business process. There are some tied up processes that exist in BI but then, you know, there's a culture of discovery and justifying your position based on evidence which is probably a bit harder than just teaching someone how to generate an invoice differently.
Shaun, ID109	So with regards to I guess almost like the psychology of providing information, so when we provide a report to clients now – when we did this we didn't used to do it. We send them the Procure Trak [her company] web view and we send them a Word report. We track who looks at the web view, so we can see who's gone to it. The majority are still looking at the hard copy Word report.
Robert, ID15	There's been resistance in a lot of customers in, "I don't want to create my own reports. That's why I employ people like him or people like her or whatever to go and create those reports. I want it on my desk every day and I want to be able to identify what needs to be actioned today."
Glenn, ID56	We spend all our time producing this stuff and no one uses it. It becomes a waste of time.

Report validation	
Andrew, ID33	<p>There does need to be some change in the way they're using this, because in terms of operationally, it's really just a comparison, this is what we're aiming for, this is what we've done. It's pretty easy and straight forward. When it's strategy, it's a little bit different in how we package it up, we need to give it more detail because it's not just comparing one number with another number, there needs to be something sitting underneath what we're forecasting to support it and there needs to be more information, probably more data, rather than just saying this is what we believe it will be based on research or based on data analysis. We actually have to explain what the analysis is when we're looking at strategy, and I guess that's about giving people some comfort that we've got appropriate methodology in the modelling. Because modelling in health is fairly – I guess the use of it's immature in a way across health and there's not enough confidence in the final number that we get that, if there was a set way of modelling and we could say well based on this method of modelling, this is the number that we have, that will be okay, as long as everyone believes that that model works, but at the moment there isn't one, we all use our own.</p>
Shaun, ID59	<p>We give it at an item level and then we aggregate it up and we say this is where you sit in the market. You might be six per cent by value better than everybody else in the market at that point in time who's buying that product or service. It's a value; it's a percentage but it also might be related to \$2 million. Now if a client looks at that and they believe they are actually better in the market than that or worse, or they have a preconceived idea of where they sit, the first thing that will happen if they don't sit with that is they will call into question the data. That's the first thing they do, they say that oh, the data was wrong, or they'll say we need to look at the data we gave you. The second thing they'll do is they'll call into question our methodology; the third thing they'll do is they'll call into question the comparative group. So we might say we've compared you with everybody in the eastern seaboard who spends between \$10 million and \$15 million, and they'll so oh no, we only want to be on the eastern seaboard, \$10 million to \$15 million, same sector. So they'll start to narrow it down, so we get closer and closer. Sometimes we don't get closer to where they believe they should be.</p>
Madison, ID76	<p>You wouldn't make a recommendation without running it past the client first because every client, even if they have the standard implementation, they are going to do their own things to it and they've got their own quirks about why they do things. So they'll always be a point of validation.</p>
Shaun, ID108	<p>This is an aggregate report for a group of clients, and then every client gets their own report. So it tells them their own recommendations, their own - so yes, we do that too. We're relying on them to read two reports, not going to happen.</p>

Ease of use	
Shaun, ID81	<p>So we don't market as consultants, so we say we give market business intelligence. Quite often now we have to – if we want to be engaged again we're going to have to drag that client along to the action end. What we say to our clients is we will give you the information to perform that action yourself. We do have clients who do that, but [with] some it's very, very painful.</p>
Shaun, ID111	<p>They [end BI users]'re going to show it to somebody else, we know that. As soon as we know they're going to show it to somebody else or use it we then actually create it in PowerPoint but we give them the web launch of just that view and say oh, you couldn't forward this on to the person you're - so they can get the interactive report, they can interrogate the data just for that view.</p>
Dale, ID49	<p>The clients that I've reported to, I kind of feel that I would still need to help them understand through an interactivity type approach. I don't think I could give them something and then leave it with them and they would actually go and action it. I still feel more confident giving them a report which they can pass around. I don't think the people that I've dealt with at that level, like the people in the operations area, have the skill-set - even though it's quite straightforward with some of these sort of Tableau outputs.</p>
Roy, ID18	<p>What you'll see with self-service comes usability and trying to make the tools as intuitive and user-friendly as possible. I know now that some of our work in the labs, and indeed some of the work even with our business partners, is about – it's now not just about what is actually the numbers that are presented on the iPad. An awful lot of the – an awful lot of execs want to carry around and iPad and take the information into board meetings and use it live. A lot of the work is going into how to make that as user-friendly to operate and get round for exec as possible.</p>

User's capability	
Date, ID56	The danger of giving them [decision-makers] something to go and explore themselves - unless you've supplemented that with something else - like supplement it with a written report, I mean, the danger is that they won't actually figure out the actual response, whereas if you're able to give them something that's interactive but at least heads them towards the right direction, I'd feel a lot more confident walking away that they'll understand. Whereas if I just sort of give them something - for decision-making purposes, unless they've got the skill-set, again they might never actually be able to summarise the data in the right ways to be able to come up with an answer.
Madison, ID53	All the ones [reports] I showed you – generally they'd be able to work them out, but it doesn't mean you can give them to somebody cold. It's not like ... We want to try and get to that place like we're a web page where it opens and it's intuitive and you know what to do straight way, but many individual clients are probably necessarily at that kind of point – they still need a bit of hand-holding. It depends what you're trying to do without visualisation as well. So some of the ones I showed you, some are explorative.
Ian, ID54	The problem was they were saying the data was wrong and I said "No the data is not wrong". It doesn't match our report. You're not asking it the right question. So once you show them to ask them the right question, how to tick the right boxes, it's the same, yeah exactly it is. They kept blaming the data and it wasn't the data.
Shaun, ID65	We get people who can't read graphs, and I mentioned that when we came out and I don't know if you've come across it. We cannot assume that all of our clients can navigate their way around a graph, it's just not a given.
Shaun, ID71	I think less people are more confident with interactive. You've still got clients who ask for graphs in PowerPoint. Despite the fact that we've got a tool that can interrogate it and show.
Shane, ID22	So that's enabling the end-person to do a bit more new – but I haven't really seen managers or people who you would expect to know more, be brave enough to go out and do manipulation of the pivot tables.

Engagement	
Shaun, ID68	I think it's the fact also that they can't understand what sits behind it and how it gets to that. So it's a bit about the visuals, but for a start most of this is irrelevant until they understand where they are. So the first thing is to say do you understand this for you, what this tells you? If you're number 11, what is this just telling you on your own? So we just concentrate with them on their own and then we broaden it out and broaden it out. That's the first thing, and it's a minority but there are people who cannot read graphs, but I think it's more a visual – and also there's people who wouldn't be able to concentrate long enough to actually take time to read, those so-called intuitive [people].
Shaun, ID42	The big assumption is that they [end BI users]'re not clear at the start, which I would say most organisations aren't crystal clear when they're going to engage or look for a solution or a service. So then that's really the way we approach it is they're not clear at that point, so that engagement clarifies that, it allows us to make sure that by the time we get to this point it's going to be a yes. It's not going to be three months and go oh, no, that's not what we wanted.
Shaun, ID73	That fear of clicking on something and then not being able to get back or explain it or get themselves out of it, almost. It's almost like the soft skill side of it, being able to say “oh, I didn't mean to do that” and they'll reset it and then I would show you again.
Shaun, ID83	We've purposely not put ourselves at the consultancy end because it implies a cost element to a client and a bringing in of external expertise. Our aim is to make that internal resource or organisational staff member an expert.
Emily, ID64	We work with them [decision-makers] and we discuss which way they want the data presented. So in the end, we work in such a way that they understand because that's what they, they are part of the selection process.
Daniel, ID21	I [as a data analyst] want to anticipate what they want to see but also give them room to allow them to customise or to tailor their own graphs. And also – depending on who we're working with – because if they are someone who's working at a high level, the summary's fine.
Daniel, ID67	A lot of times, they [BI end users]'ll look at this and they'll say “Oh, how do I do this?”, “How do I do that?”, “How do I know to do that?” and you take a step back and say “What is it that you want to do?” They'll say “This, this and this” – then we'll work towards that. And over time, once they're comfortable with understanding what they want out of it, and then applying whatever the functions are – or the features in this – then the next time they'll come with the same problem but for a different data set. They'll know how to use that. So, it's not so much the function – the function and the features are fine – it's really what is it they want to see and that's where we have to sit down with them and take them through that process.

Engagement – continued	
Nathan, ID19	<p>We don't tend to do a lot of analytics on behalf of clients. We create an environment where they can do analytics. If it comes to advanced analytics, then obviously there's, you know, some areas where clients might not have the skills but typically it's a core competency of a company to have some analytical capability. I'm not so sure that you can outsource your analytics. You can outsource your, or get help with your data logistics, but outsourcing your analytics doesn't quite make sense to me. That's what I would have thought is, you know, one of the key things that you would want to keep in-house, it's your differentiator, it's like outsourcing your strategy, "We're just going to produce widgets and get someone else to do the strategy", it doesn't quite make sense. Because analytics is so tied to strategy.</p>
Ross, ID50	<p>I can look at collaboration of the oblong minority report where both, you know multiple sets of hands or working on a big screen at once, right. I'll get to that but that's one set. There's collaboration which is I'm working on some data, and this is collaboration that exists already. I'm working on some data, previously what I'd have to do is I'd have to print, send it to you via email, call you in, have a meeting, we'd sit down around a screen and we'd stick our big fingers and hopefully not touch each other's screen too much, and that's how collaboration would be.</p>
Robert, ID16	<p>There's an icon that they click on that dashboard that says, I want to start collaboration on this. It could be an activity. It could be a blog. It could be a template where we attach files and, similar to Facebook, you can have messaging on top of messaging related to that dashboard, related to that graph or what have you.</p>
Jeffrey, ID13	<p>Business loses confidence a little bit in the BI platform. They want the control, they want to go that's what's in BI, but I know this is coming and I'll adjust this. But what we're trying to do is change that and say well that is what's in BI and that is what we're reporting.</p>