Graduate School of Business

The impact of Business Intelligence systems on the perceived quality of strategic decision making

Marco Peter Schultheis

This thesis is presented for the Degree of

Doctor of Business Administration

of

Curtin University

March 2016

Statement of original authorship

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Human Ethics

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number: GSB 13-11.

Signature:

Date: 17 November, 2015

Abstract

Over the last decade the rapid change in universities' market environment has resulted in a greater need for business intelligence to aid strategic decision making. To adapt to these changes universities have engaged strategic planning processes. A key aspect of strategic planning is strategic decision making, the quality of which is enhanced by the use of business intelligence (BI). However, there is very little empirical evidence to support this connection, especially regarding the tertiary education sector.

This study examined how Australian Universities, through the implementation of BI Systems, have enhanced the quality of the strategic decisions made. A research model was developed for this study that tested BI system usage using the Unified Theory of Acceptance and Use of Technology (UTAUT) and related this to perceptions of the quality of strategic decisions being made. The model also tested the influence other factors had on perceptions of strategic decision quality such as Team Capital, Architecture and Sensemaking. The research model thus extended the useability of the UTAUT model by expanding its theoretical foundation. This quantitative study utilised an online survey of senior managers in Australian Universities. Partial Least Squared Structured Equation Modelling was used to test a research model developed and to examine eight related hypotheses.

The study discovered that senior managers are more reliant on their own knowledge and skills and the use of a structured decision making process than the use of BI systems. Although BI system use was also found to significantly positively contribute.

The study is of significance in that it provides evidence regarding the perceived impact BI Systems have had on the quality of strategic decisions in Australian Universities. This information will allow Universities to improve their investment decisions regarding BI Systems and assist in evaluating the likely return on investment as it relates to the impact on strategic decision making.

The study also provides the following theoretical contributions. It provides the insights obtained from the use of the UTAUT model for predicting BI System usage in

higher education sector. The study confirms that Behavioural Expectation provides a stronger predictor of IT system usage than Behavioural Intentions. This research also develops measurement models for the three concepts of Team Capital, Architecture and Sensemaking, which adds new knowledge to the literature. These factors measures the influence of senior management team diversity and capability, the strategic decision making process and the use of information in decision making on the perceptions of the quality of strategic decisions, which also adds new knowledge to the literature.

Acknowledgments

My doctoral studies have been a long journey that commenced with two years of course work during which I met new people and made new friends. I have learnt a lot during these studies and will forever carry with me the positive experience this has been. This work could however not have been possible without the support of some very special people.

Firstly, I would like to thank my supervisors Professor Margot Wood and Professor Mohammed Quaddus for their expertise, guidance, support and not least of all their patience.

Of special note are the expert guidance provided on the development of the research model and the empirical aspects of this study by Professor Quaddus. Without his extensive experience in this field the data analysis, and in particular the Partial Least Squared Structural Equation modelling may have taken much longer than it did.

Although she had left the University to work in industry, Professor Wood continued to provide her time to allow me to complete my studies. Her guidance on academic writing and expertise on strategic decision making and decision quality was much appreciated.

Beyond what one could expect from one's supervisors in relation to their role in a research study I am also very appreciative of the friendship that has developed between Mohammed, Margot and I.

Thanks also go to Ms Alice Tsang, the Director Market and Institutional Research at Curtin University, who provided advice and guidance on the use of the online survey tool and the data review exercise. Her expertise in using MS Excel is second to none and saved me many hours of frustration.

A big thank you also to my good friend, Mr Jay Chinnery, who assisted me in proof reading this thesis. His command of the English language and understanding of subject matter presented, helped to present a thesis with enhanced readability.

I would like to thank my partner, Ms Nicole McKinnon, who has been very understanding and supportive during the time I have undertaken this study. The last few years have been difficult and much free time has been sacrificed on both sides. Her motivational words kept me going.

Finally I would also like to thank the senior managers at Australian universities who participated in this study. I fully understand how time poor these individuals are and it means a lot to me that so many found the time to complete the survey to allow me to undertake this study.

Key Words

Analytics

Big Data

Business Intelligence

Information Technology Adoption

Unified Theory of Acceptance and Use of Technology (UTAUT)

Information Technology

Information Systems

Decision Making

Strategic Decision Making

Strategic Decision Making Process

Strategic Decision Quality

Quality of Strategic Decision Making

Higher Education

Partial Least Square Structured Equation Modelling

Quantitative Research

Online Survey Research

Abbreviations and Definition of Terms

Business Intelligence System - Negash (2004) defines BI Systems as systems which combine data gathering, storage and knowledge management with analytical tools to present complex and competitive information to planners and decision makers.

Strategic Decision Making - For the purposes of this study, strategic decisions are those that involve strategic issues and require top-management team consideration, a definition consistent with Nooraie (2008).

Strategic Decision Making Process - The strategic decision making process is the process by which strategic decisions are generated and is defined as a three step process involving identification, development and selection (Mintzberg, Rasinghani and Theoret 1976).

Sensemaking - *"The ability or attempt to make sense of an ambiguous situation in order to make decisions. The Sensemaking dimension focuses on discovery and understanding of the decision situation"* (Pope and Klass 2010, 2). In the context of this study, Sensemaking means the use of information or business intelligence in decision making.

Architecture - *"The art or practice of design, creation and combination of frameworks, processes and tools to enhance outcomes. Architecture draws on Sensemaking and attempts to determine the most appropriate decision theoretic tool(s) to adopt, choose the right processes and systems to accommodate these tools ..."* (Pope and Klass 2010, 3). Architecture, within the context of this study, means the use of a defined or structured decision making process which is informed by business intelligence.

Team Capital - *"Encompasses those aspects which critically influence the ability of the decision making team to achieve its potential. The Team Capital dimension is to do with ensuring that the team continually builds on and improves the team's human capital, encapsulating team culture, development, training, leadership, recruitment and selection"* (Pope and Klass 2010, 5). In the context of this study, Team Capital is used to mean the diversity and capability of the senior management team.

Q**u**ality Strat**e**gic Decisions – Quality strategic decisions are defined, as per (Kopeikina 2005), as those decisions which have utilised a quality decision making process, used quality decision making content, and are aligned to the internal vision. In the context of this study, this definition is extended to include the perceived likelihood of achieving the intended outcome.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Background to the research

Over the last decade many organisations have developed BI Systems to aid the management of the organisation both operationally and strategically. In 2014, a Gartner survey indicated the demand for BI Systems within organisations continues to increase, and Worldwide expenditure on BI systems reached $14 billion in 2013 (Sommer and Sood 2014). The global BI and analytics market is expected to grow to $20.8 billion by 2018 according to forecasts made by the global market research and consulting firm MarketsandMarkets (2013). With the availability of big data, more sophisticated and powerful computing capabilities and analytical software, the availability of business intelligence for strategic decision making appears to be becoming increasingly important. The question is however, are senior managers making the most of the BI resources available to them, or are other factors considered more important to the quality of strategic decision making?

In relation to the use of business intelligence by Australian universities, Foster (2011) observed the Australian higher education sector was required to use data more effectively. She commented that *"Universities are sitting on vast quantities of student-level data that have significant potential… [By collating and analysing this data effectively] They would receive valuable information, including far more detailed benchmarking than is currently available, that they can use in positioning themselves in the market and setting their internal policies"* (Foster, 2011, 1).

One of the key drivers for this increased demand for BI System development has been the promise of improved decision making and increased potential to realise a

competitive advantage (Nemati and Barko 2001; Thomas 2001; Werner and Abramson 2003). At the 2012 Australian Association of Institutional Research (AAIR) forum for Data warehousing and Business Intelligence at Australian universities, it was evident the use of BI Systems was also very active in the University sector. Discussions at the forum indicated many universities had very mature and sophisticated systems designed to aid strategic decision making. In 2014, the Australian Network of University Planners (ANUP) conducted a survey of members to establish the BI maturity in the university sector. The results of the survey indicated that the sector had continued to develop their BI Systems and adoption within universities in Australia was relatively mature. However, given the substantial investment involved in the development of BI technologies within organisations, it is important to establish if the investment is delivering on its promise of enhancing strategic decision making. Given the paucity of evidence with regard to perceived effectiveness, this study therefore examined whether the adoption of a BI Systems by strategic decision makers has affected the perceived quality of strategic decisions made within Australian universities.

In formulating this research topic, a review of the literature was undertaken to establish what related research had previously been conducted and what further contribution could be made. Although extensive research has been conducted on the adoption of Information Technology (IT), and specifically on the adoption of BI Systems, the literature review revealed limited evidence with regard to the quality of strategic decision making (Buchanan and O'Connell 2006; Kopeikina 2005). No previous studies were found that directly explored the impact of BI System adoption on the quality of strategic decisions for universities.

1.2 Research Questions

As previously discussed the Australian university sector is relatively mature in relation to the development of BI Systems. Elbashir et al (2008) outlined that BI System developments present a substantial investment for organisations and a positive return is an important outcome. This positive return on investment is often a function of the quality of the strategic decisions that can be made as a result of BI Systems delivering enhanced information to decision makers. Arludoss, Travis and Venkatesan (2014) explained that the primary objective of BI Systems was to monitor performance and assist management with the development of business strategy and action. In the Australian University sector no research has been conducted to establish if this benefit is being realised. This means that the key questions which remains unanswered for the sector is if these BI Systems provided a positive return on investment. In particular have BI systems delivered on enhancing the decision making at Universities.

The issue which remains is that the existence of a BI System alone does not necessarily result in the system delivering benefits to decision making. Venkatesh, Brown, Maruping and Bala (2008, 483) comment that "employees' underutilization of new information systems undermines organisations' efforts to gain benefits from such systems". For a BI System to be truly effective, those making strategic decisions must in fact use/engage with the information in the system. This has previously been confirmed by Rogers (1995) diffusion of innovation theory which suggests that information systems only deliver fully on their benefits if the technology has been adopted into the day-to-day operations of the organisation.

As such, it is suggested that it is only when a BI System is adopted as part of the strategic decision making process that benefits can be fully realised. As previously discussed research by the Australian Network of University Planners (2014) has provided evidence to suggest that Universities in Australia have developed BI Systems and that in fact the sector is relatively mature in this space. However no research could be found which provides insights into the effectiveness of these BI

Systems at Universities. Therefore, drawing on this logic, this study examined the degree to which strategic decision makers within the University context perceived BI System as a means of enhancing decision quality.

To establish if senior managers at Australian Universities have adopted their BI Systems and are using them for strategic decision making a model for measuring IT adoption is required. A variety of Information System adoption models are discussed in the Literature Review in Chapter two. A key model which is used to measure Information System adoption is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008). The UTAUT model has previously been utilised in a variety of industry sectors by numerous researchers, as discussed in the Literature Review, but no evidence was found that this model has been tested in the University sector context. As such it is of interest to establish if this model could be used to predict BI System usage in the Australian University sector. Using this model would then provide a reliable means for measuring to what extent Senior Managers are using their BI Systems and then to what extent does this use influence their perceptions regarding the quality of strategic decisions being made.

Following are the specific questions explored in this study:

1. How the adoption of BI Systems influenced the perceptions associated with the quality of strategic decisions in Australian universities?

2. How does the diversity of a decision making team, the use of a defined decision making process and the use of information in decision making influence the quality of strategic decisions in Australian universities?

3. Is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008), useable as a predictive model for BI System use?

1.3 Significance and Scope of Research

1.3.1 Significance of Research

This study provides benefits in terms of both business application and a contribution to theory. Universities are expending significant resources in the deployment and adoption of BI Systems in a time when the competitive environment in the Australian and global higher education market is reaching a new peak. Watson, Abraham, Chen, Preston and Thomas (2004) explain that the implementation of a BI System is a complex and financially large exercise for an organisation. This investment, driven largely by a need for information and knowledge, aids strategic decision making. Universities and other education providers will, therefore, benefit from this study as it provides an evidence base to inform their decision making in relation to the adoption of BI Systems, and the perceived difference it has made to the quality of the strategic decision making. Insights are also provided on what factors were considered important in making quality strategic decisions beyond the use of a BI system. These insights will assist senior managers in identifying improvements in their own strategic decision making.

From a theoretical perspective, this study has validated the UTAUT model that can also be used to establish BI System adoption. In relation to the UTAUT model, an academic debate ensues regarding the role of Behavioural Intentions and Behavioural Expectations as predictors of information system usage. This study explored these two concepts and provides further insights regarding their use. This study also contributes to the decision making literature through the development of empirically tested measures of strategic decision quality. Based on theoretical concepts previously suggested by Kopeikina (2005) and Wood and Klass (2008), this study adds another piece to the decision making field. Herein, in relation to other factors influencing perceptions of strategic decision quality, this study has developed measures which allow for empirical testing of the three concepts of Team Capital, Architecture and Sensemaking, as previously suggested by Wood and Klass (2008), within a theoretical framework for enhancing strategic decision making.

1.3.2 Scope of Research

This research presents the results of a quantitative study into the relationship between BI System usage and perceptions of the quality of strategic decisions of senior managers from Australian universities in 2012.

1.4 Structure of the Thesis

This thesis is organised into seven separate Chapters. The Chapters cumulatively build the logical journey from inception through to findings and the overall conclusion. An overview of each Chapter is presented below.

1.4.1 Chapter 2: Literature Review

The literature review establishes the importance for high quality strategic decision making within the complex and dynamic higher education environment. Increased competition within the market, disruptive technologies, the unstable regulatory environment and reduced financial sustainability are outlined as key challenges impacting the higher education sector. The use of BI Systems in universities to support decision making is discussed and the question is raised as to whether strategic decision makers are in fact utilising their BI Systems and associated information in their strategic decision making.

The literature review reveals strategic decision making as a complex issue with divergent views regarding process and other factors that influence decision making and decision outcomes. The criticality of information, in particular business intelligence, is emphasized with regard to the strategic decision making process.

With the evidence gathered to support the importance of information in strategic decision making, the literature review then focuses on the primary area of this study: the use of BI systems by senior managers. It discovered the availability of a BI System

alone does not ensure its use. This insight led to an exploration of IT adoption theories and models in order to develop a base for the development of a model for measuring BI System adoption and use.

Delving further into the decision making literature, the review explores what constitutes a 'good' quality strategic decision and how high quality decision making can be measured. Team diversity, a high quality decision making process, alignment to vision and perceptions regarding achieving desired outcomes were identified as key concepts and subsequently used to define strategic decision quality in this study. Other contributing factors which positively influenced strategic decision making are also discussed.

The literature review concludes by presenting the research model and research questions for this study. The review of literature provided this study with the grounding to develop a research model, which was then tested using the research methodology described in Chapter 3.

1.4.2 Chapter 3: Research Method and Design

The selection of a positivist paradigm is substantiated as the most appropriate choice for this study, given that an objective reality existed which could be measured. Within Chapter 3, the ontology and epistemology for the study are defined and the rationale for the quantitative methodological approach is presented.

Research procedure and method are described in detail. The process begins with the identification of the research questions and research proposal, then turns to the literature review to develop a theoretical grounding, followed by the development of the research model and hypothesis, survey instrument, pre-testing of the instrument, data collection, data quality review and analysis and concludes with the interpretation and discussion of the results of this study.

The methods for data analyses used in this study are described and the process of testing the measurement model, in terms of reliability and validity, are outlined. The

rationale for measurement model tolerances in relation to item reliability, composite reliability and average variance extracted is articulated, including an explanation of item level and construct level discriminant validity tests.

The testing of the structural model, in relation to the strength and nature of relationships between constructs using Partial Least Squared Structured Equation Modelling (PLS-SEM) and the assessment of the significance of these relationships using the Bootstrapping process is also outlined. A description of how mediating variables in the structural model were tested for mediating effects concludes Chapter 3.

1.4.3 Chapter 4: Hypothesis and Research Instrument Development

Chapter 4 defines the hypotheses for this study, and each hypothesis is expressed in terms of the constructs, potential relationships are identified, and a rationale for each provided. In addition, the use of the 6 point Likert agreement scale is discussed. For each of the constructs of the structural model, measurement items are presented and referenced back to the theory or previous research. This information provides an overview of and rationale for the measurement model and research instrument applied in this study.

Chapter 4 concludes by presenting the results of the research instrument pre-test conducted, and the subsequent enhancements made.

1.4.4 Chapter 5: Analysis of Data and Findings

Chapter 5 of this study presents the data analysis and associated findings. The data collected were first analysed to establish non-response bias and was found not to suffer from any significant bias. Data quality and review procedures, described in Chapter 3, were used to test both the measurement model and structural model for

the study. In addition, item and construct reliability and validity assessment results were outlined.

The structural model was assessed for robustness and hypothesis testing was then undertaken to examine the standard regression weights and t-values using PLS-SEM. Four of the eight hypothesis proposed were supported and this is discussed in detail throughout Chapter 5. The Chapter concludes by presenting the mediation effect analysis of two constructs in the structural model, namely Behavioural Expectations and its mediating effect on Behavioural Intentions.

1.4.5 Chapter 6: Discussion and Implications

Chapter 6 takes the findings and explores the theoretical and practical implications. The eight hypothesis are explored and linked back to the purpose of the study. Each hypothesis is discussed in detail to provide insights as to why the results of the study have resulted in rejection or support of the hypothesis in question.

1.4.6 Chapter 7: Conclusion

The final Chapter draws the threads of the research study together, summarising key findings, presents limitations of the study and highlights opportunities for future research.

1.5 Summary

Chapter One has set the scene in relation to the objectives of this study, its significance and provided an overview of the thesis structure. The next Chapter examines the literature relevant to the focus of this study and provides the grounding for the development of the research questions, research model and the development of the hypotheses.

2 Literature review

2.1 Introduction

Through an examination of the relevant academic research encompassing decision quality, factors impacting strategic decision making and decision making processes, and the use of BI Systems as a means of providing input into decision making, a gap in the extant body of knowledge is revealed. It appears there is limited literature documenting understanding of the use of BI Systems and the quality of the strategic decision making in Australian Universities. Identification of this gap informed the development of the set of research questions and associated research model which underpin the hypothesis for this study presented in Chapter 4.

Making high quality strategic decisions in an increasingly globally competitive higher education market is critical for senior managers in Australian universities. Many universities have therefore been investing in Business Intelligence systems (BI Systems) to support their strategic decision making. However, the question remains whether this investment provides the returns anticipated in terms of the quality of the strategic decisions being made.

The following literature review explores this issue and in doing so provides the theoretical grounding for this research.

2.2 Literature Review Roadmap

This Chapter provides an overview of the Australian higher education market to set the scene as to why strategic decision making has gained importance in the sector in recent years. A definition of strategic decision making is developed, literature is then

presented on what constitutes a quality strategic decision, how it can be measured, and what factors influence the quality of strategic decisions. The strategic decision making process is explored and the role information plays is discussed. Having established what a quality strategic decision is, and the role of business intelligence in strategic decision making, the literature review focuses on how BI systems are supplying business intelligence. The BI System is defined, its benefits explored and models for measuring BI System adoption are presented. The importance of the quality of information and the quality of the BI System are discussed in the context of whether this influences usage behaviour. The literature review concludes by presenting the research questions and research model for this study.

2.3 Change in the Australian Higher Education Environment

The Australian higher education market is undergoing a period of significant transformational change. According to the Australian Bureau of Statistics, Education Services were Australia's third largest export in 2014 and totalled some $16.6bn (Australian Bureau of Statistics 2014). Globally, higher education has become big business and access to higher education, enabled through technology, is greater than ever. Students are presented with more choice, are able to compare institutions more easily and have greater expectations. University rankings play a significant role in student choice and global competitors are entering the Australian market both physically and online.

Simultaneously with this rise in global competitiveness, global economic conditions have impacted Australia's ability to compete internationally. Between 2009 and 2012 Australia had a relatively strong economy, in comparison to other study destinations, and was one of the most expensive study destinations, due to the strong dollar and relatively high living costs at the time. The higher education market has also become increasingly complex, with new technologies disrupting the sector, private providers exploiting opportunities in the market and substitute products such

as MOOCs emerging as an alternative way to gain knowledge (Marginson 2006; Marginson, Kaur and Sawir 2011).

Domestically, the Australian higher education market has faced significant regulatory change over the last decade. In particular, Government regulations have in recent years been designed to stimulate competition through the introduction of the Demand Driven System in 2012 and by allowing the Australian market to be more open to offshore competitors and other private providers. At the same time, Government has continued to reduce the expenditure directed towards public universities. This has resulted in universities implementing strategies designed to ensure longer term financially sustainability, including diversification of revenue streams and exploring various approaches to reduce costs (Department of Education and Training 2013).

In summary, the Australian higher education market faces some of the most significant changes it has encountered in the last two decades, and all within a market that has become more complex, dynamic and competitive. This change presents both opportunities as well as threats to Australian Universities; however, the most critical part to being sustainable in this new market environment is the ability to make good quality strategic decisions. Ahmed, Bwisa, Otieno and Karanja (2014) proposed large organisations in complex environments require good strategic decision making techniques to remain competitive. This means decision making capability, at a strategic level, has become more critical as choices made will impact the competitiveness and sustainability of individual universities. In this period of transformation, increased pressure has been placed on senior managers to make good quality strategic decisions; sound judgements that are cognisant of information about the market, its competitors and the operations of the university.

However, before further exploring this notion of information, it is appropriate to consider what actually constitutes a strategic decision. How a strategic decision is defined, who makes them and how can a 'good quality' strategic decision be defined and measured?

2.3.1 Definition of Strategic Decisions

Strategic decisions are decisions which impact the future of the organisation, define its strategic direction, and respond to changes in the environment. They are more complex than operational decisions and often include multiple inputs and variables. This view is supported by Harrison (1996) and Nooraie (2012), who further explain that strategic decisions are extremely complex and include multiple dynamic variables. The focus of strategic decisions is explained by Nooraie (2008) and Mason and Mitroff (1981) as being directed at the future path of organisations, as they aid in establishing the organisation's direction and strategies required to anticipate and respond to changes in the environment.

This is congruent with Papadakis, Lioukas and Chambers (1998, 1) claim that: *"Strategic Decision Making is of great and growing importance because of five characteristics of strategic decisions: They are usually big, risky and hard to reverse having significant long-term effects, they are the bridge between deliberate and emerging strategy, they can be a major source of organizational learning, they play an important role in the development of individual managers and they cut across functions and academic disciplines"*.

Based on the above, this study therefore adopts the view that strategic decisions as those which:

a) are more complex than operational decision making, focused on the big issues and the longer term;
b) consider the complexity of the environment and often include multiple inputs and variables; and
c) define the future direction of the organisation and or provide strategic response to environmental factors.

Although not always the case, strategic decisions are predominantly made by those in more senior roles in the organisation. A variety of researchers have indicated that strategic decision making is the role of senior managers. For example, Eisenhardt

and Zbaracki (1992) explained that strategic decisions are those that are made infrequently, by senior managers, and are critical to the direction and survival of the organisation. Harrison (1996) also shared this view, maintaining that strategic decision making is the most important activity undertaken by senior managers in all types of organisations. This was reflected in Nooraire (2012), along with Carmeli and Schaubroeck (2006) whose articles again highlighted that strategic decision making is a complex process and a key function of managers in any organisation.

Drawing together the above elements, for the purpose of this study strategic decisions are therefore defined as those which involve strategic issues, consider multiple inputs and variables, are more complex than operational decision making, and require senior management's consideration. They are generally long term in nature and not easily reversed.

However, the process of simply making strategic decisions does not necessarily result in successful outcomes. It is important to also consider the perceived quality of the judgements made. A definition of what constitutes good quality strategic decision making is developed in the next section.

2.4 Quality of Strategic Decision Making

The preceding section explained why good quality strategic decisions are critical in the complex higher education environment that Australian universities are operating in. The next logical step is to understand what constitutes a 'good quality' strategic decision and how it might be measured.

Fundamentally, the quality of strategic decision making is often considered in terms of the outcomes of a particular decision. However the literature suggests that a strategic decision cannot be measured as either high or low quality as a result of the final outcome as good decisions often lead to unfavourable outcomes if poorly implemented or if unknowable factors come into play subsequent to the decision (for example see Amason 1996; Brown, Kahr and Peterson 1974). This means that while a particular decision may have been perceived as being of good quality at that time, other factors may ultimately affect the quality of the outcome.

Given the ambiguous association with outcomes, researchers have therefore suggested that the quality of a decision should be defined in other terms. Very limited research appears to exist which provide concepts for measuring the quality of a strategic decision in an organisational setting using measures that are not tangibly associated with the outcomes of specific decision(s) made.

However, measuring perceived decision quality is also problematic (Wood and Klass 2008). They also noted that in general it involves subjective measurement using expert panels or through a set of self-reporting indicators. For example Priem, Harrison and Muir (1995) utilised two independent strategic management Professors to judge decisions on a five point Likert scale from either low quality to high quality. A further approach has been the measurement through experimental design, such as in Cardella's (2011) study, where participants played a game during which they learnt by observation resulting in improved decision quality which could be measured on the success of a player in the game.

It is however reasonable to assume that senior managers would have perceptions regarding the quality of the strategic decisions they make. Furthermore, given the complexity of the decision making, it is also reasonable to assume that perceptions of quality would be based on multiple elements. The elements of a quality strategic decision are now discussed to develop a perception based construct and related measurement items which allow for the measurement of what constitutes a quality strategic decision in the context of this study.

2.4.1 Defining and Measuring Strategic Decision Quality

Kopeikina (2005) suggested that the quality of decisions can be assessed through the three dimensions of: 1) the quality of the decision making process; 2) the decision making content; and 3) the internal alignment of the decision with the organisational vision. Michie, Dooley and Fryxell (2006) measured strategic decision quality using four concepts for assessing the quality of strategic decisions, derived from the work of Tilles (1963) and Schweiger, Sandberg and Ragan (1986). Michie, Dooley and Fryxell (2006) focused on senior managers perceptions of: 1) the quality of the information used in decision making; 2) alignment of the decision to current strategy; 3) financial responsibility of the decision; and 4) decisions overall contribution to organisational effectiveness. The study concluded that improved decision quality occurred in diverse teams which had high goal consensus, or alignment to organisational goals and objectives (Michie, Dooley and Fryxell 2006). This was consistent with Kopeikina's (2005) findings regarding alignment of the decision to the vision.

Raghunathan (1999) maintained improved information quality, when combined with improved decision maker quality, results in higher quality decisions being made. In addition, he specifically highlighted the importance of providing quality decision support tools, such as BI Systems, to enhance the decision making process. This finding aligns closely to the suggestion from Kopeikina (2005) regarding the importance of decision making content.

A further measure of decision quality is the perceived likelihood that the intended outcome is achieved (Wood and Klass 2008). This approach was also used by Carmeli, Tishler and Edmondson (2011) who, in their study, asked senior managers to assess recent decisions they had made based on: 1) the effect of the strategic decision on the organisation; 2) the results of the strategic decision relative to expectations, i.e. were intended outcomes achieved; and lastly 3) the perceived overall success of the strategic decision.

Many of the elements discussed above can be summarised using Kopeikina's (2005) definition of a quality decision. For example, quality decisions are those decisions which have utilised a quality decision making process, have used quality decision making content, and are aligned to the internal vision. However, one limitation of this is no measure of decision outcome has been included. Wood and Klass (2008) argue that the perceived likelihood of achieving the intended outcome provides a perception based measure of decision outcome. Thus, the likelihood of achieving the desired outcome was also included in the definition adopted in this study.

Subsequently, for the purpose of this study, which utilised a perception based measurement, a good quality strategic decision is defined as a decision which:

a) utilised a quality decision making process;
b) used quality decision making content (for the purpose of this study the use of quality information in decision making);
c) aligned to the internal vision; and
d) achieved its anticipated outcome.

These points are discussed further in Chapter 3 – Research Methodology.

Having agreed a definition of strategic decision quality, it is now time to consider what other factors, beyond the use of the BI System, are likely to impact on the quality of the strategic decision. This is an extensively researched field with a broad spectrum of findings and opinions, therefore this review focuses only on those aspects seen as most salient to the overall study.

2.4.2 Strategic Decision Quality and Team Diversity

As highlighted earlier, strategic decisions are most frequently made by teams of senior managers (Carmeli and Schaunroeck 2006; Harrison 1996; Nooraire 2012). It is logical to conclude that the composition of such a team, its attributes and the individual characteristics of team members, may impact on the quality of the decisions the team makes. The leading theory explaining the phenomenon is the Upper Echelons Theory, developed by Hambrick and Mason (1984) and later refined by Hambrick (2007), proposes that senior managers experience, values and personalities impact how situations are analysed and understood, ultimately impacting decision making.

Related to this, a significant amount of social psychology and management research has focused on the potential relationship between team diversity and organisational performance. Rather controversially, and against prevailing accepted wisdom, a recent meta-regression analysis of 53 empirical studies on the impact of management team diversity on organisational performance, found no link exists between team diversity and performance (Hamberg and Bui 2013). In contrast to this, numerous previous studies have suggested positive relationships between diversity in strategic decision making teams and the quality of decisions and organisational performance (see Amason 1996; Bantel and Jackson 1989; Jehn, Northcraft and Neale 1999; Hambrick 1996; Talke, Salomo and Kock 2011). For example, Talke, Salomo and Kock (2011), found a positive relationship when investigating senior management team diversity and an organisation's innovation strategies and outcomes. This was reflected the earlier findings of Jehn, Northcraft and Neale (1999) which found diverse educational and functional backgrounds contributed to decision quality by ensuring that a broader spectrum of understanding and experience contributes to the decision making process. Boerner, Linkohr and Kiefer (2011) performed a longitudinal study which observed senior management team diversity also positively impacted organisational performance when teams had been working together for a short period of time, but found that this effect diminished over time.

However, to make matters even more complex, the argument is not just between a positive connection, diminishing return or the claim of no relationship. Other studies have also indicated that the opposite is true and that there exists a negative relationship between diversity and performance. One recent example is the study by Diaz-Fernandex, Gonzalez-Rodriguez and Pawlak (2013) which found that senior management team diversity, in terms of educational-level, negatively impacted on organisational performance. Whilst functional diversity and educational background were found to have no significant impact.

An earlier study by Smith et al (1994) also suggested that some elements of diversity negatively impacted organisational performance. This echoed Ancona and Caldwells' (1992, 321) observation that a negative relationship between team diversity and decision outcomes suggested that diversity may have a negative impact on team process and outcome, they argued: *"...it may be that…[diversity]…brings more creativity to problem solving and product development, but it impedes implementation because there is less capability for teamwork".*

Even earlier, Murray (1989) found homogenous senior management teams interacted more efficiently and experienced better outcomes when competition in the market was intense. Conversely, heterogeneous groups were found to perform better in long-term decision making environments. This was attributed to greater levels of cohesion and communication within homogenous teams.

What is evident from the literature is that studies on both sides of this argument have at least one common understanding, in the majority of cases at least, the act of measuring the relationship between diversity of senior management teams and organisational performance is a complex undertaking, particularly given the large number of moderating variables (Certo et al's 2006). Yet despite the conflicted findings, the literature clearly identifies team diversity as an item which must be considered with regard to strategic decision making. As a result, this study adopts team diversity as an item to be measured in an attempt to further understand the impact it has on the perceived strategic decision quality.

The next section takes the discussion from team diversity to the concepts of team and individual cognition.

2.4.3 Strategic Decision Quality and Cognitive Ability or Capability of the Decision Makers

Team diversity is one item which has been shown to impact decision quality, other factors have also been found, for example the cognitive ability of the decision makers. Amason's (1996) position was strategic decision quality has two principle antecedents: the cognitive capabilities of strategic decision makers; and the interaction process through which strategic decision makers produce decisions or the strategic decision making process. The impact of the strategic decision making process will be discussed further in section 2.5 of the literature review.

A substantial body of research exists examining the cognitive capabilities of strategic decision making teams. One key finding was Bantel and Jackson's (1989) work which identified cognitive capability of teams is enhanced if the team is diverse in skills, knowledge, abilities and perspectives. These cognitive abilities can therefore be measured in terms of skills, knowledge, ability and perspectives and are congruent with the literature relating to team diversity. It seems logical to conclude then, that diversity is required across each of these four items.

The discussion on the cognitive ability of decision makers adds further depth to how team diversity may be measured by providing items related to diversity of skills, knowledge, abilities and perspectives. The strategic decision making process was an additional item identified, but warrants deeper discussion and will be explored further under section 2.5.

2.4.4 Summary of other key factors Impacting on Decision Quality

It has been discussed that the diversity of the decision making team, the strategic decision making process and the cognitive abilities of those making the decisions are key factors which may impact on decision quality. However, a framework is required which will capture these items under concepts which can be incorporated into the research model and measured. Work done by Wood and Klass (2008) provides a potential framework to bring these items together to allow them to be presented in the research model for this study. In particular, they suggested that decision quality is a function of the interrelationship between three concepts: 1) Sensemaking; 2) Architecture; and 3) Team capital.

Pope and Klass (2010, 5) defined these three concepts as:

"Sensemaking *is the ability or attempt to make sense of an ambiguous situation in order to make decisions. The Sensemaking dimension focuses on discovery and understanding of the decision situation."* (Pope and Klass 2010, 2)

"Architecture *is the art or practice of design, creation and combination of frameworks, processes and tools to enhance outcomes. Architecture draws on Sensemaking and attempts to determine the most appropriate decision theoretic tool(s) to adopt, choose the right processes and systems to accommodate these tools ..."* (Pope and Klass 2010, 3)

"Team Capital *encompasses those aspects which critically influence the ability of the decision making team to achieve its potential. The Team Capital dimension is to do with ensuring that the team continually builds on and improves the team's human capital, encapsulating team culture, development, training, leadership, recruitment and selection."* (Pope and Klass 2010, 5)

The framework described above was used to develop concepts for the research model. These concepts were measured using the items previously described which focused on team diversity, cognitive ability/capability, decision making process and the role of information in decision making.

As previously identified, making good quality strategic decisions is critical for senior managers in Australian Universities given the dynamic and complex environment which they operate in. Having defined what was considered a quality strategic decision, how to measure what is a quality strategic decision, and what other key factors may impact on decision quality this literature review will now examine how strategic decisions are made, which as previously mentioned, is a key factor potentially impacting on decision quality.

2.5 Strategic Decision Making Process

"A decision is a commitment to future action – whether in ten minutes or ten years."
Mintzberg (1994, 291)

The higher education sector has not escaped the impacts of economic, social, political and technological change, which have also adversely impacted other sectors over the last ten years. Global competition, online education, the global financial crisis, and uncertainty in the policy environment in Australia have all created a more complex decision environment. Nooraie (2012) explains that during times of rapid change, managers are often forced to make more decisions in shorter timeframes. During these times of more dynamic change and uncertainty, senior managers face greater pressure to make the right decisions. Critically, more pressure exists to make the right strategic decisions with regard to the future of the organisation. So, what are strategic decisions and how are senior managers making these decisions?

Strategic decision making has become one of the most actively researched areas of management. The theories and models underpinning strategic decision making are broad and have a multidisciplinary base (Ahmed et al 2014; Sheppard and Rudd 2014). In reviewing the literature relevant to this study, a variety of key elements of strategic decision making were identified to assist in developing a definition.

2.5.1 Strategic Decision Making Process

Having defined what is considered to be a strategic decision, in section 2.2.1, it is important to understand the strategic decision making process as this provides an insight as to why BI Systems have been developed to support this process. Although a substantial body of literature exists on strategic decision making, research on the strategic decision making process is more limited (Papadakis, Lioukas and Chambers 1998; Shrivastava et al 1985). Nooraie (2008) found a variety of strategic decision making processes have been described in the literature dating back to the early 1970s, and focused on the work of Mintzberg, Rasinghani and Theoret (1976), Hofer and Schendel (1978), and Dubrin (1997) and Donnelly, Gibson and Ivancevich (1998). Although these models may have a number of minor differences, they all fundamentally contain the same three stages: 1) Problem formulation and objective establishment; 2) Identification of alternatives; and 3) Analysis and evaluation of alternatives leading to a decision being made on the most suitable strategy or course of action to the problem or objective. One other critical aspect of the various strategic decision making processes are they all rely on evidence or information to inform the strategic decision making.

Although this process clearly suggests a very structured and rational approach, it is important to point out that the literature also discusses the role and use of intuition in strategic decision making (Elbanna 2006; Miller and Ireland 2005). Shrivastava and Grant (1985) explain that organisational theorists have suggested that decision making in organisations is only partially rational, this is due to the information processing ability of individual managers and systematic barriers to learning. Hodgkinson et al (2009) speculate the notion of intuition in strategic decision making is becoming a more mainstream and accepted concept, and they argue that informed intuition, intuitive decision making based on prior information and experience, is a critical competency of decision makers. Hough and Oglvie (2005) found managers who used intuition, based on objective information, tended to develop higher quality decisions. While Miller and Ireland (2005) concluded that intuition is often the only available approach to decision making when resources such as a BI system are

unavailable, they argued the use of intuition in strategic decision making should be approached with caution.

As previously mentioned, the perceptions of the quality of the strategic decision making process may impact the quality of the decision being made. The above review of literature demonstrated how the strategic decision making process can take a variety of forms, but in general is considered a rational and structured process. However, within this rational and structured process intuition, specifically informed intuition, is accepted as playing a role. Arvai and Froschauer (2010) noted that no matter how perfect a decision making process may be, it does not assure that positive outcomes are achieved.

A key insight to emerge from this literature review is that information plays a role in the strategic decision making process, this will now be examined in further detail.

2.5.2 The role of Information in the Strategic Decision Making Process

One of the defining aspects of strategic decision making is the complexity of the decisions and the need for information to assist the decision making process. This seems to suggest availability of information or business intelligence is critical to support the decision making process. Indeed, Citroen (2011) argues gathering information on both the organisations' internal operations, as well as external market environment are a critical step in the strategic decision making process. His qualitative study on the role of information in strategic decision making concluded that executive managers used information as a rational base for their decision making at each stage of the decision making process; and while information quality (integrity, clarity, robustness and timeliness) was a crucial factor, information overload was a potential issue, explaining information overload as a function of irrelevant information being received. This appears to suggest that if senior managers are provided with more information than they can reasonably digest, then the provision of information to inform the strategic decisions making process becomes counterproductive. Seemingly, if senior managers are using business

intelligence in strategic decision making, they then need to be provided with the 'right' amount of quality information to make their decisions. Anything above this 'right' amount is information overload, and apparently undermines the making of good quality strategic decisions.

Nevertheless, the literature suggests information has more of a positive influence on the strategic decision making process. For example, the continuous flow of information (i.e. business intelligence) through the strategic decision making process is argued by some to be a critical factor to success (see Harrison 1996; Raghunathan 1999). In addition, Popovic et al (2012) expand arguing that with ever increasing amounts of data and information becoming available, and facing more complex and competitive operating environments, organisations are turning to BI Systems to facilitate information provision to managers. Conversely, a study by Turpin Marais (2004) found that the decision makers they interviewed, many of whom had formal training in the use of sophisticated decision support technology, often used this technology infrequently when making decisions. The decision makers interviewed in this study claimed that intuition and the sensitivity to political environment took priority over the rational decision making process. It seems likely that the 'sensitivity to the environment' and 'intuition' Marais' decision makers discuss relies on some form of implicit intelligence which has been gathered and stored for later. As a result, the need for the 'right' information to inform decision making is evident in the literature, as is the need to turn to BI Systems to capture and deliver the 'right' information, in terms of quality and quantity, to the strategic decision makers.

The literature reviewed thus far suggests that the use of information or business intelligence is an important part of the strategic decision making process. As a result, developing a system which efficiently and effectively delivers this information, and which provides support to the decision making process is warranted and would add value. Developing a BI System is one means of achieving this, but would only deliver a return on investment if the system, and the information contained within, were used by decision makers. A 2014 survey conducted by the Australian University Planners Network (ANUP), found that most Australian Universities had developed

some form of BI System and that a good level of BI maturity was developing. However, this survey did not explore the use of these systems by decision makers.

As the focus of this study was to assess the impact BI Systems have on the perceived quality of strategic decisions, the next section will review the literature and theories associated with BI Systems and their adoption and use.

2.6 Business Intelligence Systems

The previous section explored how strategic decision making is often supported by business intelligence. This is not a new concept, and using knowledge, information or intelligence to assist in decision making, can be traced back to early military strategy. Some 2,500 years ago, Sun Tzu proclaimed that knowing yourself and knowing your enemy was critical to the development of strategy and actions.

> *"If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle - Sun Tzu, The Art of War* "(Tzu n.d., quoted in Giles 2012, 27)

Understanding the market, competitors and the strengths and weaknesses of the organisation are critical to decision making and business success (Mintzberg 1994). This knowledge is often described as Business Intelligence (BI) a term first coined by Devens (1865) in the 'Cyclopaedia of Commercial and Business Anecdotes'. Devens used the example of a banker who successfully acted on information received on the market, ahead of his competitors.

> *"Throughout Holland, Flanders, France, and Germany, he maintained a complete and perfect train of business intelligence. The news of the many battles fought was thus received first by him, and the fall of Namur added to his profits, owing to his early receipt of the news."* (Devens 1865, 210)

This would suggest that making informed decisions is generally considered to lead to improved decision outcomes. Technology has improved this capability by delivering systems to support the collection the data and the dissemination of it to decision makers. Over the last 30 years IT systems that deliver BI have continuously evolved as the availability of data and the increased appetite from decision makers for information has grown. A brief history of how the modern day BI System developed will now be explored and what a BI System is, will be defined for the purpose of this study.

2.6.1 Brief History of BI Systems

BI Systems are developed as a technological solution to store, integrate and analyse the information needed to support organisational decision making (Popovic et al 2012). The concept of a BI System, is however, not a recent development and Power (2007) explains that BI Systems evolved from decision support systems which emerged during the 1960's to aid planning and decision making.

However, prior to BI Systems being formally recognised, the concept was already being discussed. In 1958, Luhn first described the term business intelligence using Webster's dictionary definition of intelligence: *"the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal"* (Luhn, 1958, 314). In addition, Luhn also provided an overview of the basic components of a BI System, many of which are still recognisable today. Lastly, suggesting that a BI System would automatically collect data from multiple sources and communicate information to provide intelligence to allow for problem solving.

Following on from Luhn's description of the BI System, between the 1960s and 1980s various forms of Decision Support Systems (DSS) were developed to assist with decision making and planning. From DSS, data warehouses, Management Information Systems, Resource Planning Systems began to develop.

During 1990s the Gartner Group introduced the modern day term of BI defining "business intelligence" as an umbrella term to describe "concepts and methods to improve business decision making by using fact-based support systems" (Power 2007). In recent years, with increasing complexity in market environments and increasing competition between BI Systems vendors, developers have increased the capabilities of modern BI Systems to now store, synthesise, analyse and communicate data, information and insights for decision making (Power 2007; Ranjan 2008).

The modern BI System often comprises a data warehouse for storage; an extraction transformation and load capability to transform raw data from corporate systems (in preparation for the data warehouse using a range of defined data definitions and structures); the ability to data mine; dashboards for effectively communicating the data; and an analytical tool for forecasting and other insight development (Aruldoss, Travis and Venkatesan 2014). In summary, BI Systems, whether considering the modern tool or historical concept, have always focused on providing information to decision makers to inform decision making. For the purposes of this study, the BI System is defined as an IT system which:

- Stores data;
- Transforms this data into business intelligence (including analysis of data and insight development); and
- Provides business intelligence to decision makers.

Although the benefits of having such a system in place within an organisation may appear self-evident, it is useful to consider these more formally. In particular, in terms of the benefits which may relate to this study.

2.6.2 Benefits of BI System Development and Use

BI System development presents a substantial investment for organisations and as such achieving a positive return on investment is important (Elbashir et al 2008).

BI System implementation benefits have been well defined and include those related to improved decision making (Braeutigam, Gerlach and Miller 2006; Elbashir, Collier and Davern 2008; Popvic, Hackney, Coelho and Jaklic 2012; Yeoh, Koronios and Gao 2008).

Negash (2004) argues that BI Systems have been introduced to improve the timeliness and quality of the inputs of the decision making process. Aruldoss, Travis and Venkatesan (2014) stressed the fundamental purpose of a BI System should be to provide organisations with the capacity to monitor the performance and operations of the business and assist management with the development of business strategy and actions. They go on to describe one of the key benefits of any BI System being the provision of the right information at the right time to enable decision makers to make decisions using the business intelligence.

As a result, the introduction of BI Systems in organisations is often driven by a need to have improved business related information available to aid decision making. Furthermore, Gangadharan and Swami (2004) explain that data is transformed into a corporate resource and the focus shifts from quantity to quality of knowledge. As a consequence, BI Systems are designed to deliver more than raw data. Indeed, they add value through transforming raw data into information, which can then be more readily used to enhance strategic and operational decision making. However, Popovic et al (2012) explain that measuring the benefits delivered by BI Systems can be difficult as returns occur over the long term and are often indirect.

The degree to which these benefits are realised largely depends on the manner and extent to which a system is utilised. One study by Turpin and Marais (2004) found the decision makers interviewed, many of whom had formal training in the use of sophisticated decision support technology, often used this technology infrequently when making decisions. Decision makers interviewed claimed that intuition and

sensitivity to the political environment took priority over the rational decision making process. Jasperson, Carter and Zmund (2005), Mabert and Soni (2001), Venkatesh, Morris, Davies and Davies (2003), and Ramamurthy, Sen and Sinha (2008) have all suggested that under-utilisation of newly implemented systems generally means these benefits do not accrue to the organisation concerned. Popovic et al (2012) also agreed and argued benefits of a BI System, in relation enhanced decision making, can only be harvested if the BI System is used by decision makers. This would suggested that although organisations may be investing substantial resources into the development of BI Systems, the benefits may not be harvested if the BI Systems are in fact not adopted and used by the decision makers. As such it is important to gauge the extent to which senior managers within Australian universities are adopting and using their BI Systems.

The next section will now provide a model which can be used to measure BI System usage. This model will provide an indication as to the extent to which senior managers within Australian universities use their BI Systems. Having measured the extent of BI System usage, the relationship to the quality of strategic decision making will then be assessed.

2.7 Information Technology Adoption Theory and Models and Business Intelligence System

As was discussed in the previous section, BI Systems are effective only when delivering intelligence and insights to support strategic decision making, if senior managers making strategic decisions use the BI System (Popovic et al 2012). It is therefore important to get an understanding of what factors influence BI System adoption and use and how this may be measured. In this section models for measuring IT system (i.e. BI System) adoption and usage are discussed.

2.7.1 Models of IT Acceptance

IT acceptance research has yielded many competing models to gauge the acceptance and use of a technology within an organisation. An example of an early model was that of Rogers (1995) who defined the Theory of Innovation Diffusion (Rogers, 1995) as a framework for IT adoption. Subsequent work by Venkatesh et al (2003) reviewed and empirically compared eight prominent models of IT acceptance to develop a hybrid model they called the Unified Theory of Acceptance and Use of Technology (UTAUT). These eight major models, which are still used to gauge IT system user acceptance, have been summarised in Table 2-1 to provide an overview of the literature in this field.

Table 2-1: Models and Theories of Individual Acceptance of IT systems (Adapted from: Venkatesh et al, 2003)

Theory	Core Constructs
Theory of Reasoned Action (TRA) Grounded in social psychology theory is used to predict a range of human behaviours. Davis et al (1989) adopted TRA to measure human behaviour in relation to technology adoption.	Attitude Towards Behaviour Subjective Norm
Technology Acceptance Model (TAM) Developed by Venkatesh and Davis (2000), TAM is designed specific for IT acceptance and usage. The model which utilises aspects of TRA but excludes the attitude construct.	Perceived Usefulness Perceived Ease of Use Subjective Norm
Motivational Model (MM) Based on research in psychology regarding intrinsic and extrinsic motivators. Davis et al (1992) adopted this model for technology adoption and use.	Extrinsic Motivation Intrinsic Motivation
Theory of Planned Behaviour (TPB) An expansion of TRA through the addition of a construct focused on perceived behavioural control to determine of intention and behaviour.	Attitude Towards Behaviour Subjective Norm Perceived Behavioural Control
Combined TAM and TPB Taylor and Tod (1995) developed a hybrid model of TAM and TPB.	Attitude Towards Behaviour Subjective Norm Perceived Behavioural Control Perceived Usefulness
Model of PC Utilisation (MPCU) Based on Triandis' (1977) theory of human behaviour. Thompson et al (1991) adapted and refined this Triandis' theory to predict PC utilisation.	Job Fit Complexity Long-term Consequences Affect Towards Use Social factors Facilitating Conditions
Innovation Diffusion Theory (IDT) As explained by Rogers (1995) IDT is based in sociology theory. But was adopted by Moore and Benbasat (1991) to determine individual technology acceptance.	Relative advantage Ease of Use Image Visibility Compatibility Results Demonstrability Voluntariness of Use
Social Cognitive Theory (SCT) Compeau and Higgins (1995) applied the SCT to computer utilisation	Outcomes Expectations – Performance Outcomes Expectations – Personal Self-efficacy Affect Anxiety

2.7.2 Development of the Unified Theory of Acceptance and Use of Technology (UTAUT) Model for IT Adoption

Venkatesh et al (2003) argued that the basic concept underlying user adoption of IT is based on the initial reaction of the individual to the new IT system, which has an impact on the intention to use the technology and the actual use. In addition to this, they concluded that four key constructs could be identified across the eight models, and these four constructs could be used as significant determinants of user acceptance and behaviour. These are:

a) **Performance Expectancy** – The degree to which an individual believes that using the system will help him/her improve their job performance. This construct was identified as the most significant predictor of intention to use the system;

b) **Effort Expectancy** – The degree to which employees feel the system will be easy to use;

c) **Social Influence** – The degree to which an employee believes that important others believe he or she should use the system; and

d) **Facilitating Conditions** – The degree to which an employee believes that organisational and technical infrastructure exists to support his or her use of the system.

Figure 2-1, adopted from Venkatesh et al (2003), presents the research model developed through their study:

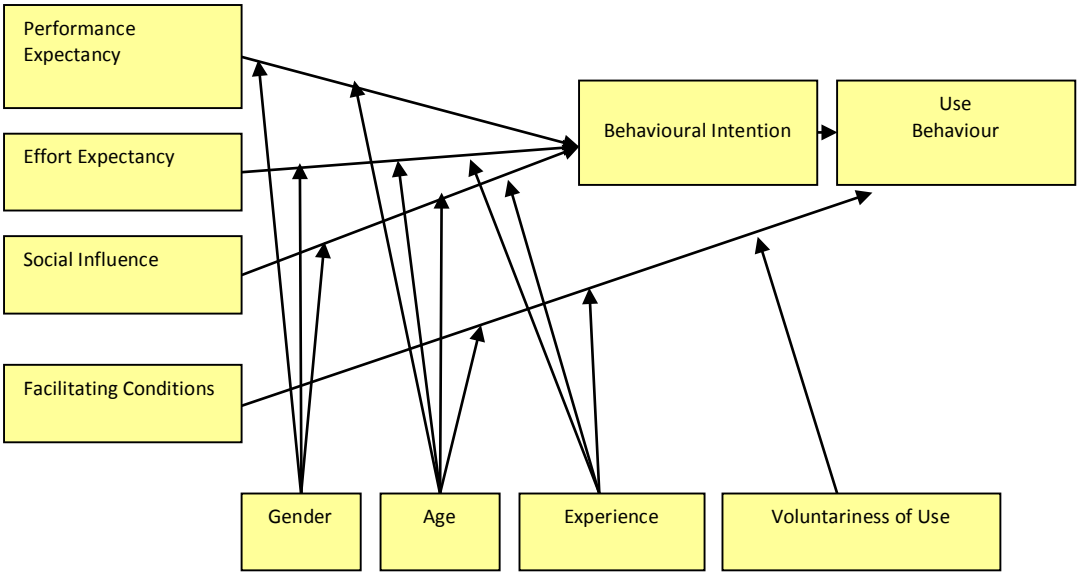


Figure 2-1: UTAUT Model, Venkatesh et al (2003)

Venkatesh et al (2003) also presented four moderating variables in the UTAUT Model which include gender, age and experience of the employees, as well as the level at which use was voluntary.

However, subsequent research by Venkatesh et al (2008) suggested that an alternative model would provide an improved predictor of IT system usage. IT System usage was defined using three commonly employed constructs of duration, frequency and intensity. Capitalising on earlier work, they suggested that IT system usage could be better predicted using behavioural intentions and facilitating conditions (from UTAUT) and behavioural expectations as related concepts (as outlined in Figure 2-2). Furthermore, Venkatesh et al (2003) demonstrated how each of these three concepts plays different roles on usage as measured through duration, frequency and intensity. This has led to the improved model presented in Figure 2-2:

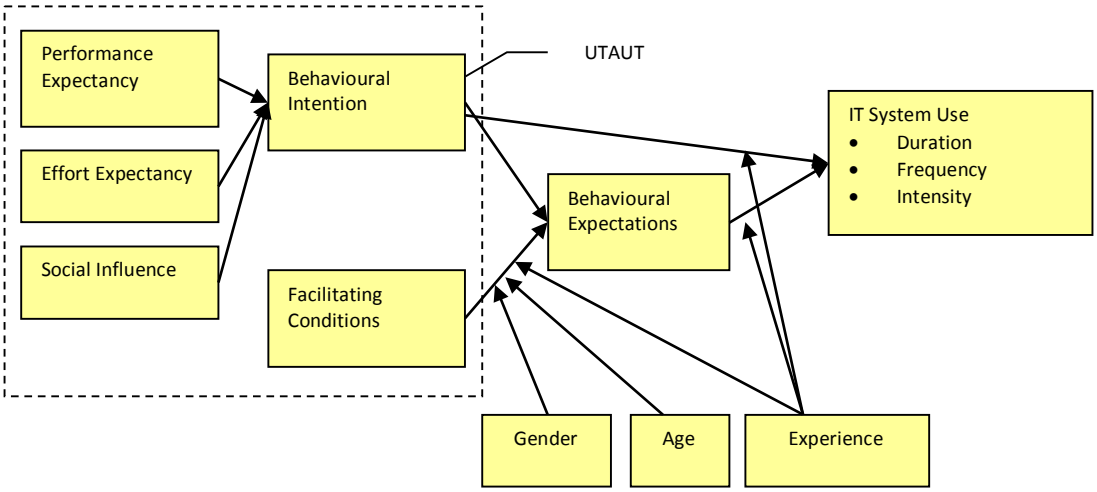


Figure 2-2: Improved UTAUT Model, Venkatesh et al (2008)

Warshaw and Davies (1985) defined behavioural expectations as the individual's self-reported probability of performing a specific behaviour. As such Venkatesh et al (2008) proposed that this construct could overcome some of the limitations identified in their UTAUT model relating to behavioural intention and facilitating conditions. Gender, age and experience were still considered as moderating variables in this model. This study adopted the model suggested by Venkatesh et al (2008) for measuring BI System usage by strategic decision makers. Thus to gauge or predict system usage, the users' perceptions regarding their behavioural intentions and behavioural expectations must first be measured/understood/explored, this in turn can then be used as a predictor of system usage.

However, other factors may also play a role in determining if a BI System is adopted. Given the important role information plays, as previously discussed, the quality of information and also the quality of the BI system need to be considered as potential factors which may influence BI system usage.

2.7.3 Quality of Information and BI System as influencers on BI System usage

Although the UTAUT model provides for a measure of predicting BI System usage, this study examined the impact that quality of information and quality of the BI System have on usage. These two concepts were explored as they were thought to have a potentially significant impact on BI System usage given that BI Systems deliver information for decision making and the importance of information to the decision making process.

A number of studies explored the importance of information and system quality as it relates to user satisfaction with the information systems. However, little research was found relating to BI System use, and thus this study. Yeoh, Koronios and Gao (2011) established the importance of data quality in their study which examined critical success factors in BI System development. In addition, Alshawi, Missi and Irani (2011) examined the factors influencing Customer Relationship Management system adoption. Whilst Nelson, Todd and Wixon (2005) examined the relationship between information and system quality and user satisfaction with data warehouse technologies. Focusing on developing a model which established measures for information and system quality, this study concluded that in relation to information quality, accuracy was the most dominant factor, whilst reliability was the dominant factor for system quality. Gorla, Somers and Wong (2010) explored to what extent system, information and service quality influenced organisational outcomes and found that these dimensions had a significant and positive influence on organisational outcomes.

Although the above does not present an exhaustive list of studies focussing on information and system quality, they closely related to the focus of this study. They also suggest information and system quality are of significant interest, and as such these two constructs have been included in the research model of this study to explore if they positively influence BI System usage.

Given the preceding review of the literature, the research questions for this study were formulated to provide a focus for the development of the research model and the hypothesis which will be further developed in Chapter 4.

2.8 Research Questions

The purpose of this section is to present the research questions this study aimed to explore. Chapter 1 had previously introduced a series of research questions which were explored in this study. The research questions were based on a research model developed from the literature reviewed in this Chapter. The following discussion contextualises the research model used herein against the extant literature.

A review of literature suggested the mere existence of a BI System does not necessarily result in the realisation of actual benefits in decision making. For a BI System to be truly effective, those making strategic decisions must use the information from within the system. This was what Rogers (1995) argued for in their diffusion of innovation theory, which posited more generally that information systems only deliver fully on their benefits if the technology is adopted into the day to day operations of the organisation. Given that BI systems are a subset of information systems, one might conclude that Rogers' theory must applies to it. As a result, it could be argued only when a BI System is adopted as part of the strategic decision making process that benefits can be fully realised. Extrapolating on this idea, this study examined the degree to which strategic decision makers, within the University context, perceived BI System as a means to enhance strategic decision quality. Specific questions arose from this, which included:

1. How the adoption of BI Systems influenced the perceptions associated with the quality of strategic decisions in Australian universities?

2. How does the diversity of a decision making team, the use of a defined decision making process and the use of information in decision making influence the quality of strategic decisions in Australian universities?

3. Is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008), useable as a predictive model for BI System use?

To answer these three research questions, a research model was developed grounded in the insights gained from the literature review. This research model then allowed for the development of associated hypotheses, discussed in Chapter 4, which could be empirically tested.

2.9 Research Model

Based on the preceding review of the literature, the research model presented in Figure 2-3, was developed for this study. The model posits that if strategic decision makers have positive behavioural intentions, and positive behavioural expectations, then this will result in increased BI System usage. Both the impact of the quality of information and the quality of the tool, i.e. BI System, on BI System usage have been included as controlling variables in the model.

BI System usage was proposed to positively influence the perceptions of the quality of strategic decisions. The model also incorporated the three variables suggested by Wood and Klass (2008) of Sensemaking (information in decision making), Architecture (decision making process) and Team Capital (diversity and capability of decision making team). It was thus proposed that the quality of strategic decisions can also be affected by the diversity of the strategic decision making team and its capabilities, the use of information in decision making, and the use of a structured decision making process. It was conceptualised that collectively these concepts would have a positive influence on the perceived quality of strategic decisions.

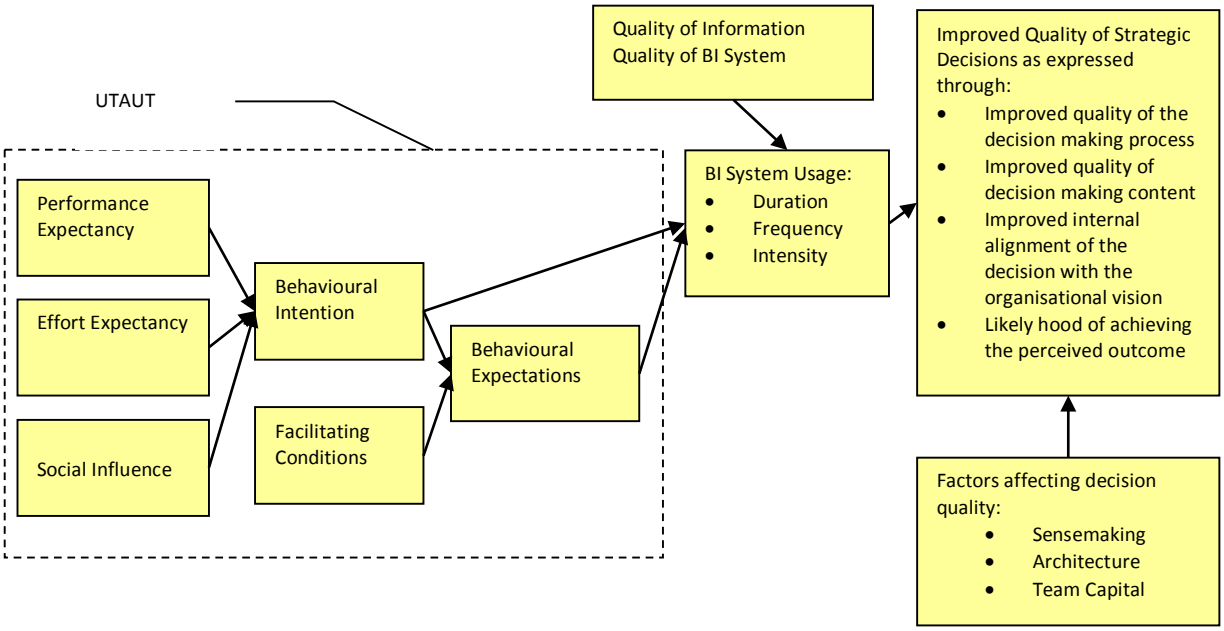


Figure 2-3: Research Model

2.10 Summary

The literature review established the importance of good quality strategic decision making in a complex and dynamic higher education environment. Increased competition in the market, disruptive technologies, unstable regulatory environment and reduced financial sustainability were outlined as key challenges impacting the higher education sector. The use of BI Systems in universities to support decision making was discussed. This led to the question as to whether strategic decision makers were in fact fully utilising BI Systems and the associated information which they provided in their strategic decision making. This presented the key focus for this study.

The literature review also highlighted strategic decision making was a complex issue. Evidence of this were the many divergent views around process and factors influencing both the process of decision making and the decision outcomes. In reviewing the literature, it was established that information, in particular business intelligence, is an important part of the strategic decision making process. However, little research was found which explored the role of information in strategic decision making.

The important role of BI Systems to disseminate business intelligence to senior managers for the purpose of strategic decision making was highlighted, and an argument formulated highlighting the availability of a BI System alone does not ensure its use. This lead to an overview of a number of IT adoption theories and models which were reviewed to enable the development of a model which could be used for measuring BI System adoption and usage.

Understanding what constitutes a good quality strategic decision, and how good quality decision making could be measured, was an important concept which was explored in detail. Team diversity, a quality decision making process, alignment to vision, and perceptions relating to achieving desired outcomes were identified as key concepts to be explored in this study and they were used to define what is

conceptualised as a quality strategic decision for the purposes this study. Other factors were also identified which positively influenced strategic decision making. Here, the three concepts proposed by Wood and Klass (2008), specifically Sensemaking (information in decision making), Architecture (decision making process) and Team Capital (capability of decision making team) were introduced.

The review of literature has provided this study with the grounding to develop a research model which was tested using the research methodology described in Chapter 3.

3 Research Method and Design

3.1 Introduction

The literature review raised three research questions which provided the focus for this study:

1. How the adoption of BI Systems influenced the perceptions associated with the quality of strategic decisions in Australian universities?

2. How does the diversity of a decision making team, the use of a defined decision making process and the use of information in decision making influence the quality of strategic decisions in Australian universities?

3. Is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008), useable as a predictive model for BI System use?

This Chapter provides an overview of the research methodology and design, collection and analysis methods used, to address the hypotheses of this study and answer the above research questions.

This study adopted a positivist paradigm utilising a quantitative research methodology. An online survey was undertaken to measure the perceptions of senior managers in Australian Universities, in relation to the use of their BI System and the perceived quality of strategic decision making.

The research paradigm, ontology, epistemology and methodology are discussed in detail throughout this Chapter. An overview of the quantitative research design and process is provided, including a description of sample selection, the pilot study, data collection and data analysis methods, including testing of both the measures and the structural model.

3.2 Research Paradigm

Guba and Lincoln (1994) argued that the choice of method should be secondary to the choice of research paradigm. Denzin and Lincoln (2000) explained that alternative enquiry paradigms exist, which allow the researcher to select the most appropriate world-view for their research study. These alternatives, according to Creswell (1998), can be defined using the following assumptions:

- Nature of reality (ontological assumption);
- Relationship of the researcher to that being researched (epistemological assumption); and
- Process for research (methodological assumption).

Table 3-1 adopted from Denzin and Lincoln (2000), provides an overview of these alternative research paradigms as they relate to the ontological, epistemological and methodological assumptions:

Table 3-1: Basic Beliefs of Alternative Enquiry Paradigms (Adapted from: Denzin and Lincoln (2000, 165)

	Positivism	***Post-positivism***	***Critical Theory***	***Constructivism***	***Participatory***
Ontology	Naïve realism – "real" reality but apprehendable	Critical realism – "real" reality but only imperfectly and probabilistically apprehendable	Historical realism – virtual reality, shaped by social, political, cultural, economic, ethnic, and gender values; crystallised over time	Relativism – local and specific constructed realities	Participative reality – subjective=objective reality, co-created by mind and given cosmos
Epistemology	Dualist/ objectivist; findings true	Modified dualist/ objectivist; critical traditional/ community; findings probably true	Transactional/ subjectivist; value-mediated findings	Transactional/ subjectivist/ created findings	Critical subjectivity in participatory transaction with cosmos; extended epistemology of experiential, propositional and practical knowing; co-created findings
Methodology	Experimental/ manipulative; verification of hypotheses; chiefly quantitative methods	Modified experimental/ manipulative; critical multiplism; falsification of hypotheses; may include qualitative methods	Dialogical/ dialectical	Hermeneutical dialectical	Political participation in collaborative action enquiry; primacy of practical; use of language grounded in shared experiential context

The ontological, epistemological, and methodological choices made are now discussed in relation to this study.

3.2.1 Ontological Choice

Ontology, which is defined as the nature of reality, is explained as differing between the two extremes. At one end of the continuum lies a positivist paradigm, while at the other a constructivists. For example, outline the positivist's world-view as a

"Single tangible reality "out there" fragmentable into independent variables and process, any of which can be studied independently of the others; inquiry can converge onto that reality until, finally, it can be predicted and controlled" (Guba and Lincoln 1985, 37).

This is echoed closely by Elshafie (2013, 5), who explains that the ontological choice of a positivist's paradigm is one of realism, that is *"one tangible reality exists out there and can be studied independently with prediction and control".*

Conversely, the constructivist world-view assumes the existence of multiple realities.

"Studied only holistically; inquiry into these multiple realities will inevitably diverge (this means each inquiry raises more questions than it answers) so that prediction and control are unlikely outcomes although some level of understanding (verstehen) can be achieved controlled" (Guba and Lincoln 1985, 37).

In selecting the most appropriate paradigm for this study, consideration was given to the nature of reality. Other studies in this area have utilised positivist paradigms, for example see Casey and Wilson (2012); Gorla, Somers and Wong (2010); Im and Kang (2011); and Venkatesh et al (2008). The research questions raised in this study, and the research model presented herein, have outlined constructs for which a single objective reality appears to exist, one which can be measured. As a result, this study was conducted using a realist ontology, under the positivist paradigm.

3.2.2 Epistemological Choice

Further to the above, the epistemology defines the relationship between the researcher and that being researched.

"The qualitative researcher interacts with those they study, whether this interaction assumes the form of living with or observing informants over prolonged period of time or actual collaboration" (Creswell 1998, 76).

Under the constructivist ontology, the epistemological assumption is one of interpretivism. Denzin and Lincoln (2000) explained that from an interpretivist's viewpoint, human (social) action is distinguished from movement of physical action in that the human action is inherently meaningful. The researcher must therefore understand the social action and attribute meaning to the action; seemingly interpretivism focuses on finding meaning or understanding (Verstehen) in what a particular action is trying to say. Whilst in a positivist's ontology the research remains independent from what is being researched, this is not always the case from an interpretivist perspective. Indeed, Cohan, Manion and Morrison (2007) argued the positivist adopts a representational epistemology, and assumed that research subjects know their own reality and can use symbols to accurately describe and this objective reality.

Throughout this study, the researcher remains independent of the subjects being researched, and it is assumed that the subjects being researched are able to understand their own reality and can describe this reality using the variables used in the study and to test the hypotheses developed. As such, the epistemology for this study is one of representation, again in line with the positivist paradigm described earlier.

3.2.3 Methodological Choice

In considering decisions regarding appropriate research methods, Creswell (1998) explains how the methodological choice emerges from the chosen reality,

researcher-research relationship, role of values and rhetoric. Having chosen a positivist paradigm with related ontology and epistemology, the choice of a quantitative research method is appropriate and consistent with the world-view adopted. The study utilised survey research to gather data from research subjects.

3.3 Research Procedure and Method

The major steps in the research process are outlined in Figure 3-1:

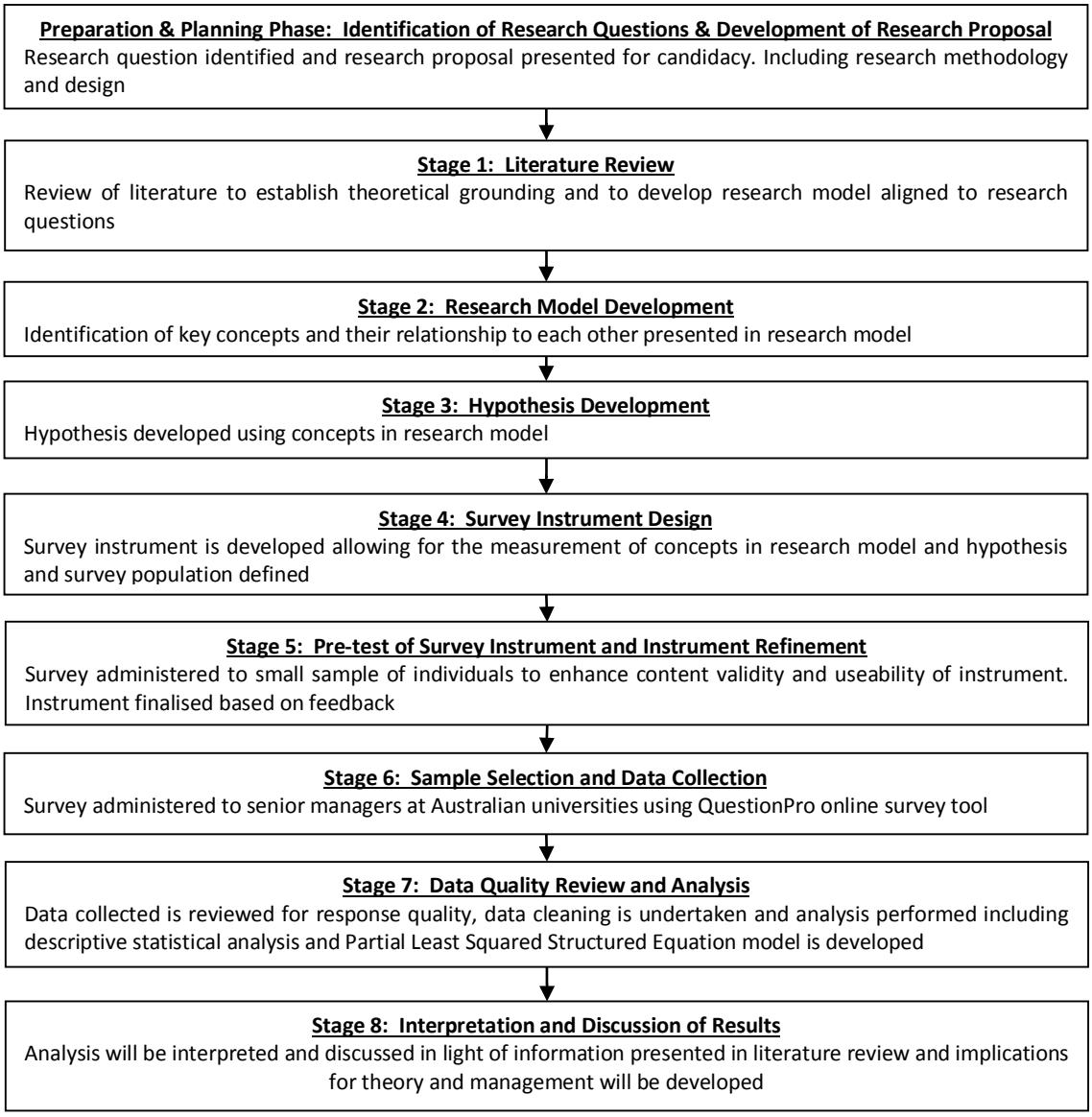


Figure 3-1: Major Steps of the Research Process

An overview of each stage and the outcomes is provided below:

3.3.1 Preparation & Planning Phase: Identification of Research Questions & Development of Research Proposal

A review of literature was undertaken to develop an understanding of the existing theory and research pertaining to this study. This led to the formulation of a series of research questions investigating the use of BI Systems by senior managers in the Australian university sector. A research proposal was drafted that outlined the research study, and described how it would be conducted. A series of research questions and the research model, as presented in Chapter 2, were then developed. The initial research proposal was presented academic staff at the Curtin University Graduate School of Business, and feedback provided during the candidacy presentation, was used to refine the approach to the study.

3.3.2 Stage 1: Literature Review

A literature review serves multiple purposes, from contextualising what is known, identifying gaps and establishing scope.

- *" provides a historical background for the research;*
- *gives an overview of the current context in which the research is situated by referring to contemporary debates, issues and questions in the field;*
- *includes a discussion of relevant theories and concepts which underpin the research;*
- *introduces relevant terminology and provides definitions to clarity how terms are being used in the context of the research;*

- *describes related research in the field and demonstrates how the research extends or challenges this, or addresses a gap in work in the field;*

- *provides supporting evidence for a practical problem or issue which the research is addressing, thereby underlining its significance"* (Ridley 2008, 16-17).

Literature relevant and significant to this study was reviewed to develop insights and understanding. The review highlighted three key research questions and provided a grounding for the development of the research model and hypotheses. In addition, this aided the interpretation of the findings of the analysis and development of the discussion and conclusions. The literature review focused on journals, books, conference papers and other available material related to strategic decision making and the decision making process, measuring and defining what is considered a quality strategic decision, the role of BI in strategic decision making, and IT system, particularly BI System, adoption and use.

3.3.3 Stage 2: Research Model Development

Utilising the insights and understanding gained during the literature review, a research model was developed. This research model, as described in Chapter 2, outlined the relationships between the various concepts this study focused on, specifically the relationship between the BI System usage and strategic decision making quality. The model also articulated concepts which may have a moderating impact on the above relationship, such as the quality of the BI System, information quality, decision making process and team. The research model provides the framework for the development of hypotheses, the variables/questions of the survey instrument, as well as a framework for the analysis of the data collected.

3.3.4 Stage 3: Hypothesis Development

Using the research model and insights gained from the literature review, a series of hypotheses were developed. These hypotheses provided a more refined breakdown, using measurable concepts, to the research questions which stimulated the need for this study.

3.3.5 Stage 4: Survey Instrument Design

The survey instrument was developed allowing for the measurement of concepts in research model and hypotheses. Survey questions related to BI System adoption and usage were adapted from the research conducted by Venkatesh et al (2008). Questions related to strategic decision making process and quality of strategic decision making were developed from the theories and discussion outlined in the literature review. Further detail on the measures related to concepts, scales and their link to literature review are provided in Chapter 4. The survey instrument was scripted using the online survey tool QuestionPro.

3.3.6 Stage 5: Pre-test of Survey Instrument and Instrument Refinement

Pre-testing an online survey instrument is a critical step to ensuring enhanced response rates and improved data quality. Fan and Yan (2010) found the response rate to online surveys was influenced negatively if the survey is lengthy, poorly formatted, or has poor logic. They argued best practice occurs when online surveys are piloted with a small group of respondents who complete the survey and provide feedback on the experience. Prior to the launch of the online survey used to conduct this study, a pre-test was conducted. To facilitate this pre-test a convenience sample was used to select a small group of individuals from the population list. This sample included senior managers from Curtin University, the University of Western Australia, University of Technology Sydney and Royal Melbourne Institute of Technology (RMIT). It was considered important the convenience sample was stratified to

include different locations to test the online survey tool for potential technical issues for those participants who accessed the survey from outside the realm of the host IT environment. A total of 30 invitations were sent to senior managers in Australian universities and 15 respondents provided feedback. While the survey was positively received, seven participants suggested improvements. This pre-test of the instrument was designed to highlight any issues related to survey administration, such as online availability from different locations, survey structure and flow, time to complete, ability to understand questions and to identify any issues related to the interpretation of survey questions. The individuals who tested the instrument were invited to complete the survey online and then to provide feedback based on a series of questions. Feedback received was considered and appropriate adjustments made to the instrument. Chapter 4 provides a more detailed discussion of the outcomes of the Pre-Test exercise.

3.3.7 Stage 6: Sample Selection and Data Collection

The sample for this study consisted of senior managers in Australian universities. Senior managers, for this study were defined as individuals in universities who have management responsibilities for a strategic business unit (e.g. a Faculty or School), or those with executive responsibilities at a university-wide level (e.g. Vice-Chancellors, Deputy Vice-Chancellors, Vice Presidents, Pro-Vice Chancellors, Executive Directors and General Managers). These individuals were considered the most likely users of BI Systems for strategic decision making within a university context, as discussed in the literature review.

An email was sent inviting senior managers at Australian universities (n=612) to complete the online survey. To enhance the survey response rate, an incentive of a small donation to a charity was promised for each completed survey. In addition, a follow up email was also sent to remind individuals of the survey two weeks after the initial invitation. Appendix A contains samples of the original and reminder emails.

To further optimise response rates, bounce back emails were monitored to identify where delivery failed. Alternative contact details from “out of office” emails were then used to ensure the intended or an alternative recipient received the invitation. In total, 26 bounce back emails were received, of which six were unable to be resolved.

The mailing list contained 612 individuals and a total of 272 responses were received. A screening question was included to select only those respondents who worked in a university with a BI System. Those respondents who indicated they did not have a BI System at their university, were asked to complete a separate version of the survey which asked them to provide responses based on their perception of what it would be like to have a BI System. These were not analysed for this study as sufficient responses were received from those respondents who worked at BI System using universities. Of the 272 responses, 196 respondents indicated their university had a BI System, or a response rate of 32.3%. A minimum sample size between 100 and 150 responses is required for structured equation modelling according to Ding, Velicer and Harlow (2009). This study therefore achieved well beyond this minimum and can be considered usable for drawing conclusions related to the hypotheses.

3.3.8 Stage 7: Data Quality Review

Responses received and data collected were reviewed for non-response bias, invalid responses and missing values. Figure 3-2 outlines the data cleansing and quality review process.

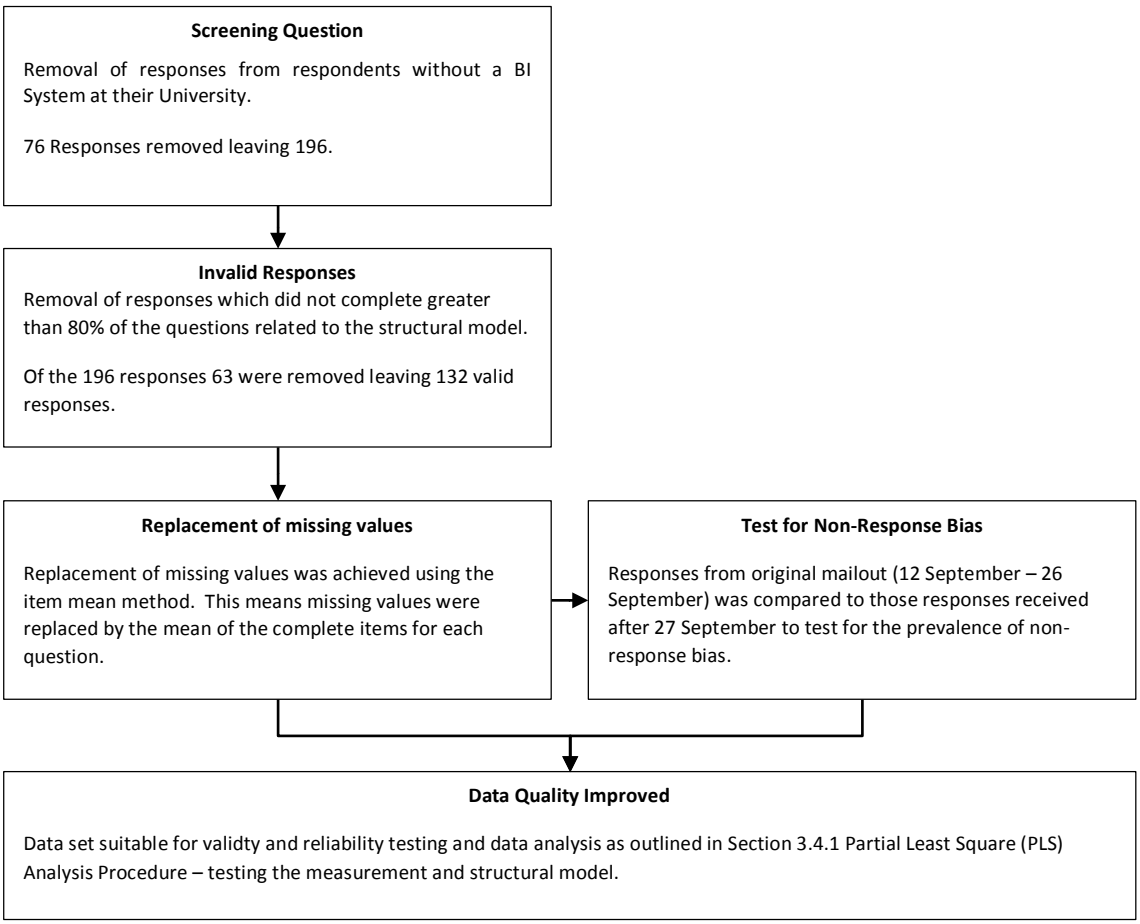


Figure 3-2: Response and Data Quality Review Process

3.3.8.1 Invalid Responses and Treatment of Missing Values

As previously discussed, a screening question ensured that the data being examined was from respondents who indicated their university had developed a BI System. These responses were then reviewed for completeness and missing values, participants not responding sufficient number of questions, and not responding to individual question/s. In their study, Downey and King (1998) concluded that missing

values could be effectively dealt with by replacing the missing value with either the item mean or person mean if in the number of respondents with missing data and the number of items missing was 20 per cent or less. Using the item mean method, they argued it is acceptable to replace the missing value with the mean of the responses which were received for a given item. The responses for this study were examined and any response which had more than 12 items missing, using Downey and King's 20 per cent rule were discarded, in this case 12 or more items. This process reduced the number of responses from 197 to 132 responses. For these remaining 132 responses, missing values were then replaced using the item mean method. The software used for the PLS-SEM, SmartPLS provided the functionality to perform this as and when data was imported.

3.3.8.2 Test for Non-response Bias

Non-response bias is concerned with the difference between results of those who responded to the survey compared to those who did not (Cascio 2012). Lambert and Harrington (1990) provided a procedure for testing for non-response bias which compared the results of those respondents who completed the survey during the early phase of a survey process compared to the results of those who responded later. For this study, testing for non-response bias was achieved by comparing responses from the first two weeks of the survey process to those responses received after the reminder email was sent. Before non-response bias testing was conducted, responses with missing vales were removed, as outlined in 3.3.8.1. To test for non-response bias, the statistical differences between the two response data sets were compared across 20 per cent of the questions related to the research model, randomly selected, along with the demographic variables. The statistical testing involved comparing the means of responses and then examining the outcomes of a t-test performed on the two data sets. Section 5.2.1 in Chapter 5 presents the results of the non-response bias testing.

3.3.9 Stage 7 (continued): Data Analysis

Descriptive statistics provided an overview of the responses profile. Partial Least Squared (PLS) Structured Equation modelling was conducted using the research model as a framework. The measurement model and structural model were tested for validity and reliability. To facilitate the PLS Structured Equation modelling a software page called SmartPLS was used (https://www.smartpls.com/). The analysis allowed for the testing of hypotheses. Section 3.4 Data Analysis provides a more detailed overview of the analysis tools utilised for this study.

3.3.10 Stage 8: Interpretation and Discussion of Results

Finally, the analysis was interpreted and discussed in light of information presented in the literature review and hypotheses and implications for theory and management were developed. Having described the research methodology and process for this study this Chapter now takes a more detailed look at the data analysis used.

3.4 Data Analysis

To demonstrate the relationships which exist in the research model data were analysed using Structured Equation modelling (SEM). It is important to understand why this statistical technique was chosen. Gefen et al (2011) explained how SEM is the preferred method when analysing path diagrams when latent variables (constructs in the case of this study) with multiple indicators (measures in the case of this study) are present. Latent variables, usually perception based, can only be measured indirectly, for example through the use of a variety of questions with the answers being expressed through a measurement scale, as done in a survey. The research model presented in Chapter 2 outlines the latent variables or constructs used in this study, with the associated measures defined in detail in Chapter 4.

When using SEM, two statistical analysis techniques present themselves, covariance-based (CB) SEM and variance-based partial least squares (PLS) SEM (Gefen, Rigdon and Straub, 2011; Hair, Ringle and Sarstedt, 2012). The two methods present some differences and their use is situation dependent. Hair, Ringle and Sarstedt (2012) contrast the two approaches by explaining that:

"CB-SEM is a confirmatory approach that focuses on the model's theoretically established relationships and aims at minimizing the difference between the model's implied covariance matrix and the sample covariance matrix. In contrast, PLS-SEM is a prediction-oriented variance-based approach that focuses on endogenous target constructs in the model and aims at maximizing their explained variance (i.e. their R-Squared value)" (Hair, Ringle and Sarstedt, 2012 312).

In other words, PLS-SEM is an appropriate statistical method for analysing situations where the focus is on predicting and explaining variations in key constructs caused by other constructs (Hair, Ringle and Sarstedt 2012; Hulland 1999). In the context of this study, would be the variations in perceived quality of strategic decision making which are caused by the use of the BI system. Hair, Ringle and Sarstedt (2012) found

PLS-SEM has the additional benefit of being able to work with small sample sizes, as is the case in this study with 132 valid responses.

PLS-SEM was the most appropriate data analysis approach for this study as it uses latent variables or constructs, each measured through multiple measures. PLS-SEM provided a prediction and explanation of the variations in constructs caused by other constructs. Furthermore, as this study is more applied and exploratory in nature, with a focus of providing insights relating to the impact BI Systems are having on the quality of strategic decision making, PLS-SEM modelling was chosen as the most appropriate technique. Had the research model used in this study been constructed to formally test existing theoretical models, CB-SEM would have been the more appropriate method (Gefen, Rigdon and Straub 2011).

To facilitate the analysis of the data, SmartPLS was used. At the time of analysis, SmartPLS was considered to be one of the leading software packages for PLS-SEM. The software allows for the calculation of standard regression weights between constructs, and individual measure reliability through factor loadings of the measures onto each construct, as well as correlation coefficients to explain the percentage variance between constructs. SmartPLS also provides significance testing capabilities and t-statistics can be generated to establish the level of statistical significance between constructs which allows for mediation testing to determine direct and indirect effects between dependent, independent and mediating variables. A more detailed overview of the PLS-SEM analysis procedure is presented below.

3.4.1 Partial Least Square (PLS) Analysis Procedure – Testing the measurement and structural model

Before the relationships between constructs in the research model could be described, it was necessary to ascertain the validity and reliability of the

measurements taken. This was to ascertain whether the measures which provided the data for each of the constructs, adequately represented the concept in question.

The following statistical testing was undertaken to test the measurement and structural model. Hulland (1999) explained how PLS-SEM can assess both links between measures and their assigned constructs, i.e. loadings or simple correlations, and the links between different constructs, i.e. path coefficients. To test the PLS-SEM model, the structural model is analysed and interpreted through a two-step process (Santosa, Wei and Chan, 2005):

1) Step One – Assessment of the measurement model for reliability and validity

    a. Assessed by examining the individual item reliability, the convergent and discriminant validity of the measures associated with individual constructs (Hulland, 1999; Santosa, Wei and Chan, 2005).

2) Step Two – Assessment of the structural model

    a. Assessed by examining relationships between constructs in the research model by establishing path coefficients. This provides an indication of the nature of the relationship between constructs (either positive relationship or negative) and the adequacy of the research model (Hulland 1999; Santosa, Wei and Chan 2005).

3.4.1.1 Step One – Assessment of the reliability and validity of the measurement model

Before the research model was used to explain the relationships that exist between constructs and to test the hypotheses presented in this study, the measurement model was tested using the following statistical techniques for reliability and construct validity. Figure 3-3 outlines the process followed (Hulland 1999; Santosa, Wei and Chan 2005):

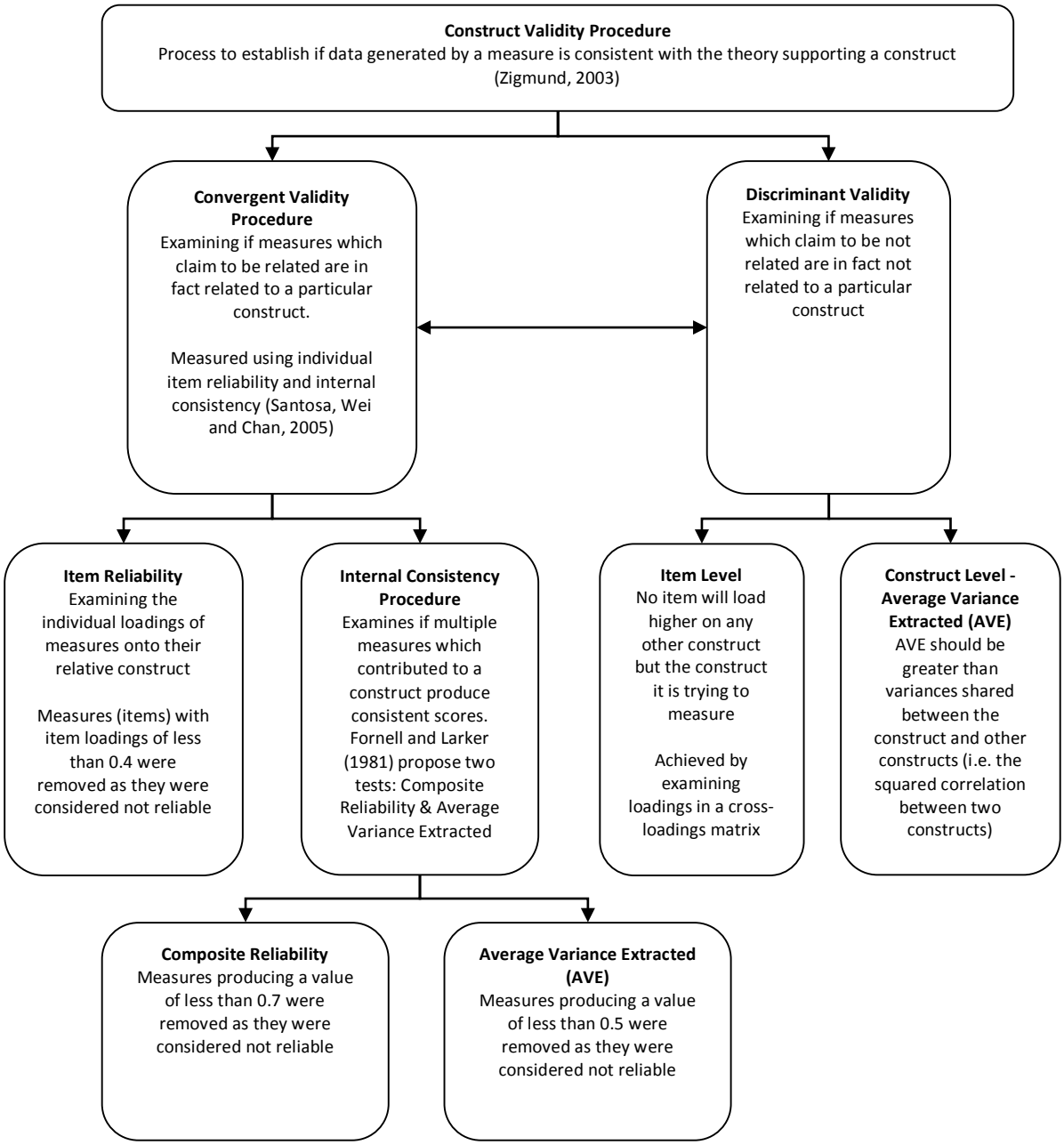


Figure 3-3: Major Steps of the Research Process

Construct Validity Procedure – Testing for Convergent Validity and Discriminant Validity

Construct validity demonstrates the measure being used is a valid measure of the theory which grounds the construct they propose to measure (Hulland 1999; Zikmund 2003). In simple terms, convergent validity demonstrates that measures which claimed to be related are, in fact, related; while discriminant validity demonstrates those measures which are not related are not related. Achieving both convergent and discriminant validity demonstrates that construct validity exists (Santosa, Wei and Chan 2005).

Convergent Validity

Convergent validity is measured through individual item reliability and internal consistency:

Individual Item Reliability Test

Using PLS-SEM, the reliability of the individual measures which make up the construct were tested. This was achieved by examining the individual loadings of measures onto their relative construct (Santosa, Wei and Chan 2005). These loadings were presented as simple correlations. These correlations of individual items onto the construct provided a measure of the strength of the measure. Hulland (1999) explained how many researchers, when undertaking a correlation analysis, will not accept items with loadings less than 0.7. A variety of factors cause low loadings. For example, poor item wording can lead to poor reliability outcomes; an item being inappropriate for the concept leading to poor construct validity; or the item improperly being transferred from one context to another resulting in poor generalizability of the item across contexts/settings. However, he also explains, that it is not unusual to have several items below 0.7 when new items or scales are used. He explained as a general rule, when using PLS-SEM items loadings less than 0.4 should be removed from the analysis. Items with

loadings of less than 0.4 were removed from this analysis to strengthen the reliability of the measurement model.

Internal Consistency

Internal consistency tests if multiple measures, which contributed to a construct, produce consistent scores. To assess internal consistency, this study has adopted the measure developed by Fornell and Larker (1981) who explained how traditional t-test and a chi square tests are problematic for structural equation models. They argued their method is similar to Cronbach's alpha, but unlike Cronbach's alpha, which assumes equal contributions of measures onto a construct, their approach is argued to be superior as it "uses the item loadings estimated within the causal model" (Barclay, Higgins and Thompson 1995, 297), and is independent of the number of items which load onto the construct. The assessment procedure involves testing for Composite Reliability and Average Variance Extracted.

Composite Reliability is calculated as the sum of the loadings, all squared, divided by the sum of the loadings, all squared, plus the sum of the error terms (Barclay, Higgins and Thompson 1995; Fornell and Larker 1981). It is suggested by Barclay, Higgins and Thompson (1995) that a value of 0.7, also used for Cronbach's alpha according to Nunnally (1978), is generally considered an acceptable value.

The second test for internal consistency outlined by Fornell and Larcker (1981) is called Average Variance Extracted (AVE). AVE measures how much of the variance captured by the latent variable in a structural equation model is shared among its measures. For first time studies, it is generally accepted that items returning an AVE above 0.5 should be retained (Hulland 1999). As a result, items which obtained an AVE of less than 0.5 were not considered to be contributing to the internal consistency and were removed for this study.

Discriminant Validity

Hulland (1999) explained the complementary nature of discriminant validity with convergent validity, and defined it as the degree to which measures of one construct are different from those of another construct. To ensure discriminant validity is achieved, constructs should share more variance with its measures than with other constructs in the research model. Discriminant validity is measured at both the item and construct level.

Construct level

At the construct level, Fornell and Larcker (1981) suggested the measure of Average Variance Extracted should be greater than variances shared between the construct and other constructs, i.e. the squared correlation between two constructs. This general rule has been applied to this study. The software package used to undertake the PLS-SEM for this study, SmartPLS, provides the functionality to undertake this test.

Item level

Barclay, Higgins and Thompson (1995) and Hulland (1999) explained that discriminant validity must also be measured at the item level. The test at an item level, achieved through examining cross-loadings, should show that no item loads higher on any other construct, but the construct it is trying to measure. This general rule has been applied to this study. The software package used to undertake the PLS-SEM for this study, SmartPLS, provides the functionality to undertake this test.

3.4.1.2 Step Two – Assessment of Structural Model

The structural model, i.e. the research model, described the relationship between latent constructs in the research model Santosa, Wei and Chan (2005). The relationships being tested were described through the hypotheses presented in Chapter 5.

Santosa, Wei and Chan (2005) explained how the structural model was tested using Bootstrap or Jackknife sampling, through which, path coefficients and related t-values can be obtained. Figure 3-4 presents the structural model used in this study, outlining independent, mediating and dependent variables (constructs).

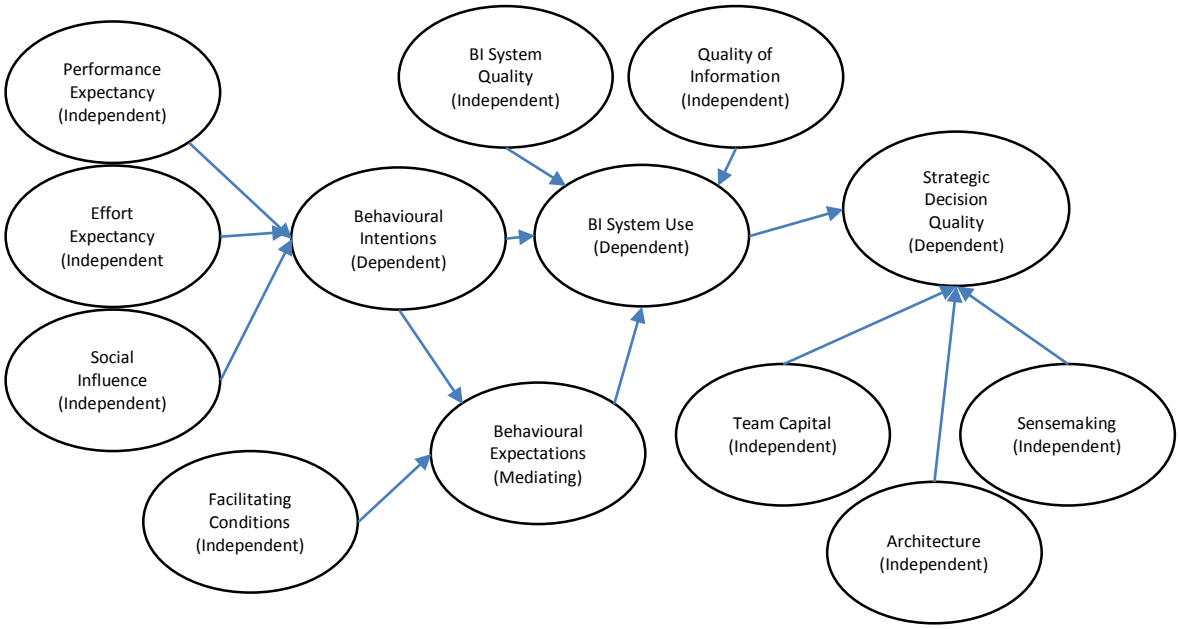


Figure 3-4: Structural Model

The structural model was assessed using PLS-SEM techniques. Barclay, Higgins and Thompson (1995) explained how the relationships between constructs in a research model can be measured using R-Squared values. To test the structural model, R-Squared values were used to show how much of the variance in one latent construct could be explained by the other latent construct, along with the direction (positive or negative) of the relationship between two latent variables. T-statistics were used to test the significance of the path coefficients. This PLS-SEM analysis, and the related bootstrap test, were able to be performed using SmartPLS. As part of the process for testing the structural model, the model was adjusted to enhance the robustness of the model.

3.4.1.3 Mediating Effects

The structural model was also tested for any mediating effects which may exist between constructs. Sobel (1990) explained how a mediating effect is observed when a construct impacts on the relationship between other constructs. Figure 3-5 provides a diagrammatic example of the mediating effect. The relationship is observed between Independent Variable (X) and Dependent Variable (Y) and is expressed as t-value (A). The introduction of the mediating variable (Z) has the effect of mediating the relationship between the Independent Variable (X) and the Dependent Variable (Y) to produce a new t-value (B).

Figure 3-5 outlines the mediating effect mode as outlined by MacKinnon et al (2007).

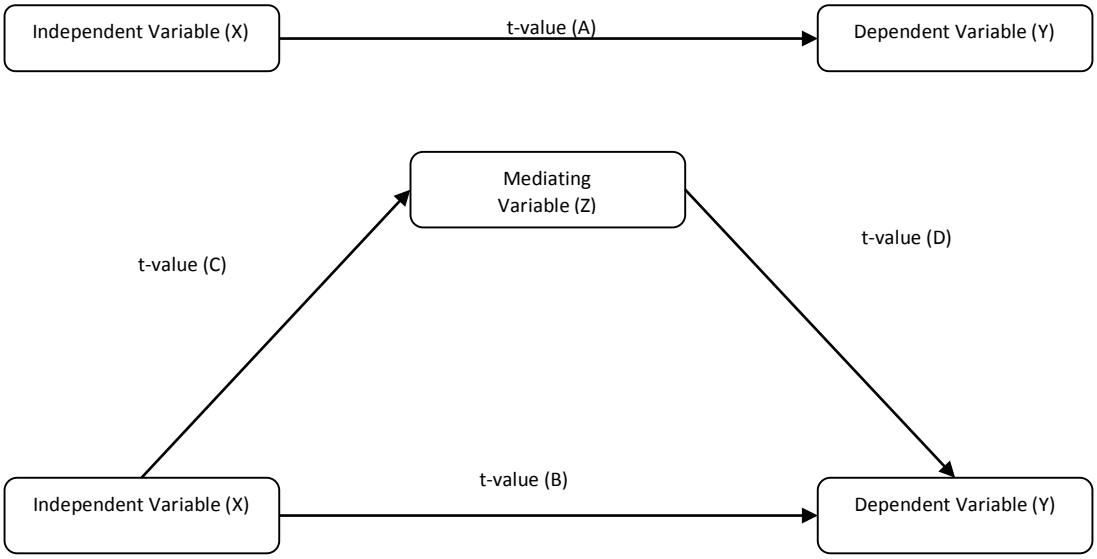


Figure 3-5: Mediation (Adapted from Grapentine, 2000, MacKinnon et al, 2007 and Sobel, 1990)

Hair, Ringle, and Sarstedt (2013) explained how many researchers did not test structural models for mediation and often relationships between two latent constructs were dismissed as not being significant rather than having been impacted by a mediating variable. Furthermore, they suggested most research models are subject to mediating effects. To establish any mediating effects that may exist between latent constructs in the research model, bootstrapping analysis was

undertaken. Grapentine (2002) and Silva et al (2010) explained that mediation can be tested by examining the significance of indirect paths between independent and dependent constructs using the bootstrapping procedure available in the SmartPLS software.

The testing for mediation was described by Baron and Kenny (1986):

> *"(a) the independent variable must have an effect on the dependent variable; (b) the independent variable must have an effect on the intervening variable(s); and (c) intervening variable(s) must affect the outcome, after controlling for the independent variable. To establish full mediation, the total effect of the independent variable on the outcome must become non-significant in the presence of the intervening variable(s), while the indirect effect is significant. Partial mediation is established when the path remains significant but is substantially reduced and the indirect effect is significant"* (Baron and Kenny 1986, as quoted in Silva et al 2010, 595).

Mediation testing was used by this study to enhance the understanding of the relationships being observed in the structural model.

3.5 Summary

This Chapter discussed the rationale for the chosen research paradigm. The research paradigm options available were outlined and contrasted in the context of this study. A positivist paradigm was substantiated as the most appropriate choice of this study given that an objective reality existed which could be measured. The ontology and epistemology for the study were defined, while the methodological choice was outlined to be a quantitative methodology.

Research procedure and method were described in their various parts. This provides an overview of the research process used from the initial identification of the research questions and research proposal, to the literature review that provided the theoretical grounding, and the development of the research model and hypotheses. The research process then continued with the development of the survey instrument, pre-testing of the instrument, data collection, and data quality review and analysis. Testing of the hypotheses to the interpretation and discussion of the results concluded the process.

The data analysis methods used in this study were described. The process of testing the measurement model in terms of reliability and validity were outlined. The rationale for measurement model tolerances in relation to item reliability, composite reliability and average variance extracted were also described. The need for item and construct level discriminant validity tests were explained.

How the structural model was tested, in particular regarding the strength and nature of relationships between constructs, the significance of these relationships, and the use of both PLS-SEM and the Bootstrapping process, was described. A description of how mediating variables, in the structural model, were tested for mediating effects concluded the section of testing the structural model.

Chapter 4 now develops the hypotheses for this study and describes how the research instrument which was developed. This includes an overview of the items

that make up measurement model relative to the constructs in the structural model. The outcomes of the research instrument pre-test are provided next.

4 Hypotheses and Research Instrument Development

4.1 Introduction

This Chapter outlines how the research hypotheses, for the study derived from the research model, are aligned to the research questions. The development of the survey instrument is explained in relation to the research model. The measures/items used to give meaning to the constructs are outlined with reference to the theory and the research discussed in the literature review. The Chapter concludes by presenting the outcomes of the pilot study used to pre-test the survey instrument and survey administration processes.

4.2 Development of Hypotheses

The hypotheses presented in this Chapter have been developed from the constructs presented in the research model (Figure 4-1).

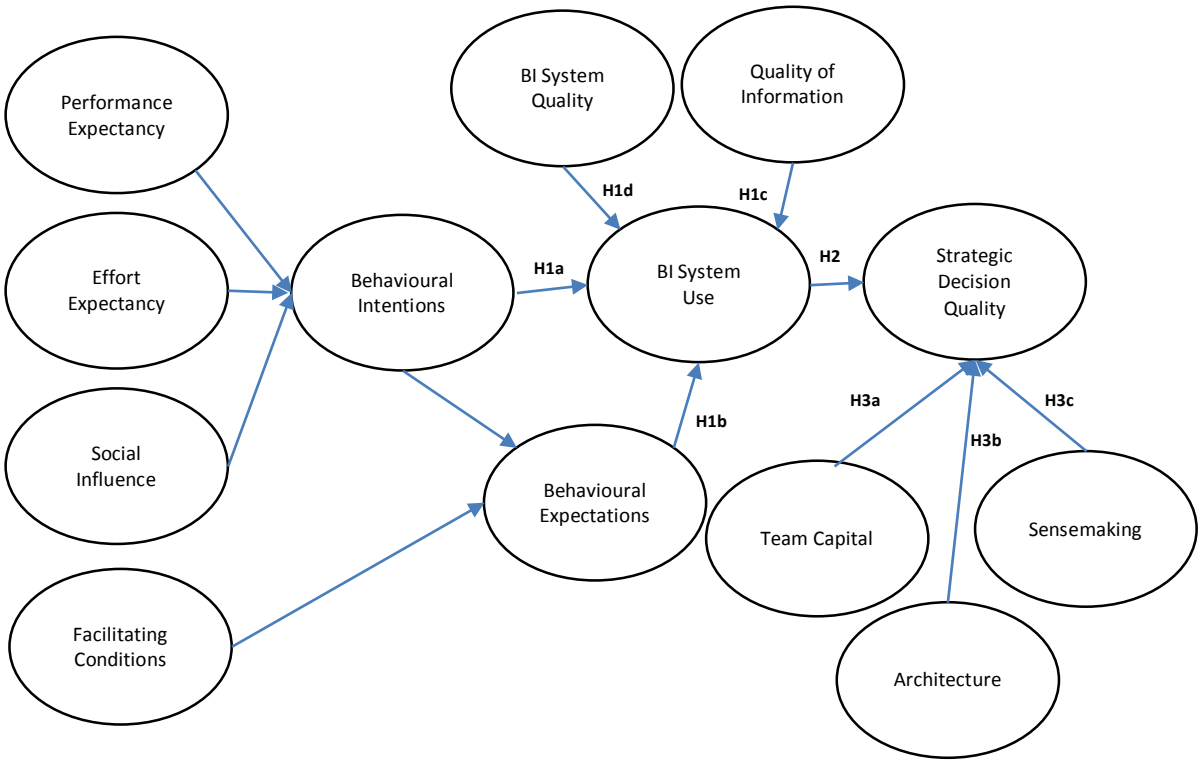


Figure 4-1: Research Model and related Hypotheses

The research model presented 13 constructs. The hypotheses presented below are expressed in terms of the constructs and the relationships between constructs in this model. It should however be noted that the constructs of Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions, although required for this study to ensure the integrity of the UTAUT model will not be directly used to test the hypothesis of this study. Each hypothesis, and the related rationale, are presented next.

4.2.1 Predictors of BI System usage

The use of behavioural intentions, as a predictor of behaviour, can be traced back to a study by Ajzen and Fishbein (1974), which lead to the development of the Theory of Reasoned Action. As discussed in the literature review, research conducted by Venkatesh et al (2003) found behavioural intentions could also be used as a predictor of IT system usage. However, subsequent research by Venkatesh et al (2008) indicated that the use of behavioural intentions, on its own, had limitations. Warshaw and Davies (1984) previously argued that behavioural expectations were a stronger predictor of behaviour. Venkateshet al (2008) continued to refine their IT adoption model showing how the limitations of behavioural intentions could be improved through the introduction of the measurement of behavioural expectations in their model. More recently, Mahardika (2013) outlined how several studies had assessed the predictive performance of behavioural intentions versus behavioural expectations, with those that measured the constructs in a single time interval showing behavioural expectations provided greater predictive capabilities. Mahardika's (2013) study, which examined the temporal stability over time of behavioural expectations opposed to behavioural intentions, also found that behavioural expectations were the stronger predictor of behaviour.

To further test the predictive capabilities of behavioural intentions and behavioural expectations, and to verify the UTAUT model presented by Venkatesh et al (2008), this study explored these two constructs in the context of BI System usage. Two hypotheses, developed to test the relationship between the two constructs, are presented below:

> *H1a: Behavioural Intention will positively influence BI System usage (duration, frequency and intensity).*
>
> *H1b: Behavioural Expectations will positively influence BI System usage (duration, frequency and intensity).*

Although the UTAUT model provides a validated model for establishing IT system adoption, the review of literature suggested that the quality of information and the

quality of an IT system may also have a controlling influence on usage. This led to the development of these two hypotheses that explored if these two constructs influenced BI System usage.

4.2.2 Other Factors influencing BI System usage – Information and System Quality

The constructs of quality of information and BI System quality were introduced into the research model as controlling variables, to test if they influenced BI System use. Alshawi, Missi and Iranis' (2011) review of the literature relating to factors influencing the adoption of Customer Relationship Management (CRM) Systems indicated that data quality has been shown to have a direct influence on CRM system adoption. Frequently, the terms data quality and information quality are used interchangeably throughout the literature and, as such, parallels between data quality in CRM systems and the quality of information in BI Systems seem logical.

In the context of the quality of strategic decision making, a qualitative study by Citroen (2011), suggested that quality information was considered an important factor by executive managers when making decisions. More directly, Nelson, Todd and Wixon (2005) suggested the quality of information and the quality of the IT system were important factors related to the successful adoption of an IT system. Their study had explored the influence of information and system quality on user satisfaction with an IT system and found that both constructs positively influenced satisfaction with the IT system. In the context of this study, it was therefore of interest to see whether these two constructs also positively influenced BI System usage. From this, the following hypotheses were developed:

H1c: Quality of information will positively influence BI System usage (duration, frequency and intensity).

H1d: Quality of BI system will positively influence BI System usage (duration, frequency and intensity).

4.2.3 BI System usage influence on Perception of Strategic Decision Quality

The literature review discussed the importance of evidence based decision making and the use of information in decision making processes (Citroen 2011; Harrison 1996; Popovic 2012; Raghunathan 1999).

Whilst Negash (2004) argued that BI Systems had been introduced to improve the timeliness and quality of information which informed the decision making process. Other studies, Ramamurthy, Sen and Sinha (2008) and Anderson, Fries and Johannsson (2008) have also found a positive relationship between BI System availability and decision making process and organisational performance. However, Turpin and Marais (2004) found their qualitative study provided some evidence to suggest that decision makers infrequently used decision support technology when making decisions. The literature reviewed has determined whether BI System usage by senior managers improves the quality of strategic decisions. As a result, a hypothesis was developed to examine this:

> *H2: BI System usage will positively influence the perceived quality of strategic decisions (Quality of process, content and alignment to vision).*

As previously discussed, BI System usage cannot be considered as the single factor influencing the quality of strategic decision making. This study thus considered three further factors that may be influential in this area.

4.2.4 Factors influencing Strategic Decision Quality

As discussed in the literature review, strategic decision making is a complex process and extensive research exists on the strategic decision making process, its elements and factors influencing its success. For the purpose of this study, three key constructs were identified and hypothesised as having a positive influence on the quality of strategic decision making. These three constructs, as previously discussed, were Architecture, Team Capital and Sensemaking. It has been argued that strategic decision quality is influenced by attributes which could be attributed to the decision

making team (Amason 1996; Bantel and Jackson 1989; Hambrick and Chen 1996; Jehn, Northcraft and Neale 1999; Murray 1989). These included the cognitive abilities of team members, diversity of skills, perspectives and knowledge, capacity and experience. The literature review also highlighted the importance of the decision making process. Although the role of a less structured decision making processes was acknowledged, the majority of the research reviewed suggested that a rational and structured process was an important part of strategic decision making. Of particular interest to this study were Kopeikina's (2005) definition of what constituted a good quality decision, and again a key factor was the quality of the decision making process.

The final element focuses on the role of information in decision making. As previously discussed Harrison (1996), Raghunathan (1999), Popovic et al (2012), and Citroen (2011) had all suggested that information plays a key role in decision making. Although this study has examined the use of BI Systems as a source of information, such systems are not the only source for information. As such, the more generic concept of using information in decision making needed to be tested as part of this study. That is, did senior managers consider information and its perceived quality, as an important influence on the quality of the decisions they make?

In summary, decision making team attributes and capabilities, decision making processes and the use of information emerged as key concepts to be examined in the context of this study. Wood and Klass (2008) developed a theoretical framework which suggested decision making was influenced by the three concepts of Architecture, Team Capital and Sensemaking. Using these concepts three hypotheses were developed which suggested that:

> *H3a: Team Capital (diverse in skills, knowledge, abilities and perspectives of the decision making team) will positively influence the perceived quality of the strategic decision (Quality of process, content and alignment to vision).*

H3b: Architecture (defined and structured decision making process which uses BI) will positively influence the perceived quality of the strategic decision (Quality of process, content and alignment to vision).

H3c: Sensemaking (decision making which uses business intelligence or information) will positively influence the perceived quality of the strategic decision (Quality of process, content and alignment to vision).

4.3 Development of Research Instrument

4.3.1 Measurement Scales

A variety of measurement scale options exist when measuring using a quantitative survey instrument. A commonly used scale for measuring attitudes is the Likert-type scale, developed by Likert (1932). A Likert-type scales provides a single choice on a continuum from agreement to disagreement. Much debate exists in academia regarding the number of points these Likert-type scale should use to be more effective, but the findings across various studies are inconclusive (Chang 1994). In choosing a Likert-type scale for this study, consideration was given to the scales used in Venkatesh et al (2008) research on the UTAUT model. With the exception of BI System usage, which used a simple interval scale measuring mutually independent time intervals, this study utilised a six point Likert-type agreement scale to measure the constructs presented in the research model. The six point scale included the response options of Strongly disagree, Disagree, Agree, Strongly agree. The six point scale was also chosen as it did not provide a neutral point thus forcing respondents to take a position in terms of agreement or disagreement rather than remaining uncommitted in their response.

4.3.2 Constructs and Related Measures

This section provides an overview of how the identified constructs have been defined and how they were measured using the survey. Unless otherwise indicated, a six-point Likert agreement-disagreement scale was used to measure individual items, as explain in the previous section. The individual constructs have been defined with their associated measures below:

4.3.2.1 Performance Expectancy, Effort Expectancy, Social Influence Constructs and Facilitating Conditions

As was discussed in the literature review Venkatesh et al (2008) model for predicting IT system adoption and usage identified four key constructs which could be used as significant determinates of user acceptance and behaviour. These are:

a) **Performance Expectancy** – The degree to which an individual believes that using the system will help him/her improve their job performance.

b) **Effort Expectancy** – The degree to which employees feel the system will be easy to use.

c) **Social Influence** – The degree to which an employee believes that important others believe he or she should use the system.

d) **Facilitating Conditions** – The degree to which an employee believes that organisational and technical infrastructure exists to support his or her use of the system.

To measure these constructs, measures were adopted from the research conduct by Venkatesh et al (2003), Venkatesh et al (2008), Im and Kang (2011), Casey and Wilson-Evered (2012), and Gruzd, Staves, and Wilk (2012).

Each of the constructs are now examined in the context of these four studies, to provide a grounding for the measurement tools used.

Performance Expectancy

Performance Expectancy involves establishing whether a respondent feels the BI System will enhance their job performance. Venkatesh et al (2003) developed this construct in their original study to develop the UAUT model. As discussed in the literature review in Chapter 2, their study examined a variety of information technology acceptance models and tested the measurement items used in these models to identify the items which presented the strongest loadings. To develop the items required to measure Performance Expectancy, the researchers tested 24 items across five constructs from different information technology acceptance models. The item loadings of these 24 items were examined to develop the four items used to measure the construct they called Performance Expectancy in their UTAUT model. Venkatesh et al (2003, 460) presented the four items using the following phrases:

(1) ''I would find the system useful in my job'',

(2) ''Using the system enables me to accomplish tasks more quickly'',

(3) ''Using the system increases my productivity'' and

(4) ''If I use the system, I will increase my chances of getting a raise."

Subsequently, other researchers used the Performance Expectancy construct and items from the UTAUT model, three examples being the studies of Casey and Wilson-Evered (2012), Gruzd, Staves, and Wilk (2012), and Im and Kang (2011). Of particular interest was the study by Gruzd, Staves, and Wilk (2012) which utilised the UTAUT model and the Performance Expectancy construct and related items on respondents working at Universities to establish social media system adoption. Their study was of interest primarily as it was conducted within the same organisational context as this study, and although qualitative in nature, Gurzd, Straves and Wilk (2012)

provided some useful item wording changes. Item four, "If I use the system, I will increase my chances of getting a raise" was reworded to "getting a promotion", which in a university context, was deemed a more appropriate reflection of reward, in particular for academic staff.

As a result, this study adapted these items, but slightly modified the wording provided by Venkatesh et al (2003) to relate all questions to the use of a BI system. Item four was reworded following Gruzd, Staves and Wilk (2012) lead to better reflect the use of promotion in a university context opposed to "getting a raise". Table 4-1, outlines the modified measures used for the Performance Expectancy construct in this study:

Table 4-1: Performance Expectancy Item Measures

Construct	Adapted Associated Measures	Source/ Adopted from
Performance Expectancy The degree to which an individual believes that using the system will help him/her improve their job performance. This construct was identified as the most significant predictor of intention to use the system	• I find the BI System useful in my job • Using the BI System enables me to accomplish tasks more quickly • Using the BI System increases my productivity • If I use the BI System, I will increase my chances of getting a promotion **Question 7 (1,2,3,4)** (See Appendix B)	Venkatesh et al (2003) Im, Hong and Kang (2011) Casey and Wilson-Evered (2012)

Effort Expectancy

This construct, originally developed by Venkatesh et al (2003) examines the perception regarding how easy an information technology is to use. The hypothesis here is 'user friendliness' positively influences behavioural intentions regarding usage behaviour. Venkatesh et al (2003) developed this construct and related items by testing 14 items from across the three constructs of Perceived Ease of Use (Davies 1989), Complexity (Thompson et al 1991) and Ease of Use (Moore and Benbasat 1991). Venkatesh et al (2003) found that four of the fourteen items provided the strongest loadings and these were used as the items to measure Effort Expectancy in

the UTAUT model. The four items were presented using the following phrases, Venkatesh et al (2003, 460):

(1) ''My interaction with the system would be clear and understandable'',

(2) ''It would be easy for me to become skilful at using the system",

(3) ''I would find the system easy to use'' and

(4) ''Learning to operate the system is easy for me.''

As previously discussed, other studies utilised the UTAUT model and the Effort Expectancy construct and items (Casey and Wilson-Evered 2012; Gruzd, Staves, and Wilk 2012; Im, Hong and Kang 2011). Casey and Wilson-Evered (2012) utilised the UTAUT model, and three of the items from the Effort Expectancy construct, to establish the potential adoption of an Online Family Dispute Resolution System. Their study had found the three items used to measure the Effort Expectancy construct provided strong item loadings, and a positive and significant relationship existed between the Effort Expectancy construct and its dependent variable, Behavioural Intentions. This study adopted these items by slightly modifying the original wording provided by Venkatesh et al (2003) to focus the intent of the question to the use of a BI system. Table 4-2, outlines the modified measures used for the Effort Expectancy construct in this study:

Table 4-2: Effort Expectancy Item Measures

Construct	Associated Measures	Source/ Adapted from
Effort Expectancy The degree to which employees feel the system will be easy to use	• I find the BI System easy to use • My interaction with the BI System is clear and understandable • It is easy for me to become skilful at using the BI System • Learning to operate the BI System is easy for me **Question 8 (1,2,3,4)** (See Appendix B)	Venkatesh, Morris, Davies and Davies (2003) Im, Hong and Kang (2011) Casey and Wilson-Evered (2012) Gruzd, Staves, and Wilk (2012)

Social Influence

The next construct used in the UTAUT model examines items which measure the social influence which may exist relative to the use of the information technology. The related construct, called Social Influence, was originally developed by Venkatesh et al (2003). In developing the construct, the researchers explored individual item loadings and significance of nine items from previous studies and theory into subjective norms, social factors and image. Their study found that four of the nine items demonstrated consistently stronger item loadings. These four items were, Venkatesh et al (2003, 460):

a) "People who influence my behaviour think that I should use the BI System";

b) "People who are important to me think that I should use the system";

c) "The senior management of this business has been helpful in the use of the system"; and

d) In general, the organisation has supported the use of the system".

Other studies, Im, Hong and Kang (2011), Casey and Wilson-Evered (2012), Gruzd, Staves, and Wilk (2012) deployed these as a measures of the construct of Social Influence. For example, Im, Hong and Kang (2011) used the UTAUT model to test cross cultural differences in information technology adoption by surveying individuals in Korea and the US in relation to their use of MP3 players and internet banking. Their study hypothesised that social influence positively impacted behavioural intentions. Using Venkatesh et al (2003) items, they found they measured the construct of social influence and that results supported the hypotheses. Further, Gruzd, Staves and Wilk (2012) explored the use of social media systems by academic staff in Universities. This study, which also deployed the UTAUT model and items related to social influence, was of particular interest as it utilised the model in the same university context as this study. Although qualitative in methodology the study found that found that the ''social influence'' had a strong positive influence on respondents decisions regarding social media use. However, it

observed a limitation regarding the original items which formed the construct. As the items had originally been grounded in an organisational context where social influence is often "top down", its use in the population of their study showed some limitations. Seemingly, social influence in academia can be multifaceted, meaning academics may be influenced by colleagues, peers, management, students and other individuals who introduced them to the social media system. This limitation was not considered a concern for this study.

As a result, this study adapted the original UTAUT model items for this construct by slightly modifying the original wording provided by Venkatesh et al (2003) to focus the intent of the question on one related to the use of a BI system. Other context specific changes included changing the item "The senior management of the business has been helpful in the use of the system" to "The administration of the university has been helpful in the use of the system" given respondents of the survey were senior management themselves. Further changes included using the word "university" rather than the more generic term of "business" or "organisation" to ensure better alignment to the language used within a university context. Table 4-3, outlines the modified measures used for the Social Influence construct in this study:

Table 4-3: Social Influence Item Measures

Construct	Associated Measures	Source/ Adopted from
Social Influence Social Influence – The degree to which an employee believes that important others believe he or she should use the system	• People who influence my behaviour think that I should use the BI System • People who are important to me think that I should use the BI System • The administration of the University has been helpful in the use of the BI System • In general, the University has supported the use of the BI System **Question 11 (1,2,3,4)** (See Appendix B)	Venkatesh et al (2003) Im and Kang (2011) Casey and Wilson-Evered (2012) Gruzd, Staves, and Wilk (2012)

Facilitating Conditions

As previously defined, Facilitating Conditions, described the degree to which an employee believes that organisational and technical infrastructure exists to support his or her use of the system. The construct, has origins in the UTAUT model developed by Venkatesh et al (2003). To develop the items used to measure the construct, the research team tested a series of items previously used in three other information technology adoption models across three separate survey events. Of the eleven items tested from the three different models, four items exhibited strong item loadings, and it was proposed that these four items could be used as reliable measures of the construct of Facilitating Conditions. The four items were worded as, Venkatesh et al (2003, 460):

a) "I have the resources necessary to use the System";

b) "I have the knowledge necessary to use the System";

c) "The System is not compatible with other systems I use"; and

d) "A specific person (or group) is available for assistance with System difficulties".

The items, using the wording deployed by Venkatesh et al (2003), were further tested by Venkatesh et al (2008) in a study examining a new information system within a telecommunications company in four separate survey events. At each survey event, they found consistently strong item loadings indicating that items provided a reliable measure of Facilitating Conditions as a construct. Im and Kang (2011) also used the UTAUT model to examine the use of new technologies in two different cultural settings. Their study deployed the items, as originally developed by Venkatesh et al (2003), and delivered results indicating item reliability existed.

Gruzd, Staves and Wilk (2012) had also tested the construct of Facilitating Conditions through 51 semi-structured interviews. By asking the respondents the four items originally developed by Venkatesh et al (2003), with some minor contextual modifications, their study showed that Facilitating Conditions would positively

impact on decisions to adopt social media systems amongst respondents. It was concluded that the items originally developed by Venkatesh et al (2003) would provide a reliable means of measuring the construct of Facilitating Conditions and as such this study adopted these items.

As a result, this study used the items with slightly modified wording to focus the intent of the question on one related to the use of a BI system. Table 4-4, outlines the modified measures used for the Facilitating Conditions construct in this study:

Table 4-4 Facilitating Conditions Item Measures

Construct	Associated Measures	Source/ Adopted from
Facilitating Conditions The degree to which an employee believes that organisational and technical infrastructure exists to support his or her use of the system	• I have the resources necessary to use the BI System • I have the knowledge necessary to use the BI System • The BI System is not compatible with other systems I use (reverse scored) • A specific person (or group) is available for assistance with BI System difficulties **Questions 12 (1,2,3,4)** (See Appendix B)	Venkatesh et al (2003) Venkatesh, Brown, Maruping and Bala (2008) Im and Kang (2011) Gruzd, Staves, and Wilk (2012)

4.3.2.2 Behavioural Intention Constructs

Individual item measures for Behavioural Intention were adopted from Venkatesh et al (2003) and Venkatesh et al (2008). Behavioural Intentions, as a predictor of actual usage behaviour, has been a central part of the UTAUT model since its inception in 2003. The study by Venkatesh et al (2003) extensively explored a variety of information technology adoption models in an attempt to develop a unified model, which would utilise the previously discussed constructs, together with a respondents behavioural intentions, to predict information technology or system usage. To measure Behavioural Intentions as a construct, Venkatesh et al (2003) drew on the work of Sheppard (1988) and the behavioural psychology theory as discussed previously. The three items Venkatesh et al (2003) used to measure Behavioural Intentions produced consistently strong item reliability. The wording of the items for the items were, Venkatesh et al (2003, 460):

a) "I plan to continue to use the System in the next X months";

b) "I predict I would continue to use the System in the next X months; and

c) "I intend to continue to use the System in the next X months"

Venkatesh et al (2008) used these same items in a subsequent study, which considered some limitations in relation to the use of Behavioural Intentions and facilitating conditions. In this study, items, using the same wording but in a different context, across four separate survey events, also produced consistently strong item reliabilities. Another quantitative study which successfully used the items included the study by Im and Kang (2011). Here the researchers adopted Venkatesh et al's (2003) and Venkatesh et al (2008) wording verbatim and produced good item level reliability.

This study, adapted the item wordings by slight modifying them to bring them into the context of this study, specifically relating to the emphasis on BI systems. In addition, a 12 month time frame, considered a reasonable time span, was added to

items to further gauge senior managers' intent over time. Table 4-5 summarises the construct and related measures.

Table 4-5: Construct Behavioural Intentions

Construct	Associated Measures	Source/ Adopted from
Behavioural Intention The individual's self-report probability of **intending** to perform a specific behaviour.	• I plan to continue to use the BI System in the next 12 months • I predict I would continue to use the BI System in the next 12 months • I intend to continue to use the BI System in the next 12 months **Question 15 (1,2,3)** (See Appendix B)	Venkatesh et al (2003) Venkatesh et al (2008) Im and Kang (2011)

4.3.2.3 Behavioural Expectations Construct

Measures for Behavioural Expectations were adopted from Venkateshet al (2008). In this study, the researchers introduced Behavioural Expectations as predictor alongside Behavioural Intentions and Facilitating Conditions. Their study survey some 720 employees from a telecommunications company which had recently introduced a new web-based front-end information and transactions system. They hypothesised that Behavioural Expectations provided greater predictive capabilities than Behavioural Intentions. The study used four items to measure Behavioural Expectations. The items were developed using the guidelines of Warshaw and Davis (1985) and Sheppard, Hartwick and Warshaw (1988). The four items used by Venkatesh et al (2008), across four different survey events, were found to have consistently strong item loadings, which indicated item level reliability had been achieved. The wording used for these four items in their study was, Venkatesh et al (2008, 490):

a) "I expect to use the System in the next X months";

b) "I am likely to use the System in the next X months";

c) "I am going to use the System in the next X months"; and

d) "I will use the System in the next 12 months"

The item wording for this study adapted the original text by modifying it to specifically focus on BI systems. Additionally, a time frame of 12 months was also added to the item, which was considered a reasonable timeframe in which a senior manager would have been expected to use the BI system.

In examining the items which make up the constructs of Behavioural Intentions and Behavioural Expectations, it was apparent respondents may find them difficult to differentiate between. To mitigate this issue, respondents were not exposed to the questions related to these two constructs in sequence. Indeed, they were separated and dispersed throughout the survey instrument. For example, Behavioural Expectations was presented as question 9 in the survey sued for this study. This was followed by unrelated questions, before respondents were presented items about their Behaviour Intentions in question 15. This improvement in the structure of the survey instrument was identified during the pilot study.

Table 4-6 summarises the construct and related measures.

Table 4-6: Constructs Behavioural Intentions and Expectations

Construct	Associated Measures	Source/ Adopted from
Behavioural Expectations The individual's self-report probability of **expecting** to perform a specific behaviour.	• I expect to use the BI System in the next 12 months • I am likely to use the BI System in the next 12 months • I am going to use the BI System in the next 12 months • I will use the BI System in the next 12 months **Question 9 (1,2,3,4)** (See Appendix B)	Venkatesh et al (2008)

4.3.2.4 BI System Usage

BI System usage was measured using the measures of frequency, duration and intensity. These commonly used constructs were also used by Venkatesh et al (2008) in their study and have therefore been adopted for this study as part of the adoption of the UTAUT model. Using time based measures examines how often the system is used (i.e. frequency), how long a respondent has been using the system (i.e. duration) and the length of each individual usage (i.e. intensity).

Mandal and McQueen (2012) in their qualitative study on social media use in businesses utilised the UTAUT model as a framework. Their study utilised frequency, duration and intensity to measure social media system. Similarly Im and Kang (2011), in their previously discussed study, also used frequency, duration and intensity related item measures to establish system usage. The scales developed for these measures are relatively standard time based measures. Table 4-7 provides an overview of the constructed and the related measures and scales.

Table 4-7: Construct BI System Usage

Construct	Associated Measures	Source/ Adopted from
BI System Usage The usage of the BI System can be defined in relation to how frequently a person uses the system, the duration they have used the system for and the intensity of use.	**Frequency of use** I use the BI System: 1. daily 2. weekly 3. monthly 4. every second month 5. quarterly 6. twice a year 7. annually 8. Other **Question 4** (See Appendix B)	Venkatesh et al (2008) Im and Kang (2011) Mandal and McQueen (2012)

Construct	Associated Measures	Source/ Adopted from
	Duration of use I have been using the BI System for: 1. Less than 6 months 2. 6 months to less than a year 3. 1 year to less than 2 years 4. 2 year to less than 3 years 5. 3 year to less than 4 years 6. 4 year to less than 5 years 7. 5 year to less than 6 years 8. More than 6 years **Question 5** (See Appendix B)	Venkatesh et al (2008) Mandal and McQueen (2012)
	Intensity of use When I use the BI System I usually use it for: 1. Less than an hour 2. 1 hour to less than 2 hours 3. 2 hours to less than 3 hours 4. More than 3 hours **Question 6** (See Appendix B)	Venkatesh et al (2008) Mandal and McQueen (2012)

4.3.2.5 Quality of BI System

As suggested in the literature review the quality of the BI System may be an important factor which impacts on the use of the BI System. This construct was added as a controlling variable to explore if they it had a positive influence on BI System usage.

To develop the items used to measure BI system quality consideration was given to the research previously conducted by Nelson, Todd and Wixon (2005) and Gorla, Somers and Wong (2010) who had examined information system quality by measuring items related to system flexibility (items related to system features and

function as well as flexibility to make changes) and system sophistication (items related to integration, response time, and user friendliness).

A study conducted more closely aligned to the context of this study, this means BI system quality and usage was the study of Nelson et al (2005) who argued that successful IT adoption is based on linkages between quality (information and system), satisfaction (information and system) and usage. Nelson's research suggested that the determinants of system quality are defined as accessibility, reliability, response time, flexibility and integration. In their study they had surveyed 465 data warehouse users to establish the relationship between these items and satisfaction with the BI system. To measure BI system quality Nelson et al (2005 210) had used a series of items to test the constructs of a) Accessibility *("…. Allows information to readily accessible to me; …. Makes information very accessible; …. Makes information easy to access"*); b) Reliability *("…. Operates reliably; …. Performs reliably"*); c) Response time *("…. It takes too long for the Bi system to respond to my request; …. Provides information in a timely fashion; …. Returns answers to my request quickly"*); d) Flexibility (*"…. Can be adapted to meet a variety of needs; … can flexibly adjust to new demands or conditions; …. Is versatile in addressing needs as they arise"*) e) Integration *("…. Effectively integrates data from different areas of the company; …. Pulls together information that used to come from different places in the company; …. Effectively combines data from different areas of the company").* Their study had found that these five constructs provided an effective model for measuring BI system quality. For the purpose of this study, as this construct was introduced as a controlling variable, the construct of BI system quality was measured using items related to the five constructs outlined above as individual items. This means the a) Accessibility, b) Reliability, c) Response Time, d) Flexibility and e) Integration were considered as individual items which made up the construct of BI system quality.

Table 4-8 provides an overview of the construct and related measures.

Table 4-8: Constructs Quality of BI System

Construct	Associated Measures	Source/ Adopted from
Quality of BI System The quality of the BI System can be defined in terms of the ease of access, its reliability, timeliness of being able to obtain information, flexibility, and its ability to integrate with other systems.	**System Quality – BI System:** • Is easily accessible • Is reliable • Provides information in a timely manner • Provides flexibility in how it provides information • Is integrated with other management processes (e.g.: Performance Review process, monitoring of KPIs, budget and load planning) **Question 16 (1,2,3,4,5)** (See Appendix B)	Nelson, Todd and Wixon (2005) Gorla, Somers and Wong (2010)

4.3.2.6 Quality of Information

As suggested in the literature review the quality of the quality of information (i.e. Business Intelligence) may be an important factor which impacts on the use of the BI System. This construct was added as a controlling variable to explore if it had a positive influence on BI System usage. As previously discussed the research of Nelson et al (2005) argued that successful IT adoption is based on linkages between quality (information and system), satisfaction (information and system) and usage. Their research suggested that the key dimensions of information quality are accuracy, completeness, currency and format.

To measure these information quality constructs Nelson et al (2005 210) had used the following items: a) Completeness *("…Provides me with a complete set of information; …Provides comprehensive information; …Provides me with all the information I need");* b) Accuracy ("*…Produces correct information; There are few*

errors in the information I obtain from…; The information provided by…is accurate"); c) Format *("The information provided is well informed; The information provided is well laid out; The information is clearly presented on the screen")*; d) Currency *("…Provides me with the most recent information; …produces the most current information; The information is up to date"*).

Gorla, Somers and Wong (2010) had measured information quality in their study using similar constructs and items. Both studies had shown positive relationships between information quality and information system quality (Gorla et al (2010)) satisfaction with the information system (Nelson et al (2005)). As the study by Nelson et al (2005) provided good alignment to the focus of this study a selection of items from their study were adopted to measure the construct of information quality. The items selected measured if the BI system provided information that was accurate, complete, current and in the required format.

Table 4-9 provides an overview of the construct and related measures.

Table 4-9: Constructs Quality of BI System and Information

Construct	Associated Measures	Source/ Adopted from
Quality of BI System and Information Quality information is defined as information which is accurate, complete, current and in the format required	**Information Quality – BI System provides:** • Accurate information • Information which is complete • Information which is current • Information in the format I require **Question 17 (1,2,3,4)** (See Appendix B)	Nelson, Todd and Wixon (2005) Gorla, Somers and Wong (2010)

4.3.2.7 Improved Quality of Strategic Decisions

The literature review discussed that strategic decision quality could be defined using three concepts identified by Kopeikina (2005) and a suggested item from Wood and Klass (2008). Kopeikina's (2005) explained that good quality decisions are those decisions which have utilised a good quality decision making process, used good quality decision making content and are aligned to the internal vision. The literature review discussed that one limitation of the above elements is that no measure of decision outcome is included. Wood and Klass (2008) had suggested that perceived likelihood of achieving the intended outcome provides a perception based measure of decision outcome. As no quantitative studies could be found which tested the theoretical concepts discussed by Kopeikina (2005) and Wood and Klass (2008) a series of related item measures were developed which expressed the sentiment of the theoretical concepts.

Table 4-10 provides an overview of the construct and related measures.

Table 4-10: Construct Improved Quality of Strategic Decision Making

Construct	Associated Measures	Source/ Adopted from
Improved Quality of Strategic Decisions as expressed through: • Improved quality of the decision making process • Improved quality of decision making content • Improved internal alignment of the decision with the organisational vision • Likely hood of achieving the perceived outcome	• The decision making process has improved • The decision making content has improved • The decisions are aligned to the Vision of the University • The decisions being made are more likely to achieve the perceived desired outcome **Question 18 (1,2,3,4)** (See Appendix B)	Kopeikina (2005) Wood and Klass (2008)

4.3.2.8 Sensemaking, Architecture and Team Capital

The literature review discussed that that the diversity of the decision making team (Bantel and Jackson, 1989; Jehn, Northcraft and Neale, 1999; Hambrick, 1996; Amason, 1996), the strategic decision making process and the cognitive abilities (Amason, 1996; Bantel and Jackson 1989) of those making the decisions are key factors which may impact on decision quality. Wood and Klass (2008) have suggested that decision quality is a function of the interrelationship between three concepts: 1) Sensemaking, 2) Architecture and 3) Team Capital.

Wood and Klass (2008) had developed these three concepts through a qualitative study which explored characteristics of decision making. The review of the literature could not find any studies which have adopted these three concepts and measured them quantitatively. However, three concepts and related theory were found to provide the most appropriate framework in the context of this study through a review of the related literature.

As such the framework described above was used to develop concepts for the research model. These concepts were measured using the items previously described that focused on team diversity, cognitive ability and decision making process.

Measures relating to the constructs of Sensemaking, Architecture and Team Capital were developed using the underlying concept explained by from Wood and Klass (2008) and through the related theoretical groundings presented by Bantel and Jackson (1989), Jehn, Northcraft and Neale (1999), Hambrick (1996), and Amason (1996). Table 4-11 provides an overview of the construct and related measures.

Table 4-11: Sensemaking, Architecture and Team Capital

Construct	Associated Measures	Source/ Adopted from
Factors affecting decision quality: • **Sensemaking** • **Architecture** • **Team capital**	**Sensemaking** • Decisions are made in consideration of internal business intelligence or performance information • Decisions are made in consideration of information or business intelligence on external factors • Information informs decision making **Question 19 (1,2,3)** **Architecture** • Decision making is undertaken using a defined or structured process • Decision making process is informed by the BI System **Question 19 (4,5)** **Team Capital:** When making decisions as a team, the decision making team has: • a diverse set of skills • a diverse set of knowledge • the capacity to make good decisions • a diverse set of perspectives **Question 20 (1,2,3,4)** (See Appendix B)	Wood and Klass (2008) Bantel and Jackson (1989) Jehn, Northcraft and Neale (1999) Hambrick (1996) Amason (1996)

4.3.2.9 Demographic and Other Variables

To develop a profile of the respondents a variety of demographic items were included in the survey. These items did not contribute to the analysis of the research model or hypotheses testing. Data was collected on the gender of respondents, their age, and seniority. Of particular interest was the question related to seniority as this provided an insight on whether the respondents in fact had managerial responsibility. As discussed in the literature review, strategic decision making is the role of managers, if the individuals responding were not in management roles this may have impacted the quality of the data received. Table 4-12 provides an overview of the demographic and other variables.

Table 4-12: Demographic and Other Variables

Construct	Associated Measures	Source/ Adopted from
Demographic: • **Gender** • **Age** • **Seniority** • **Function**	**GENDER** Please indicate your gender: 1. Male 2. Female **AGE** Please indicate which age range you belong to: 1. 18 – 25 2. 26 – 35 3. 36 – 45 4. 46 – 55 5. 56 – 65 6. 65+ **SENIORITY** Please indicate the type of position you hold within the University: 1. Senior Executive (e.g.: Vice-Chancellor, President, Deputy Vice-Chancellor, Pro Vice-Chancellor, Executive Dean, Executive Director, Vice President, CFO, CIO) 2. Senior Manager (e.g.: Director of an area, Head of School) 3. Manager (e.g.: Manager of an operational unit, Head of Department) 4. Academic staff member engaged in teaching and or research 5. Professional/general staff member 6. Other (See Appendix B)	Not Applicable.

4.3.2.10 BI System Variables

It was also considered important to establish if the organisations at which the respondents worked in fact had a BI System, what this system was called and if the respondents in fact used the system themselves or had someone access the system for them. Respondents who indicated they did not have a BI System (in Question 1 of the survey) were directed to a second version of the survey which asked them to provide a response as if they did have a BI System. Responses from the second version of the survey were not included in the analysis as sufficient responses had been received from individuals who indicated their University has a BI System. Table 4-13 provides an overview of the BI System related variables.

Table 4-13: BI System Variables – BI System Exists, Name and Access

Construct	Associated Measures	Source/ Adopted from
BI System Exists in the University **Name of BI System** **Access**	**Have a BI System** Do you have data and information available to you through a data warehouse, dashboard, information portal, Management Information System, Decision Support System or BI System? 1. Yes 2. No 3. I know **BI System name** This section asks questions regarding your usage of the BI System. At my University we refer to our BI System as a (choose all that apply): 1. Business Intelligence System 2. Decision Support System 3. University dashboard 4. Data warehouse 5. Corporate or University reporting System 6. Management Information System 7. Information Portal 8. Other, please specify **Access** When accessing business intelligence (e.g.: data): 1. I access the BI System directly myself 2. Someone accesses the BI System for me and provides me with the BI 3. Don't know	Not Applicable.

The next section of this Chapter discusses the outcomes of the pre-test exercise which was conducted on the survey instrument.

4.4 Pre-Test of Survey Instrument

As discussed in Chapter 3, a pre-test was conducted to test the survey instrument. This section describes the key outcomes of the pilot study and outline the improvements made to the research instrument.

The pilot study of the instrument was designed to highlight any issues related to survey administration using the online tool (such as online availability from different locations, survey structure and flow, time to complete, ability to understand questions) and to establish any issues related to the interpretation of survey questions.

A total of 15 responses were received for the pilot study, of those, seven respondents provided feedback. In general respondents were positive about the survey process, introduction letter and the questions in the survey instrument. Positive feedback made included comments about the ease of following the instructions provided, clarity of questions and response items, invitation letter providing clear rational for the research and motivation to respond, logical flow and the survey not taking an excessive amount of time (between 10-15 min was reported). Some minor grammatical and spelling errors were identified and rectified in the final version. However, feedback also identified several key issues which needed to be considered to ensure the final survey instrument optimised response rates and provided robust data for analysis. Table 4-14, presented on the next page, provides a synthesis of the key items of feedback and provides a response as to how it was considered and what changes were made to the instrument or its administration processes.

Table 4-14: Pilot Study Feedback and Response

Pilot Study Feedback	Response
Duration and Intensity of Use Question Scale not mutually exclusive Questions related to duration and intensity of use is not mutually exclusive across the response items. For example: How long have you being using BI System: a) 6 months, b) 6 months to a year, c) a year to 2 years …….	**Feedback was accepted and changes made** Response items of the two questions were reworded to ensure individual items were mutually exclusive. For example: I have been using the BI System for: 1. Less than 6 months 2. 6 months to less than a year 3. 1 year to less than 2 years
Differentiation between Behavioural Intentions and Behavioural Expectations Questions and Items Questions to measure behavioural intentions and behavioural expectations were presented in the same section of the survey instrument in the pre-test version. Feedback from several pre-test respondents was that they found the questions repetitive and could not differentiate them. The location of both questions and related items in the same section resulted in respondents providing identical scores for two different but related constructs.	**Feedback was accepted and changes made** Questions related to behavioural intentions and behavioural expectations were separated and presented in two separate sections that were interrupted by several questions related to other constructs. This ensured that respondents did not have line of sight to previous responses provided and provided the opportunity to introduce the two concepts differently. The introduction to each question was re-written to provide clearer points of differentiation. Individual response items were re-examined and slightly reworded to provide a stronger level of differentiation. It is however acknowledged that the two constructs appear very similar in meaning. As is demonstrated in Chapter 5, respondents continued to have difficulty differentiating the items through the responses provided. However as these items had been adopted from Venkatesh, et al's (2008) UTAUT model it was felt that changes that deviated too far from the original model may compromise the validity and reliability of the instrument and the structural model.
Feeling that questions are repetitive Some respondents felt that questions related to use of the BI System (Frequency) and some of the questions related to Behaviour Expectations and Intentions were very repetitive.	**Feedback was accepted and changes made** Clearer explanations introducing the questions were developed and, as discussed above, Behavioural Expectation and Behavioural Intentions questions were separated in the survey.

At the conclusion of the pilot study all respondents were thanked for their participation and changes were made to the survey instrument in preparation for the study to be launched.

4.5 Summary

Chapter 4 defined the hypotheses for this study. Each hypotheses was expressed in terms of the constructs and the potential relationships outlined in the research model. The rational for each hypotheses was provided. The use of the 6 point Likert agreement scale was discussed. For each of the constructs of the structural model measurement items were presented and referenced back to the theory or previous research they were grounded in. This provided an overview of the measurement model and research instrument for this study.

The Chapter concluded by presenting the results of the pre-test that was conducted on the research instrument and the enhancements to the instrument and process was discussed. The pre-test identified some minor wording and survey logic issues which were improved prior to the survey being administered to survey population.

Next, Chapter 5 provides the analysis of the data collected through the research instrument presented in this Chapter. The results of the validity and reliability test are presented to demonstrate the robustness of the measurement model. The structural model is assessed and hypotheses developed in this Chapter tested. The structural model is also be assessed for the mediation effect of the mediating variable Behavioural Expectations.

5 Analysis of Data and Findings

5.1 Introduction

This Chapter outlines the analysis of the data collected through the online survey of senior managers at Australian Universities. Chapter 5 thus provides the results of the measurement and structural model testing procedures which were described in Chapter 3. The Chapter also presents the outcomes of the Partial Least Squared Structured Equation Modelling (PLS-SEM) performed on the data contributing to the structural model and hypotheses for this study outlined in Chapter 2 and Chapter 4. Tests for mediation effects of the mediating variable, Behavioural Expectations, are also presented.

5.2 Survey Administration and Respondent Profile

As discussed in Chapter 3, the data collection for this study was undertaken through an online survey of senior managers at Australian universities. The survey was administered to 612 potential respondents and a total of 272 responses were received. The online survey contained a screening question which asked respondents if their university had a BI System. Only the respondents who worked in a university with a BI System were of interest to this study. One hundred and ninety seven responses fit this criterion, delivering a response rate of 32.2%. The data from this group was then screened to ensure it was suitable for use in the analysis, as outlined in Chapter 3 (Section 3.3.8 and 3.3.8.1). The outcome of the data quality screening procedure produced 132 usable responses, a response rate of 32.3%. The survey also captured two waves of responses, those collected before and

after a reminder email was sent. These two waves were compared for non-response bias, applying the procedure outlined in Chapter 3, Section 3.3.8.2. The results of the non-response bias testing are discussed next.

5.2.1.1 Test for Non-response Bias

As described in Chapter 3 non-response bias is concerned with the difference between results of those who responded to the survey compared to those who did not Cascio (2012). Lambert and Harrington (1990) provide a procedure for testing for non-response bias which compares the results of those respondents that completed the survey during the early phase of a survey process compared to the results of those who responded later. For this study testing for non-response bias was achieved by comparing responses from the first two weeks of the survey process to those responses received after a reminder email was sent. The initial wave of responses achieved an n=131 (which included 87 valid responses), responses received after the reminder email was sent n=65 (which included 45 valid responses). To test for non-response bias the statistical differences between the two response data sets was compared across 20 per cent of the questions related to the research model (randomly selected) and the demographic variables. The statistical testing involved comparing the means of responses and then examining the outcomes of a t-test performed on the two data sets. A null hypotheses was proposed which suggested that means of the two groups of respondents was equal, the alternative hypotheses suggests that they are not:

Ho: $\mu 1 = \mu 2$ (means of the two groups are equal)

Ha: $\mu 1 \neq \mu 2$ (means are not equal)

Table 5-1 provides an overview of the means of questions relating to the research model and the demographics and the t-test results provide an indication if the differences in means are statistically significant. A t-test result of (alpha value) above

0.05 is considered acceptable and would indicate that the results from both groups of respondents are not statistically significantly different.

Table 5-1: Non-Response Bias Assessment

Questions/Items for Non-response Bias Test	MEAN for initial wave of responses N=87	MEAN for second wave of responses (after reminder email was sent) N=45	Test for statistically significance difference between two means (alpha = >0.05 no statistical difference between means)
Randomly selected questions related to research model			
Q6: Intensity of Use: When I use the BI System I usually use it for …….	1.37	1.38	0.93
Q7: Using the BI System increase my productivity	2.45	2.42	0.90
Q8: Learning to use the BI System is easy for me	2.98	2.67	0.22
Q9: I expect to use the BI System in the next 12 months	1.51	1.47	0.84
Q10: Using the BI System is a good idea	1.61	1.73	0.36
Q12: I have the resources necessary to use the BI System	2.54	2.49	0.82
Q12: A specific person (or group) is available for assistance with BI System difficulties	2.20	2.20	0.98
Q15: I plan to continue to use the BI System in next 12 months	1.59	1.53	0.80
Q16: The BI System quality is reliable	2.62	2.62	0.99
Q16: The BI System provides flexibility in how it provides information	2.90	2.98	0.75
Q19: Decisions are made in consideration of information or business intelligence on external factors	2.52	2.42	0.60
Q19: Information informs decision making	2.00	2.13	0.44
Demographic Questions			
Q22: Gender	1.32	1.31	0.92
Q23: Age	4.22	4.22	0.99

The results show that minimal difference exists between the two response groups, Hypotheses: Ho was accepted, and as such non-response bias was not considered an issue for this study.

5.2.2 Response Profile

This study has focused on measuring the perceptions of senior managers in Australian universities in relation to their use of BI System in strategic decision making. A series of demographic questions were included in the online survey to develop an understanding of the demographic characteristics of respondents. This section provided an overview of the gender, age, type of position held and organisational function of the respondents.

5.2.2.1 Gender

Of the 132 usable responses received, 39% were female and 55% were male. Some 7% of respondents did not indicate their gender in their response. Table 5-2 provides an overview of the gender profile of respondents. The results received are not unusual and are in fact in line with the Australian Public sector averages for 2012. The Australian Bureau of Statistics reports in their Gender Indicators Report (July, 2012) that 39% of the Senior Executives in the Australian Public Service were female. It would therefore suggest that the respondents profile is aligned to that of the population surveyed.

Table 5-2: Respondents Gender Profile

Gender	Frequency	Percentage of Respondents
Female	51	39%
Male	72	55%
Missing Values	9	7%
Total	132	100%

5.2.2.2 Age

Of the 132 usable responses received, the majority (73%) of respondents were aged between 46 – 65 years of age. As the survey targeted senior managers the age profile returned from the respondent group is not unusual. Table 5-3 provides an overview of the age profile of the respondents.

Table 5-3: Respondents Age Profile

Age Range	Frequency	Percentage of Respondents
18-25	0	0%
26-35	3	2%
36-45	20	15%
46-55	49	37%
56-65	47	36%
65+	10	8%
Missing	3	2%
Total	132	100%

5.2.2.3 Position

Of the 132 usable responses received the majority (88%) of respondents indicated they were working in a management position. Forty two percent indicated they worked as Senior Executives. Position classifications here included Vice-Chancellor, President, Deputy Vice-Chancellor, Pro Vice-Chancellor, Executive Dean, Executive Director, Vice President or other C level position titles. Senior Managers made up 32% of the respondents and the survey instrument defined this categorisation as either Director of an area or a Head of School. Managers made up 14% of respondents and these were defined in the survey instrument as managers of operational units or Heads of Departments. The position profile of respondents was encouraging, as traditionally it is more difficult to obtain good response rates from executive and senior management level positions due to the workload or time pressures placed on individuals in these positions. Table 5-4 provides an overview of the positions held by the respondents.

Table 5-4: Respondents Position Profile

Position	Frequency	Percentage of Respondents
Senior Executive	55	42%
Senior Manager	42	32%
Manager	18	14%
Academic staff	6	5%
Professional staff	7	5%
Other	0	0%
Missing	4	3%
Total	132	100%

5.2.2.4 Work Area

Of the 132 usable responses received the majority (61%) of respondents indicated they were working in a support or administrative area. This result aligns with the 42% of respondents who indicated they were in senior executive roles as these roles are positioned within the central administration of most universities organisational structures. Eighteen percent of respondents indicated they worked in a teaching and research areas, suggesting these respondents may have been senior managers of Faculties or Schools who would have both teaching and research functions. Table 5-5 provides an overview of the area individuals worked in.

Table 5-5: Respondents Work Area

Work Area	Frequency	Percentage of Respondents
Teaching area	8	6%
Research area	11	8%
Teaching and research area	24	18%
Support or administrative area	81	61%
Other	3	2%
Missing	5	4%
Total	132	100%

5.2.2.5 BI System access

Of the 132 usable responses received, the majority (55%) of respondents indicated they accessed the BI System themselves whilst 43% indicated they had someone access the system for them to obtain the business intelligence they required. Given that 42% of respondents indicated they were in senior executive roles it is reasonable to assume that they would have support roles, such as business analysts, to extract the required business intelligence from the system for them. Table 5-6 provides an overview of the BI Systems access profile of respondents.

Table 5-6: BI System Access

BI System access	Frequency	Percentage of Respondents
I access the BI System directly myself	72	55%
Someone accesses the BI System for me and provides me with the BI	57	43%
Don't know	2	2%
Missing	1	1%
Total	132	100%

5.2.3 Frequency distributions for Items related to Constructs

To provide further insights for the analysis of the findings beyond the interrogation of the analysis related to the structural model using PLS – SEM frequency distributions across the response scales were calculated for each of the items used to measure the constructs.

The findings for questions using the 6-point agreement scale are presented in table 5-7.

Table 5-7: Frequency distributions for Items related to Constructs with Agreement/ Disagreement Scale

		Survey Question		Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly Agree	Missing	Total
Social Influence	Q11_1	People who influence my behaviour think that I should use the BI System	N=	7	12	21	40	35	16	1	132
			%	5.30%	9.09%	15.91 %	30.30 %	26.52 %	12.12 %	0.76%	100%
	Q11_2	People who are important to me think I should use the BI System	N=	8	15	18	43	35	12	1	132
			%	6.06%	11.36 %	13.64 %	32.58 %	26.52 %	9.09%	0.76%	100%
	Q11_3	The administration of the University has been helpful in the use of the BI System	N=	3	5	18	39	49	17	1	132
			%	2.27%	3.79%	13.64 %	29.55 %	37.12 %	12.88 %	0.76%	100%
	Q11_4	In, general, the University has supported the use of the BI System	N=	1	5	10	28	54	33	1	132
			%	0.76%	3.79%	7.58%	21.21 %	40.91 %	25.00 %	0.76%	100%
Performance Expectancy	Q7_1	I find the BI System useful in my job	N=	0	3	2	25	60	37	5	132
			%	0.00%	2.27%	1.52%	18.94 %	45.45 %	28.03 %	3.79%	100%
	Q7_2	Using the BI System enables me to accomplish tasks more quickly	N=	0	5	19	37	45	22	4	132
			%	0.00%	3.79%	14.39 %	28.03 %	34.09 %	16.67 %	3.03%	100%
	Q7_3	Using the BI System increases my productivity	N=	1	5	16	38	45	23	4	132
			%	0.76%	3.79%	12.12 %	28.79 %	34.09 %	17.42 %	3.03%	100%
Effort Expectancy	Q8_1	I find the BI System easy to use	N=	7	10	17	44	37	11	6	132
			%	5.30%	7.58%	12.88 %	33.33 %	28.03 %	8.33%	4.55%	100%
	Q8_2	My interaction with the BI System is clear and understandable	N=	6	11	15	51	39	7	3	132
			%	4.55%	8.33%	11.36 %	38.64 %	29.55 %	5.30%	2.27%	100%
	Q8_3	It is easy for me to become skilful at using the BI System	N=	6	12	24	42	36	8	4	132
			%	4.55%	9.09%	18.18 %	31.82 %	27.27 %	6.06%	3.03%	100%
	Q8_4	Learning to operate the BI System is easy for me	N=	6	9	24	38	39	10	6	132
			%	4.55%	6.82%	18.18 %	28.79 %	29.55 %	7.58%	4.55%	100%
Facilitating Conditions	Q12_1	I have the resources necessary to use the BI System	N=	4	7	12	34	51	22	2	132
			%	3.03%	5.30%	9.09%	25.76 %	38.64 %	16.67 %	1.52%	100%
	Q12_2	I have the knowledge necessary to use the BI System	N=	3	7	13	42	49	18	0	132
			%	2.27%	5.30%	9.85%	31.82 %	37.12 %	13.64 %	0.00%	100%
	Q12_4	A specific person (or group) is available for assistance with BI System difficulties	N=	0	9	9	25	47	40	2	132
			%	0.00%	6.82%	6.82%	18.94 %	35.61 %	30.30 %	1.52%	100%
Beh	Q15_1		N=	4	2	0	9	32	82	3	132

		Survey Question		Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly Agree	Missing	Total
		I plan to continue to use the BI System in the next 12 months	%	3.03%	1.52%	0.00%	6.82%	24.24 %	62.12 %	2.27%	100%
	Q15_2	I predict I would continue to use the BI System in the next 12 months	N=	4	2	0	10	34	77	5	132
			%	3.03%	1.52%	0.00%	7.58%	25.76 %	58.33 %	3.79%	100%
	Q15_3	I intend to continue to use the BI System in the next 12 months	N=	5	2	1	15	27	78	4	132
			%	3.79%	1.52%	0.76%	11.36 %	20.45 %	59.09 %	3.03%	100%
Behavioural Expectations	Q9_1	I expect to use the BI System in the next 12 months	N=	3	3	0	9	23	91	3	132
			%	2.27%	2.27%	0.00%	6.82%	17.42 %	68.94 %	2.27%	100%
	Q9_2	I am likely to use the BI System in the next 12 months	N=	3	3	0	9	22	83	12	132
			%	2.27%	2.27%	0.00%	6.82%	16.67 %	62.88 %	9.09%	100%
	Q9_3	I am going to use the BI System in the next 12 months	N=	4	2	0	13	26	76	11	132
			%	3.03%	1.52%	0.00%	9.85%	19.70 %	57.58 %	8.33%	100%
	Q9_4	I will use the BI System in the next 12 months	N=	4	2	2	13	24	78	9	132
			%	3.03%	1.52%	1.52%	9.85%	18.18 %	59.09 %	6.82%	100%
BI System Quality	Q16_1	BI System is accessible	N=	3	7	15	29	56	22	0	132
			%	2.27%	5.30%	11.36 %	21.97 %	42.42 %	16.67 %	0.00%	100%
	Q16_2	Reliable	N=	4	7	18	35	45	20	3	132
			%	3.03%	5.30%	13.64 %	26.52 %	34.09 %	15.15 %	2.27%	100%
	Q16_3	Provides timely information	N=	2	8	19	34	39	24	6	132
			%	1.52%	6.06%	14.39 %	25.76 %	29.55 %	18.18 %	4.55%	100%
	Q16_4	Flexible in how it provide information	N=	7	11	24	36	34	17	3	132
			%	5.30%	8.33%	18.18 %	27.27 %	25.76 %	12.88 %	2.27%	100%
	Q16_5	Integrated with other processes	N=	12	26	24	34	20	12	4	132
			%	9.09%	19.70 %	18.18 %	25.76 %	15.15 %	9.09%	3.03%	100%
Quality of Information	Q17_1	Accurate	N=	0	4	11	40	53	24	0	132
			%	0.00%	3.03%	8.33%	30.30 %	40.15 %	18.18 %	0.00%	100%
	Q17_2	Complete	N=	2	11	26	46	28	19	0	132
			%	1.52%	8.33%	19.70 %	34.85 %	21.21 %	14.39 %	0.00%	100%
	Q17_3	Current	N=	1	5	23	38	43	22	0	132
			%	0.76%	3.79%	17.42 %	28.79 %	32.58 %	16.67 %	0.00%	100%
	Q17_4	Required format	N=	6	13	25	52	23	12	1	132
			%	4.55%	9.85%	18.94 %	39.39 %	17.42 %	9.09%	0.76%	100%
Strategic Decision Quality	Q18_1	The decision making process has improved	N=	2	3	14	39	42	29	3	132
			%	1.52%	2.27%	10.61 %	29.55 %	31.82 %	21.97 %	2.27%	100%
	Q18_2	The decision making content has improved	N=	1	2	10	37	50	29	3	132
			%	0.76%	1.52%	7.58%	28.03 %	37.88 %	21.97 %	2.27%	100%
	Q18_3		N=	3	4	17	44	49	13	2	132

		Survey Question		Strongly disagree	Disagree	Somewhat disagree	Somewhat agree	Agree	Strongly Agree	Missing	Total
		The decisions are aligned to the Vision of the University	%	2.27%	3.03%	12.88 %	33.33 %	37.12 %	9.85%	1.52%	100%
	Q18_4	The decisions being made are more likely to achieve the perceived desired outcome	N=	3	3	16	43	48	15	4	132
			%	2.27%	2.27%	12.12 %	32.58 %	36.36 %	11.36 %	3.03%	100%
Sensemaking	Q19_1	Decisions are made in consideration of internal business intelligence or performance information	N=	1	2	11	41	55	21	1	132
			%	0.76%	1.52%	8.33%	31.06 %	41.67 %	15.91 %	0.76%	100%
	Q19_2	Decisions are made in consideration of information or business intelligence on external factors	N=	1	2	14	45	53	15	2	132
			%	0.76%	1.52%	10.61 %	34.09 %	40.15 %	11.36 %	1.52%	100%
	Q19_3	Information informs decision making	N=	0	0	7	37	46	39	3	132
			%	0.00%	0.00%	5.30%	28.03 %	34.85 %	29.55 %	2.27%	100%
Architecture	Q19_4	Decision making is undertaken using a defined or structured process	N=	4	7	16	52	41	10	2	132
			%	3.03%	5.30%	12.12 %	39.39 %	31.06 %	7.58%	1.52%	100%
	Q19_5	Decision making process is informed by the BI System	N=	0	5	11	43	55	16	2	132
			%	0.00%	3.79%	8.33%	32.58 %	41.67 %	12.12 %	1.52%	100%
Team Capital	Q20_1	Decision making team has a diverse set of skills	N=	1	1	2	29	53	41	5	132
			%	0.76%	0.76%	1.52%	21.97 %	40.15 %	31.06 %	3.79%	100%
	Q20_2	Decision making team has a diverse set of knowledge	N=	1	1	4	26	56	39	5	132
			%	0.76%	0.76%	3.03%	19.70 %	42.42 %	29.55 %	3.79%	100%
	Q20_3	Decision making team has the capacity to make good decisions	N=	2	2	5	28	50	40	5	132
			%	1.52%	1.52%	3.79%	21.21 %	37.88 %	30.30 %	3.79%	100%
	Q20_4	Decision making team has a diverse set of perspectives	N=	1	0	9	27	61	29	5	132
			%	0.76%	0.00%	6.82%	20.45 %	46.21 %	21.97 %	3.79%	100%

Two survey questions utilised time related scales to measure the BI system usage frequency and experience. These questions related to the construct of BI system usage. Frequency distribution results are presented in Table 5-8.

Table 5-8: Frequency distribution of Constructs using time scales

		Survey Question		Other	Annually	Twice a year	Quarterly	Every second month	Monthly	Weekly	Daily	Missing	Total
BI System Usage	Q4	Frequency of use	N=	9	2	4	9	6	31	53	17	1	132
			%	6.82 %	1.52 %	3.03 %	6.82 %	4.55 %	23.48%	40.15%	12.88%	0.76 %	100 %
	Q5	Experience (duration of time using BI System)		More than 6 years	5 year to less than 6 years	4 year to less than 5 years	3 year to less than 4 years	2 year to less than 3 years	1 year to less than 2 years	6 months to less than a year	Less than 6 months	Missing	Total
			N=	10	5	24	24	17	8	10	34	0	132
			%	7.58 %	3.79 %	18.18%	18.18%	12.88%	6.06 %	7.58 %	25.76%	0.00 %	100 %

The results provided through the frequency distributions presented in table 5-7 and 5-8 are discussed further in Chapter 6 to provide further insights in into the analysis of the results as they pertain to the hypotheses of this study.

The remainder of Chapter 5 presents the analysis related to the structural equation modelling.

5.3 Data analysis using Structured Equation Modelling

As discussed in Chapter 3 PLS-SEM was the primary data analysis technique in this study. Again, as previously discussed, a research model was developed which proposed that BI System usage could be confirmed using the UTAUT model developed by Venkatesh, Morris, Davies and Davies (2003) and the relationship between BI System usage and the quality of strategic decision making could then be measured. The model tested and analysed in this study is presented in Figure 5-1.

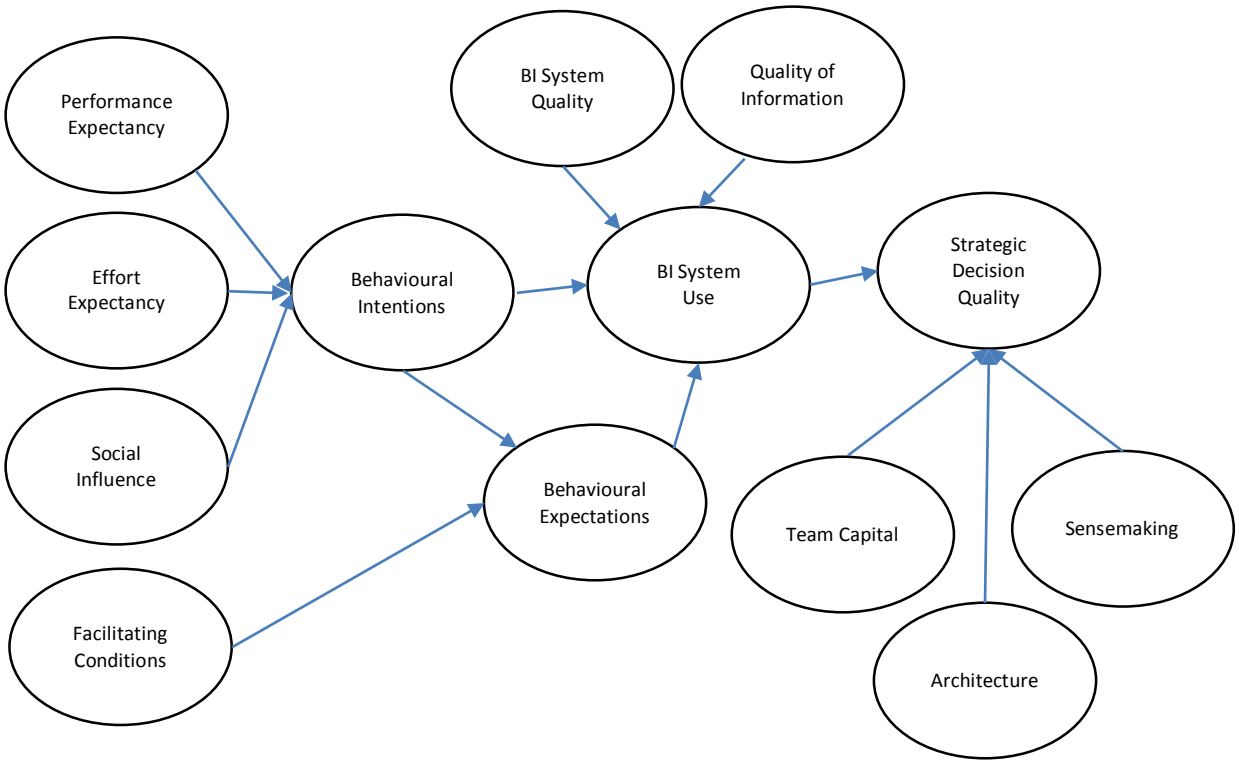


Figure 5-1: Structural Model

Bagozzi (2005) explains that the relationship between indicators and constructs can be either formative or reflective. Relationships between indicators and constructs are said to be formative if the measures are viewed as causes of the construct. Whilst the relationship between indicators and constructs is considered reflective if the

indicators used provide meaning to the construct or are reflective of the construct. In this instance the indicators used should correlate as they are all measuring the same construct. The 13 constructs presented in the model in Figure 5-1 utilised indicators, with data collected through the online survey, which were reflective of the constructs presented in the structural model. For example, the construct of Performance Expectancy was measured through five indicators which gave meaning to the construct. These five indicators measured if respondents felt the BI System was perceived as easy to use, was useful in their job, improved the speed at which they could work, improved their productivity and enhanced their chance of a promotion. These five related indicators were all considered to be measures of improvement of an individual's work performance and as such provided data which informed the construct named Performance Expectancy.

Before the hypotheses of this study could be tested the measurement model was examined for construct validity (test for reliability and validity). Following the procedure outlined in Chapter 3 ensured that before conclusions were drawn regarding the hypotheses of this study the validity and reliability of measurement model was verified and improved as required and that the robustness of the structural model had been assured.

5.3.1 Assessment of the Measurement model

The procedure for assessing the measurement model was outlined in section 3.4.1.1. The first step in testing the measurement model was to confirm and improve item reliability (Santosa, Wei and Chan, 2005). Once item reliability had been confirmed and items not considered meeting minimum loadings were removed, the measurement model was tested for internal consistence. A test for composite reliability and Average Variance Extracted confirmed internal consistency of the measurement model as explained by Fornell and Larker (1981).

Discriminant Validity was then tested at both an item and construct level.

5.3.1.1 Testing for Item Reliability

Santosa, Wei and Chan (2005) explains that individual item reliability measures the loadings of items on their designated construct. Correlations are measured using loadings providing an indication of the extent an item loads onto a construct. Hulland (1999) suggested that a minimum loading of 0.4 is acceptable as discussed in Chapter 3. For this study, items which did not achieve this minimum loading were determined not to be reliable enough in relation to the measurement of the construct assigned to them and were removed. Table 5-9 provides the results of the item reliability test using the original data across the 49 items which provided the data for the structural model.

Table 5-9: Original Item Loadings

Construct	Question Number	Items/ Questions from online survey (<0.4 highlighted)	Loading (<0.4 highlighted)
Social Influence	Q11_1	People who influence my behaviour think that I should use the BI System	0.7300
	Q11_2	People who are important to me think I should use the BI System	0.7763
	Q11_3	The administration of the University has been helpful in the use of the BI System	0.8529
	Q11_4	In, general, the University has supported the use of the BI System	0.8106
Performance Expectancy	Q7_1	I find the BI System useful in my job	0.8196
	Q7_2	Using the BI System enables me to accomplish tasks more quickly	0.9293
	Q7_3	Using the BI System increases my productivity	0.9223
	Q7_4	If I use the BI System I will increase my chances of getting a promotion	0.3660
Effort Expectancy	Q8_1	I find the BI System easy to use	0.8698
	Q8_2	My interaction with the BI System is clear and understandable	0.8472
	Q8_3	It is easy for me to become skilful at using the BI System	0.9463
	Q8_4	Learning to operate the BI System is easy for me	0.9329
Facilitating Conditions	Q12_1	I have the resources necessary to use the BI System	0.8098
	Q12_2	I have the knowledge necessary to use the BI System	0.7491
	Q12_3	The BI System is not compatible with other systems I use (Note: item was recoded due to inverted scale)	0.2648
	Q12_4	A specific person (or group) is available for assistance with BI System difficulties	0.7743

Construct	Question Number	Items/ Questions from online survey (<0.4 highlighted)	Loading (<0.4 highlighted)
Behavioural Intention	Q15_1	I plan to continue to use the BI System in the next 12 months	0.9768
	Q15_2	I predict I would continue to use the BI System in the next 12 months	0.9889
	Q15_3	I intend to continue to use the BI System in the next 12 months	0.9704
Behavioural Expectations	Q9_1	I expect to use the BI System in the next 12 months	0.9702
	Q9_2	I am likely to use the BI System in the next 12 months	0.9863
	Q9_3	I am going to use the BI System in the next 12 months	0.9853
	Q9_4	I will use the BI System in the next 12 months	0.9739
BI System Use	Q4	Frequency of use	0.9509
	Q5	Experience (duration of time using BI System)	0.6544
	Q6	Intensity of use (Note: item was recoded due to inverted scale)	-0.0604
BI System Quality	Q16_1	BI System is accessible	0.7627
	Q16_2	Reliable	0.8489
	Q16_3	Provides timely information	0.8247
	Q16_4	Flexible in how it provide information	0.8626
	Q16_5	Integrated with other processes	0.6641
Quality of Information	Q17_1	Accurate	0.8829
	Q17_2	Complete	0.8818
	Q17_3	Current	0.7689
	Q17_4	Required format	0.8117
Strategic Decision Quality	Q18_1	The decision making process has improved	0.8994
	Q18_2	The decision making content has improved	0.8782
	Q18_3	The decisions are aligned to the Vision of the University	0.8566
	Q18_4	The decisions being made are more likely to achieve the perceived desired outcome	0.9322
Sensemaking	Q19_1	Decisions are made in consideration of internal business intelligence or performance information	0.9144
	Q19_2	Decisions are made in consideration of information or business intelligence on external factors	0.9142
	Q19_3	Information informs decision making	0.8613
Architecture	Q19_4	Decision making is undertaken using a defined or structured process	0.8753
	Q19_5	Decision making process is informed by the BI System	0.9319
Team Capital	Q20_1	Decision making team has a diverse set of skills	0.9317
	Q20_2	Decision making team has a diverse set of knowledge	0.9146
	Q20_3	Decision making team has the capacity to make good decisions	0.8401
	Q20_4	Decision making team has a diverse set of perspectives	0.8671

The item reliability test of the original data set showed that 46 of the items achieved the minimum loading of 0.4. However, three items did not achieve a loading of more than 0.4. These three items are outlined below:

1. **If I use the BI System I will increase my chances of getting a promotion (Q7_4) with a loading of 0.3660**

This item related to the Performance Expectancy construct in the structural model. With a loading of 0.366 this item was not considered reliable. It is suggested that as 74% of the respondents were already in executive and or senior management positions that the prospect of further promotion is not something which significantly impacts these individuals as they may have reached the end stage of progress in their career. As a consequence using the BI System to enhance chances of a promotion may not have been a relevant question for these respondents and the reliability testing suggests that the underlying data is not reliable. The item was removed from further analysis.

2. **The BI System is not compatible with other systems I use (Note: item was recoded due to inverted scale) (Q12_3) with a loading of 0.2648**

This item related to the construct of Facilitating conditions. Facilitating conditions examines the support available for BI System users to establish if an environment exists in which is either supportive or not. It is being suggested that the reliability of this item is low as respondents may have found this question difficult to understand as BI Systems are very much reporting based systems. The suggestion that the BI System is compatible with other systems does not necessarily make sense. BI System, as discussed in Chapter 2, draw together data from corporate systems and other data sources, this technical layer of a BI System is not something respondents may have been familiar with and in either case if this linkage to data sources is not achieved a BI System would not be functional. It should also be noted that this item had reversed scales, this means the statement was presented as a negative reflection, and all other items were presented as a positive statement. For the data analysis, the responses for this item were recoded to allow SmartPLS to deal with a reverse coded item. However, the inclusion of a reverse coded scale may have

confused respondents resulting in unreliable data being collected. Again, this item was removed from further analysis to strengthen the measurement model.

3. **Intensity of use (Note: item was recoded due to inverted scale) (Q6) with a loading of -0.0604**

This item contributed to the constructed related to BI System use. The question being asked of respondents allowed for four choices and the question was also reverse coded. This means the higher response (i.e. 4) was a positive rating, the majority of other questions presented in the survey had a six point Likert scale with 1=strongly agree and 6=strongly disagree. This item may have received a low loading due to the reverse scale and also as the scale may not have been refined enough with only four choices. Again, this item was removed from further analysis to strengthen the measurement model.

After these three items were removed from the measurement model, the item reliability test was performed again to ensure their removal did not impact other items' reliability. The final structural model consisted of 46 items and the reliability of these items is shown in table 5-10.

Table 5-10: Final Item Loadings

Construct	Question Number	Items/ Questions from online survey (<0.4 highlighted)	Loading (<0.4 highlighted)
Social Influence	Q11_1	People who influence my behaviour think that I should use the BI System	0.7300
	Q11_2	People who are important to me think I should use the BI System	0.7763
	Q11_3	The administration of the University has been helpful in the use of the BI System	0.8529
	Q11_4	In, general, the University has supported the use of the BI System	0.8106
Performance Expectancy	Q7_1	I find the BI System useful in my job	0.8196
	Q7_2	Using the BI System enables me to accomplish tasks more quickly	0.9293
	Q7_3	Using the BI System increases my productivity	0.9223
Effort Expectancy	Q8_1	I find the BI System easy to use	0.8698
	Q8_2	My interaction with the BI System is clear and understandable	0.8472
	Q8_2	It is easy for me to become skilful at using the BI System	0.9463
	Q8_3	Learning to operate the BI System is easy for me	0.9329

Construct	Question Number	Items/ Questions from online survey (<0.4 highlighted)	Loading (<0.4 highlighted)
Facilitating Conditions	Q12_1	I have the resources necessary to use the BI System	0.8098
	Q12_2	I have the knowledge necessary to use the BI System	0.7491
	Q12_4	A specific person (or group) is available for assistance with BI System difficulties	0.7743
Behavioural Intention	Q15_1	I plan to continue to use the BI System in the next 12 months	0.9768
	Q15_2	I predict I would continue to use the BI System in the next 12 months	0.9889
	Q15_3	I intend to continue to use the BI System in the next 12 months	0.9704
Behavioural Expectations	Q9_1	I expect to use the BI System in the next 12 months	0.9702
	Q9_2	I am likely to use the BI System in the next 12 months	0.9863
	Q9_3	I am going to use the BI System in the next 12 months	0.9853
	Q9_4	I will use the BI System in the next 12 months	0.9739
BI System Use	Q4	Frequency of use	0.9509
	Q5	Experience (duration of time using BI System)	0.6544
BI System Quality	Q16_1	BI System is accessible	0.7627
	Q16_2	Reliable	0.8489
	Q16_3	Provides timely information	0.8247
	Q16_4	Flexible in how it provide information	0.8626
	Q16_5	Integrated with other processes	0.6641
Quality of Information	Q17_1	Accurate	0.8829
	Q17_2	Complete	0.8818
	Q17_3	Current	0.7689
	Q17_4	Required format	0.8117
Strategic Decision Quality	Q18_1	The decision making process has improved	0.8994
	Q18_2	The decision making content has improved	0.8782
	Q18_3	The decisions are aligned to the Vision of the University	0.8566
	Q18_4	The decisions being made are more likely to achieve the perceived desired outcome	0.9322
Sensemaking	Q19_1	Decisions are made in consideration of internal business intelligence or performance information	0.9144
	Q19_2	Decisions are made in consideration of information or business intelligence on external factors	0.9142
	Q19_3	Information informs decision making	0.8613
Architecture	Q19_4	Decision making is undertaken using a defined or structured process	0.8753
	Q19_5	Decision making process is informed by the BI System	0.9319
Team Capital	Q20_1	Decision making team has a diverse set of skills	0.9317
	Q20_2	Decision making team has a diverse set of knowledge	0.9146
	Q20_3	Decision making team has the capacity to make good decisions	0.8401
	Q20_4	Decision making team has a diverse set of perspectives	0.8671

In reviewing the final item loadings presented in Table 5-10, it can be seen that all items exceed the Hulland (1999) suggested value of 0.4. None of the items in the final measurement model presented loadings of less than 0.6. Only two items scored loadings less than 0.7, Question 16.5 with a loading of 0.6641 and Question 5 with a loading of 0.6544. All other items loaded with values of 0.7, suggesting a reliable measurement model had been achieved as per the general rule for correlation analysis described by Hulland (1999).

Having established that individual items measuring constructs were reliable in terms of the data they provided on their designated construct, tests for internal consistency were performed next. Of interest here was whether the multiple items which measured a construct, produced consistent scores.

5.3.1.2 Testing Internal Consistency of Constructs

Internal consistency testing was achieved using the measure developed by Fornell and Larker (1981), as outlined in Chapter 3. The assessment procedure involves testing for Composite Reliability and Average Variance Extracted. Composite Reliability is calculated as the sum of the loadings, all squared, divided by the sum of the loadings, all squared, plus the sum of the error terms. (Fornell and Larker, 1981; Barclay, Higgins, Thompson, 1995). It is suggested by Barclay, Higgins, Thompson (1995) that value of 0.7, also used for Cronbach's alpha according to Nunnally (1978), is generally considered an acceptable value.

The second test for internal consistency outlined by Fornell and Larcker (1981) is called Average Variance Extracted (AVE). AVE measures how much of the variance captured by the latent variable in a structural equation model is shared among its measures. For first time studies it is generally accepted that items returning an AVE above 0.5 should be retained (Hulland, 1999). This means items which obtained an AVE of less than 0.5 were not considered to be contributing to the internal consistency and were removed for this study. Table 5-11 provides the results of the internal consistency test and shows that AVE for all constructs is above 0.5 and all

Composite Reliability score were above 0.7. The measurement model was therefore considered to have achieved internal consistency.

Table 5-11: Internal Consistency Test Results

Constructs	Average Variance Extracted (AVE) (>0.5 required)	Composite Reliability (>0.7 required)
Architecture	0.8173	0.8994
BI System Quality	0.6334	0.8955
BI System Use	0.6652	0.7933
Behavioural Expectations	0.9584	0.9893
Behavioural Intention	0.9579	0.9856
Effort Expectancy	0.8410	0.9405
Facilitating Conditions	0.5866	0.8501
Performance Expectancy	0.6722	0.8884
Quality of Information	0.7018	0.9037
Sensemaking	0.8046	0.9250
Social Influence	0.6300	0.8716
Strategic Decision Quality	0.7957	0.9396
Team Capital	0.7906	0.9378

Measurement model testing next consider discriminant validity. This means to what extent are measures used for one construct different to the measures used for another constructs Hulland (1999).

5.3.1.3 Discriminant Validity

As discussed in Chapter 3 Section 3.4.1.1 Hulland (1999) explains that discriminant validity is defined as the degree to which measures of a construct are different from measures from another construct. To ensure discriminant validity is achieved constructs should share more variance with its measures than with other constructs in the research model. Discriminant validity is measured at both the item and construct level.

Construct level

At the construct level Fornell and Larcker (1981) suggest that the measure of Average Variance Extracted (or square root of the AVE) should be greater than variances

shared (or correlation) between the construct and other constructs (i.e. the squared correlation between two constructs). This general rule was applied to this study. Table 5-12 provides the result of the construct level test for discriminant validity. The results showed that the square root of the AVE for each construct was in all cases higher than the correlation of the construct with other constructs.

Table 5-12: Construct Level Discriminant Validity Test Results

(Note: highlighted diagonal results = Square-root of the AVE, other values are correlation values)

	Architecture	BI System Quality	BI System Use	Behavioural Expectations	Behavioural Intention	Effort Expectancy	Facilitating Conditions	Performance Expectancy	Quality of Information	Sensemaking	Social Influence	Strategic Decision Quality	Team Capital
Architecture	0.9040												
BI System Quality	0.5736	0.7959											
BI System Use	0.1950	0.1888	0.8162										
Behavioural Expectations	0.2628	0.1695	0.4053	0.9790									
Behavioural Intention	0.2540	0.1679	0.3662	0.9380	0.9787								
Effort Expectancy	0.3882	0.5425	0.0655	0.1555	0.1288	0.9171							
Facilitating Conditions	0.4471	0.6350	0.1988	0.2899	0.2909	0.6054	0.7659						
Performance Expectancy	0.5105	0.6249	0.4148	0.2731	0.2724	0.5461	0.5642	0.8199					
Quality of Information	0.5842	0.7877	0.2165	0.1809	0.2028	0.4862	0.6173	0.6501	0.8377				
Sensemaking	0.7287	0.5203	0.2349	0.2023	0.1801	0.3673	0.4486	0.4445	0.5036	0.8970			
Social Influence	0.4987	0.4564	0.1894	0.2598	0.2079	0.4159	0.6577	0.4546	0.4395	0.5106	0.7937		
Strategic Decision Quality	0.6926	0.6247	0.2939	0.2271	0.2107	0.4156	0.5464	0.6771	0.6610	0.6209	0.5359	0.8920	
Team Capital	0.5149	0.3886	-0.075	0.0717	0.0765	0.2776	0.3989	0.2844	0.3939	0.5485	0.3956	0.5262	0.8892

Item level

As previously discussed Barclay, Higgins, Thompson (1995) and Hulland (1999) explain that discriminant validity must also be measured at the item level. The test

at an item level, achieved through examining cross-loadings, should show that no item loaded higher on any other construct but the construct it is trying to measure. SmartPLS provides a cross loadings output which is presented in table 5-13.

Table 5-13: Item Level Discriminant Validity (Cross Loadings)

	Architecture	BI System Quality	BI System Use	Behavioural Expectations	Behavioural Intention	Effort Expectancy	Facilitating Conditions	Performance Expectancy	Quality of Information	Sensemaking	Social Influence	Strategic Decision Quality	Team Capital
Q19_4	0.8753	0.5025	0.1118	0.239	0.2316	0.4043	0.4078	0.3665	0.4631	0.6210	0.4380	0.5282	0.4613
Q19_5	0.9319	0.5343	0.2259	0.2381	0.2297	0.3249	0.3751	0.5182	0.5806	0.6918	0.4636	0.7040	0.4718
Q16_1	0.4513	0.7627	0.1833	0.2522	0.2198	0.5476	0.5793	0.472	0.4965	0.3893	0.4641	0.4211	0.3207
Q16_2	0.4676	0.8489	0.1597	0.0703	0.0802	0.4643	0.479	0.496	0.715	0.4291	0.3443	0.5767	0.3563
Q16_3	0.5165	0.8247	0.1499	0.1256	0.133	0.4029	0.4185	0.4894	0.7237	0.4645	0.3223	0.5448	0.3046
Q16_4	0.4782	0.8626	0.1261	0.1199	0.1195	0.4367	0.4777	0.4888	0.7000	0.4292	0.4303	0.5418	0.3168
Q16_5	0.3459	0.6641	0.1108	0.0644	0.0861	0.3675	0.3935	0.4007	0.5051	0.3507	0.2047	0.3962	0.2218
Q4	0.1755	0.1818	0.9509	0.4641	0.4228	0.0922	0.2083	0.4008	0.1827	0.1998	0.2098	0.2769	-0.075
Q5	0.1521	0.1179	0.6544	0.0731	0.0575	0.0426	0.0877	0.289	0.1981	0.2112	0.0514	0.1985	-0.0403
Q9_1	0.2902	0.1768	0.4113	0.9702	0.9238	0.1778	0.3143	0.276	0.2058	0.2451	0.2829	0.2486	0.0955
Q9_2	0.2177	0.1392	0.378	0.9863	0.9217	0.1368	0.2674	0.2243	0.1552	0.1832	0.2414	0.1818	0.0675
Q9_3	0.2472	0.185	0.3791	0.9853	0.9298	0.179	0.3037	0.2744	0.1822	0.1742	0.2571	0.2226	0.0587
Q9_4	0.2734	0.1623	0.4188	0.9739	0.8971	0.1432	0.2743	0.2887	0.1646	0.1892	0.2351	0.2361	0.0586
Q15_1	0.2816	0.165	0.3685	0.9298	0.9768	0.1436	0.2784	0.2757	0.2062	0.219	0.2183	0.2149	0.0982
Q15_2	0.2282	0.1375	0.3496	0.9237	0.9889	0.1035	0.2837	0.2478	0.1767	0.1674	0.1887	0.1741	0.0800
Q15_3	0.2352	0.1907	0.357	0.9002	0.9704	0.1236	0.2986	0.2967	0.2123	0.1413	0.203	0.2296	0.0457
Q8_1	0.3475	0.5453	0.1439	0.1553	0.0977	0.8698	0.4806	0.4783	0.5252	0.3996	0.4299	0.4369	0.2651
Q8_2	0.4010	0.5812	0.1245	0.0628	0.034	0.8472	0.5209	0.6018	0.5209	0.3581	0.4644	0.4563	0.233
Q8_3	0.4031	0.5044	0.0592	0.1674	0.1491	0.9463	0.4597	0.4798	0.4547	0.3679	0.3876	0.4113	0.2269
Q8_4	0.307	0.5016	0.0463	0.1449	0.1115	0.9329	0.5451	0.3613	0.446	0.3151	0.3777	0.3476	0.3179
Q12_1	0.3886	0.4626	0.1739	0.1893	0.1994	0.4312	0.8098	0.4153	0.4319	0.4077	0.6164	0.3963	0.3152
Q12_2	0.2662	0.4005	0.2062	0.2056	0.2323	0.6105	0.7491	0.3699	0.4211	0.2465	0.4583	0.2911	0.1869
Q12_4	0.3445	0.5183	0.1053	0.2763	0.2433	0.2699	0.7743	0.3472	0.4783	0.3472	0.3869	0.4567	0.3612
Q7_1	0.3624	0.4739	0.4467	0.2191	0.2313	0.3442	0.3808	0.8196	0.4959	0.3027	0.3174	0.535	0.1134
Q7_2	0.5176	0.5693	0.319	0.2547	0.2572	0.4986	0.4573	0.9293	0.62	0.3842	0.4525	0.6402	0.262
Q7_3	0.4491	0.5413	0.382	0.2514	0.2579	0.483	0.4449	0.9223	0.5487	0.432	0.3674	0.6022	0.3287
Q17_1	0.4846	0.6763	0.2328	0.126	0.1661	0.4446	0.516	0.5254	0.8829	0.4701	0.4333	0.5582	0.3291
Q17_2	0.5122	0.6692	0.1248	0.1708	0.2049	0.4354	0.4295	0.5036	0.8818	0.394	0.3651	0.5493	0.3472
Q17_3	0.4783	0.7013	0.1076	0.2211	0.2017	0.3936	0.4012	0.4751	0.7689	0.4491	0.2702	0.4785	0.3217
Q17_4	0.4966	0.626	0.2001	0.1351	0.1388	0.456	0.5316	0.567	0.8117	0.377	0.3546	0.603	0.3313
Q19_1	0.6784	0.4801	0.1532	0.1908	0.1649	0.4252	0.3922	0.374	0.4686	0.9144	0.499	0.5662	0.4943
Q19_2	0.6401	0.4789	0.1983	0.1095	0.1083	0.3637	0.3806	0.414	0.4696	0.9142	0.4421	0.5767	0.5418
Q19_3	0.6432	0.4399	0.2865	0.2508	0.2167	0.264	0.3834	0.341	0.4148	0.8613	0.4323	0.5264	0.4359

	Architecture	BI System Quality	BI System Use	Behavioural Expectations	Behavioural Intention	Effort Expectancy	Facilitating Conditions	Performance Expectancy	Quality of Information	Sensemaking	Social Influence	Strategic Decision Quality	Team Capital
Q11_1	0.2004	0.1938	0.1941	0.1813	0.1051	0.3089	0.3546	0.2317	0.2069	0.2755	0.7300	0.2646	0.2606
Q11_2	0.3279	0.2071	0.1827	0.2457	0.1668	0.3414	0.3793	0.2519	0.2102	0.341	0.7763	0.2932	0.3245
Q11_3	0.4653	0.5337	0.0972	0.2074	0.1833	0.4411	0.6443	0.437	0.477	0.4806	0.8529	0.5557	0.3324
Q11_4	0.5115	0.439	0.1533	0.1895	0.1841	0.2966	0.5074	0.3913	0.4383	0.4746	0.8106	0.5196	0.326
Q18_1	0.6044	0.5684	0.2987	0.1721	0.1637	0.4222	0.49	0.6529	0.6147	0.531	0.4729	0.8994	0.4268
Q18_2	0.5671	0.5595	0.299	0.1568	0.1264	0.3454	0.4573	0.6036	0.63	0.4946	0.4011	0.8782	0.4183
Q18_3	0.6469	0.5375	0.2141	0.2100	0.1865	0.4001	0.4222	0.5572	0.5217	0.5931	0.5571	0.8566	0.5240
Q18_4	0.6461	0.5642	0.2427	0.2648	0.2671	0.4022	0.4209	0.5659	0.5974	0.5884	0.472	0.9322	0.5001
Q20_1	0.4651	0.3826	-0.0491	-0.0043	0.0126	0.3276	0.4054	0.292	0.406	0.5139	0.3802	0.4772	0.9317
Q20_2	0.4189	0.3232	-0.06	0.0251	0.0341	0.2298	0.3444	0.2477	0.3556	0.5103	0.3413	0.4246	0.9146
Q20_3	0.5315	0.3756	-0.0779	0.1737	0.1587	0.2122	0.2765	0.1702	0.3288	0.5136	0.3844	0.4928	0.8401
Q20_4	0.4044	0.2933	-0.0786	0.0518	0.0592	0.2486	0.3239	0.2434	0.3081	0.4092	0.2949	0.4676	0.8671

All items loaded higher on the construct they were designated to measure than any other construct in the model. As such, item level discriminant validity was achieved.

The measurement model test has shown that the measures being used to supply data to the structural model for this study were sufficiently valid and reliable to provide meaningful analysis in relation to the hypotheses of this study. However, the structural model also needs to be assessed. The next section examined the relationships between constructs to establish if the structural model used is robust, this means provides statistically significant relational information between constructs. After the structural model has been assessed hypotheses testing results are presented before the outcomes of mediation testing are discussed.

5.3.2 Analysis of the Structural Model

As discussed in Chapter 3, the structural model was assessed by examining relationships between constructs in the model using path coefficients. This provided an indication of the nature of the relationship between constructs (either positive

relationship or negative) and the adequacy of the research model. (Hulland, 1999; Santosa, Wei and Chan, 2005)

Barclay, Higgins, Thompson (1995) explained that the relationships between constructs in a structural model can be measured using R-Squared values. To test the structural model R-Squared values are used to show how much of the variance in one latent construct can be explained by the other latent construct and the direction (positive or negative) of the relationship between two latent variables. SmartPLS provided the functionality to undertake this analysis and Figure 5-2 presents the outcomes of this test of the structural model.

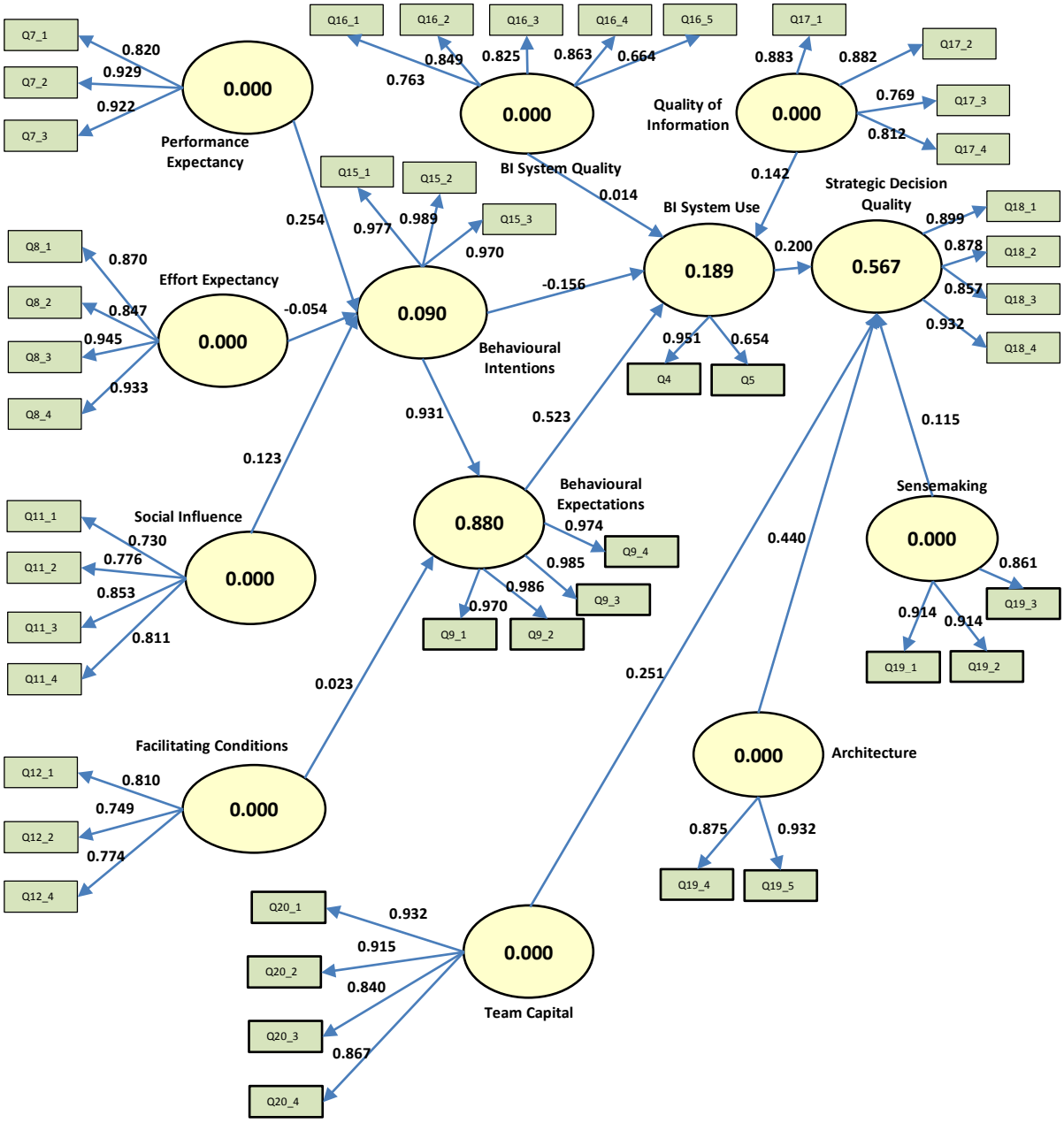


Figure 5-2: PLS-SME Output from SmartPLS

The SmartPLS output in figure 5-2 showed both item loadings, i.e. between items and constructs, regression weights, shown on the path arrows between constructs which indicates the strength and nature, i.e. either positive or negative, of the relationship between constructs and the R-Squared of each construct which shows the percentage variance in a construct explained by the other constructs in model related

to the constructs. The results of the model are interpreted later during the hypotheses testing section 5.4.

After running the PLS-SEM a Bootstrap test was run to test the significance of the path coefficients and thus the predictive properties of the structural model. To test the significance of the path coefficients t-statistics are used. The general rule that was applied was that path coefficients with a t-statistic greater than 1.96 was considered significant at the 95% confidence level.

Figure 5-3 presents the SmartPLS Bootstrap Test output. Values presented between on the structural model are t-statistics used to establish the significance of path coefficients.

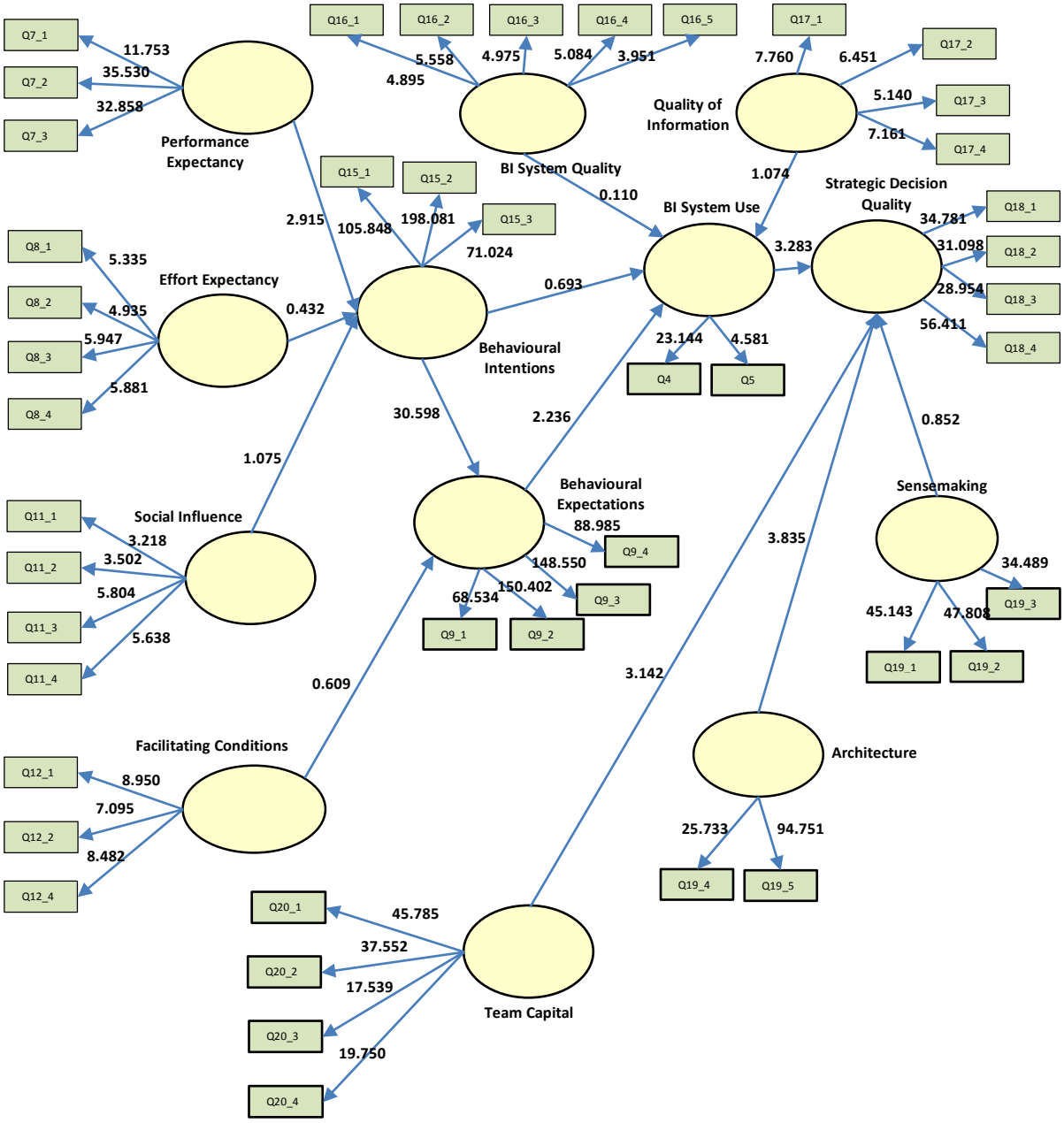


Figure 3: Bootstrap Test of Structural Model

5.4 Hypotheses Testing

This section discusses the results of the data analysis with respect to the hypotheses previously discussed in Chapter 4. Chapter 6 discusses the results related to each of the hypotheses, in relation to the theory and research outlined in literature review.

To test the hypotheses proposed for this study, the results from the PLS-SEM and the Bootstrap test presented in section 5.3.2 in figures 5-2 and 5-3 are summarised in table 5-14. As previously discussed, to test the hypotheses an assessment of the standard regression weights or path coefficients between constructs related to the hypotheses were measured to provide insights into the strength of the relationships and their nature (either positive or negative). The path coefficients were also assessed for significance. The test for statistical significance is achieved through a t-test. Unless a path coefficient achieves a t-statistic above 1.96 it was not considered significant and the related hypotheses was rejected. Those hypotheses with t-statistics above 1.96 were supported and in this instance the standard regression weights provide meaningful insights into the strength of the relationship and its nature (positive or negative).

Table 5-14: Hypotheses Testing

#	Hypotheses	Beta (Standard regression weight)	t-statistic (test for significance >1.96 @ 95% confidence level)	Support for Hypotheses achieved
H1a	Behavioural Intention will positively influence BI System usage (duration, frequency and intensity).	-0.156	0.693	Rejected
H1b	**Behavioural Expectations will positively influence BI System usage (duration, frequency and intensity).**	**0.523**	**2.236**	**Supported**
H1c	Quality of information will positively influence BI System usage (duration, frequency and intensity).	0.142	1.074	Rejected
H1d	Quality of BI System will positively influence BI System usage (duration, frequency and intensity).	0.014	0.110	Rejected
H2	**BI System usage will positively influence the perceived quality of strategic decisions (Quality of process, content and alignment to vision).**	**0.200**	**3.283**	**Supported**
H3a	**Team Capital (diverse in skills, knowledge, abilities and perspectives of the decision making team) will**	**0.251**	**3.142**	**Supported**

#	Hypotheses	Beta (Standard regression weight)	t-statistic (test for significance >1.96 @ 95% confidence level)	Support for Hypotheses achieved
	be positively influenced he perceived quality of the strategic decision (Quality of process, content and alignment to vision).			
H3b	**Architecture (defined and structured decision making process which uses BI) will be positively influenced he perceived quality of the strategic decision (Quality of process, content and alignment to vision).**	**0.440**	**3.835**	**Supported**
H3c	Sensemaking (decision making which uses business intelligence or information) will be positively influenced he perceived quality of the strategic decision (Quality of process, content and alignment to vision).	0.115	0.852	Rejected

5.4.1 H1a: Behavioural Intention will positively influence BI System usage

One of the key components of the research model of this study was the use of the UTUAT model for measuring IT system adoption and use. The UTAUT model, developed by Venkatesh, Morris, Davies and Davies (2003), suggested that Behavioural Intentions, mediated by Behavioural Expectations, positively influences IT system usage.

This study has however, found that the relationship between Behavioural Intentions and BI System usage is not significant. The impact of the mediating variable Behavioural Expectations are discussed further in Section 5.5. The standard regression weight between the two constructs produced a Beta of -0.156 and was not found to be significant with a t-statistic of 0.693.

5.4.2 H1b: Behavioural Expectations will positively influence BI System usage

As discussed in 5.4.1 Behavioural Intentions, from the UTAUT model, was assessed in relation to its predictive ability towards BI System use. Likewise, Venkatesh, Morris, Davies and Davies (2003) has also proposed that a related concept of Behavioural Expectations, which is informed by Behavioural Intentions, provides a positive influence on BI System usage. Venkatesh, Morris, Davies and Davies (2003) has suggested in his studies that Behavioural Intentions provides a positive influence on IT system adoption and use. From this it is possible to infer that the stronger the Behavioural Intentions of an individual the more likely they are to use the IT system. The results of this study support Venkatesh's findings. Behavioural Expectations was found to positively (Beta = 0.523) and significantly (t-statistic = 2.236) influence BI System usage. The hypotheses was supported.

5.4.3 H1c: Quality of information will positively influence BI System usage

As discussed in Chapter 4, the perceived quality of information was included in the research model to explore if it had any controlling influence on BI System use. This lead to the development of a hypotheses which proposed that the quality of information provided through a BI System influenced usage behaviours of the BI System. It was proposed that with increased quality of information the usage of the BI System would increase. A study by Gorla, Somers and Wong (2010) had discussed the use of this construct and quality of IT system, which is discussed next, in their study to examine its effect on organisational impact. The study found that information quality had a significant direct effect on organisational impact. As organisational impact has some similar items in intent to BI System use, the study of Gorla, Somers and Wong (2010) is of some interest to this discussion.

The results of this study however, suggest that the effect of the quality of the information does not significantly influence BI System usage. The standard regression weight with a Beta=0.142 is not considered strong but more importantly

the associated path coefficient did not produce a result which was above 1.96 (i.e. t-statistic=1.074) indicating the relationship is not significant.

5.4.4 H1d: Quality of BI System will positively influence BI System usage

As with the quality of information construct, the quality of the BI System was also added to the research model, as discussed in Chapter 4, to explore if it had any controlling influence on BI System use. A related hypotheses was developed to test this potential relationship. As Discussed in 5.4.3 Gorla, Somers and Wong (2010) had discussed the use of this construct (and quality of information) in their study to examine its effect on organisational impact. Although the study found that system quality did not have a significant direct effect on organisational impact. However, the indirect effect, if moderated through information quality, was significant.

The analysis also revealed that the quality of BI System did not influence BI System usage. The path coefficient between the two constructs of BI System quality and BI System usage received a standard regression weight of 0.014, which was not considered significant with a t-statistic of 0.110. The hypotheses was rejected.

5.4.5 H2: BI System usage will positively influence the perceived quality of strategic decisions

BI System usage and its influence on the perceived quality of strategic decisions was a central hypotheses for this study. The literature review highlighted that BI Systems exist to deliver information to decisions makers and the assertions that this would have a positive outcome on the quality of the decisions being made. The results indicate that BI System usage was found to positively (Beta = 0.200) and significantly (t-statistic = 3.283) influence perceptions of the quality of strategic decision making. This means the hypotheses was supported.

5.4.6 H3a: Team Capital will positively influence the perceived quality of the strategic decision

Team capital, a concept developed by Wood and Klass (2008), measured as the diversity of skills, knowledge, abilities and perspectives of the decision making team and their capability, was hypothesesed to have a positive influence on the perceptions of the quality of the strategic decision making. Bantel and Jackson's (1989) study found that the cognitive capability of teams is enhanced if the team is diverse in skills, knowledge, abilities and perspectives. Amason (1996) had suggested that the diversity of decision making team, their cognitive abilities and knowledge contributed to the quality of the strategic decision making by senior managers.

The results of this study confirmed that the construct of Team Capital positively (Beta = 0.251) and significantly (t-statistic = 3.142) influences the perceived quality of strategic decision. This means the hypotheses was supported.

5.4.7 H3b: Architecture will positively influence the perceived quality of the strategic decision

Architecture, the use of a defined and structured decision making process informed by BI, was discussed in the literature review as having had a positive influence on the quality of decision making. Wood and Klass (2008) and Kopeikina (2005) suggested that through their theoretical frameworks that a rational and structured decision making process would have a positive influence on the quality of decision making. The results of this study provide supporting evidence to this theory as the construct of Architecture positively (Beta = 0.440) and significantly (t-statistic = 3.835) influenced the perceived quality of strategic decision. The hypotheses was supported.

5.4.8 H3c: Sensemaking will positively influence the perceived quality of the strategic decision

The final hypotheses presented considered the construct of Sensemaking, this means decision making which uses business intelligence or information, and its influence on the perceived quality of strategic decision making. As discussed in the literature review information as an input to decision making is generally accepted as having a positive impact (Citroen, 2011; Harrison, 1996; Ragunathan, 1999). Surprisingly the results of this study indicated that Sensemaking does not significantly contribute to the perceived quality of strategic decision making, all be it in the context of the research model presented. The results show that Sensemaking with standard regression weight to the with a Beta=0.115 is not considered strongly related to perceived quality of strategic decision making, but more importantly the associated path coefficient did not produce a result which was above 1.96 (i.e. t-statistic=0.52) indicating the relationship is not significant. The hypotheses was therefore not supported.

The results of the hypotheses testing is discussed in more detail in Chapter 6. The outcomes of mediation testing between the mediating variable of Behavioural Expectations and the independent variable of Behavioural Intentions and the dependent variable of BI System use are now be presented.

5.5 Analysis of Mediation Effect

The structural model developed for this study contained one mediating variable, Behavioural Expectations. This mediating variable was proposed to impact the relationship between Behavioural Intentions and BI System Usage. As discussed in Chapter 4 mediation is the effect observed when a construct impacts on the relationship between other constructs Sobel (1990).

Figure 5-4 shows the mediating effect which was tested in this study. Here it was proposed that a significant relationship exists between Independent Variable (Behavioural Intentions) and Dependent Variable (BI System use) as measured by t-value (A). The introduction of the mediating variable (Behavioural Expectations) is proposed to have the effect of mediating the significance of the relationship between the Independent Variable (Behavioural Intentions) and the Dependent Variable (BI System use) to produce a t-value (B).

Figure 5-4 outlines the mediating effect:

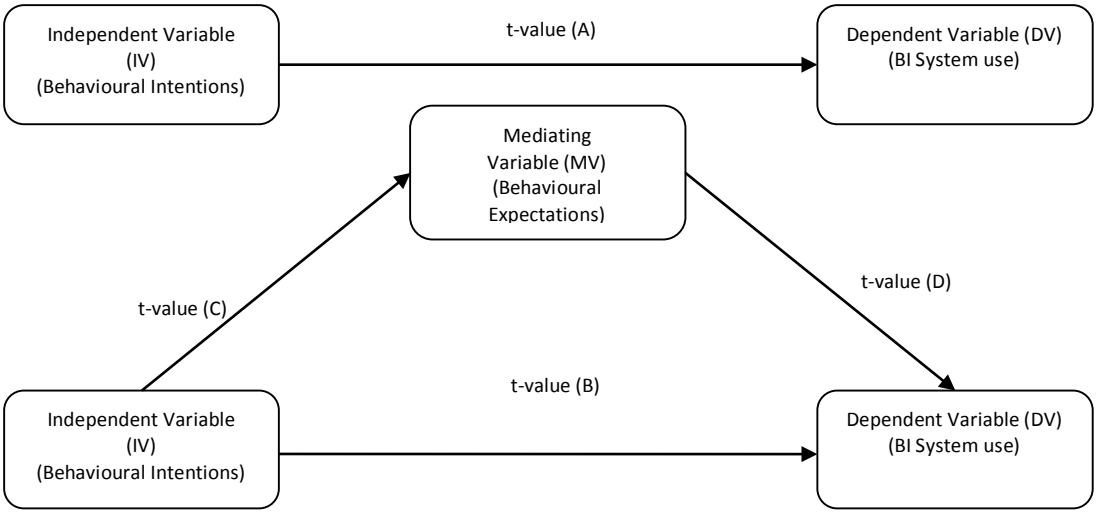


Figure 5-4: Mediation (Adapted from Grapentine, 2000, MacKinnon, 2007 and Sobel, 1990)

A four step process was used to test for mediation effect as outlined in figure 5-5. Step one involved measuring the significance and nature of the relationship between Behavioural Intentions (IV) and BI System Use (DV). This showed that a significant (t-value = 4.213) and positive relationship (Beta value= 0.406) existed, indicating that Behavioural Intentions has an effect on BI System Use.

Step two then tested the relationship between Behavioural Intentions (IV) and the mediating variable Behavioural Expectations (MV).

In this step the mediating variable effectively becomes the dependent variable. This showed that Behavioural Intentions (IV) has an effect on Behavioural Expectations (MV) with the results indicating that a significant (t-value = 37.765) and positive relationship (Beta = 0.938) existed.

The third step involved testing what effect the mediating variable Behavioural Expectations (MV) had on the dependent variable BI System Use (DV). The results showed that a significant (t-value = 4.881) and positive relationship (Beta = 0.445) existed.

Step 4 tested for the effect of the mediating variable on the relationship between the independent and the dependent variable. It was found that with the introduction of the mediating variable, Behavioural Expectations (MV), the relationship between the independent variable, Behavioural Intentions (IV) and the dependent variable, BI System use (DV) was affected. With the introduction of the mediating variable the effect between Behavioural Intentions (IV) and BI System Use (DV) was mediated to the extent that the relationship (Beta = - 0.111) was now no longer significant (t-value = 0.494 which is < 1.96 @ 95% confidence). However, the relationships between Behavioural Intention and the Behavioural Expectations and also between Behavioural Expectations and BI System Use remained positive and significant in both cases. Figure 5-5 provides a summary of the pathway diagrams from SmartPLS which show the four step process being executed and Table 5-15 provides a summary of the results.

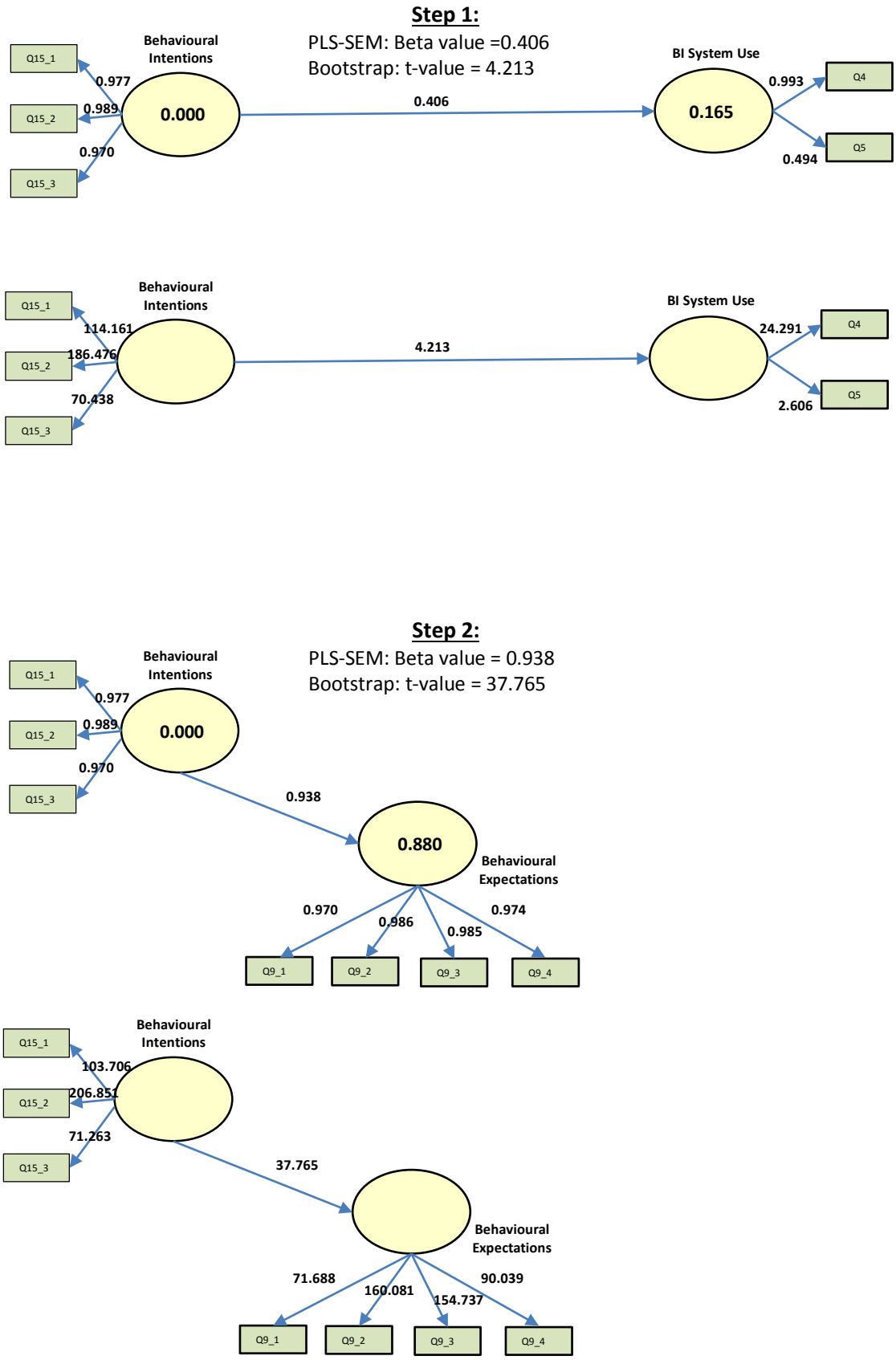
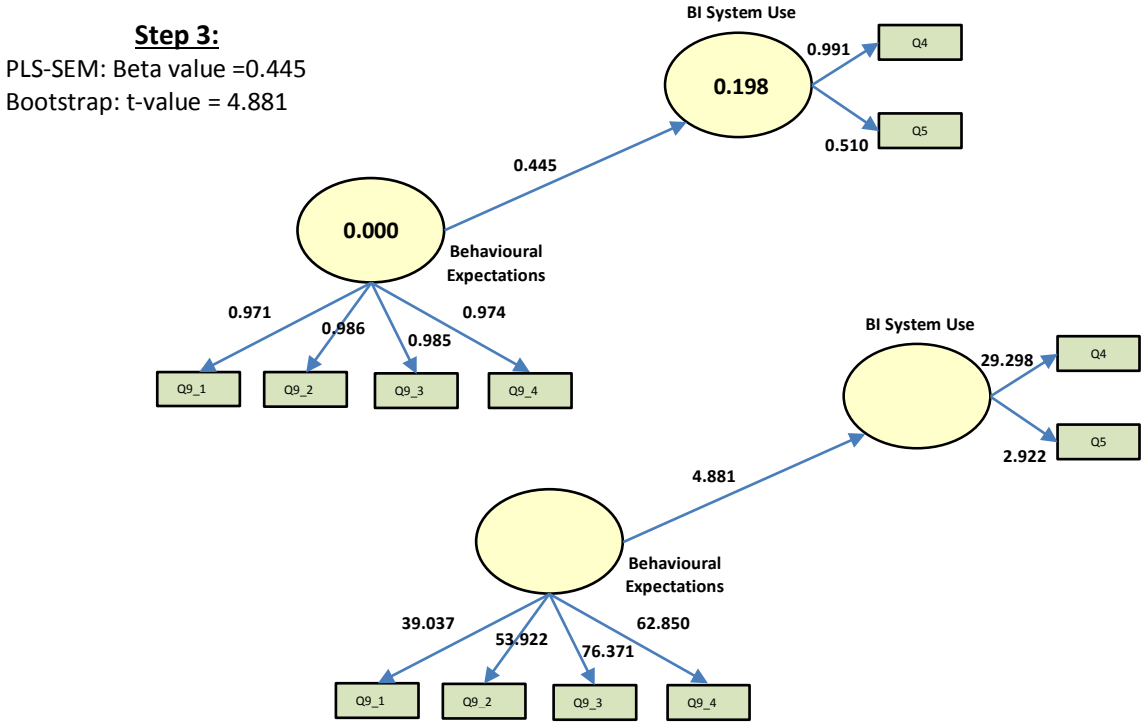


Figure 5-5: Four Step Process of Mediation Test



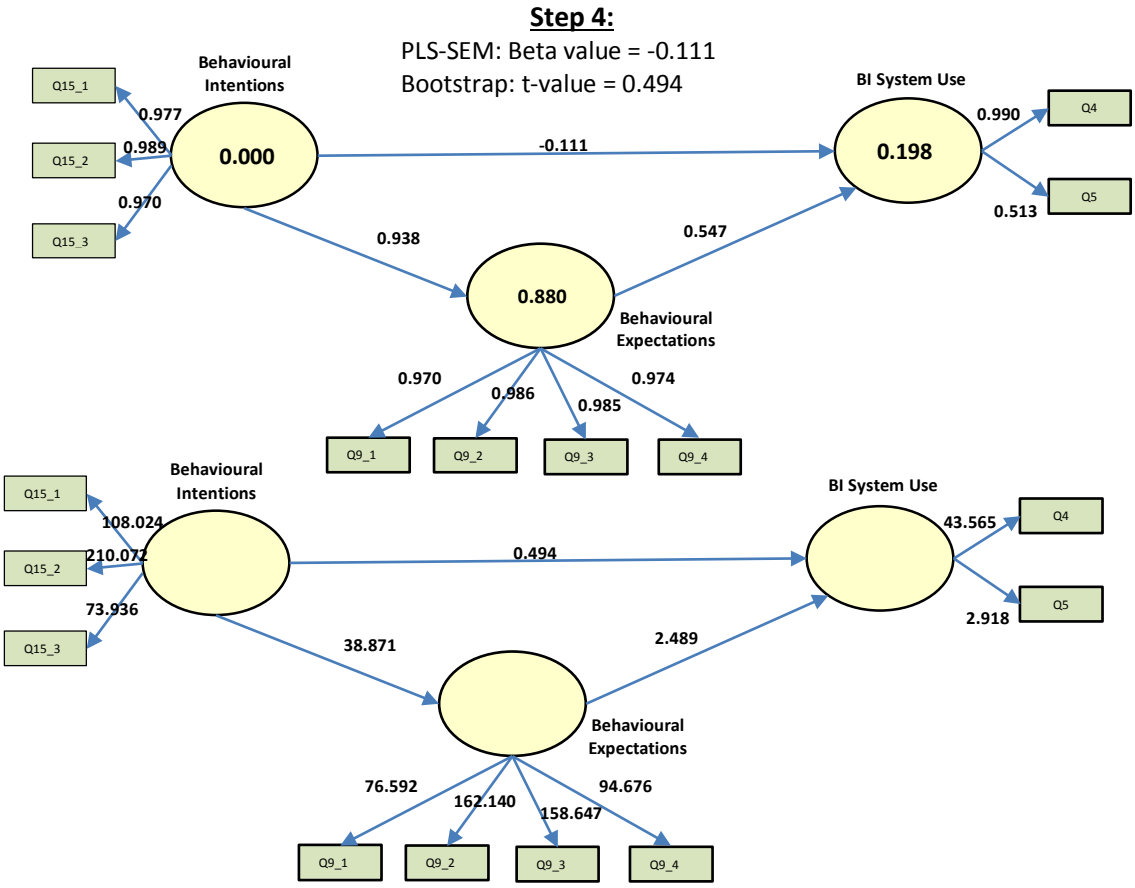


Figure 5-5 (continued): Four Step Process of Mediation Test

Table 5-15: Mediation Effect Testing

Test	Model	Beta value (Standard regression weight)	t-value (test for significance >1.96 @ 95% confidence level)
Independent -> Dependent	Behavioural Intention -> BI System Use	0.406	4.213
Independent -> Mediating (Mediating Variable treated as Dependent Variable)	Behavioural Intention -> Behavioural Expectations	0.938	37.765
Mediating -> Dependent (Mediating Variable treated as Independent Variable)	Behavioural Expectations -> BI System Use	0.445	4.881
Independent -> Dependent (with Mediating Variable impacting)	Behavioural Intentions -> BI System Use (with Behavioural Expectations as mediating variable)	-0.111	0.494

In summary, Behavioural Expectations has a mediating effect on the relationship between Behavioural Intentions and BI System Use. Table 5-15 shows that Behavioural Expectations is a slightly stronger and more significant predictor of BI System usage than Behavioural Intentions.

5.6 Summary

This Chapter presented the results of the data analysis for this study. The data collected through the online survey of senior managers in Australia Universities was first analysed to establish non-response bias. This was achieved by comparing the means of two waves of respondents for any statistically significant differences. The response data was found not to suffer from any significant non response bias. Data quality and review procedures described in Chapter 3 were followed to test both the measurement model and structural model used in the study. Item reliability testing resulted in strong item loadings being observed across all but three of items which resulted in their removal for further analysis. Constructs were tested for internal consistency and all constructs used achieved the required Average Variance

Extracted of greater than 0.5 and a composite reliability of above 0.7, demonstrating that the constructs used in the structural model had achieved internal consistency. Discriminant validity was examined at the item and construct level. At a construct discriminant validity was achieved. Examining cross loadings at an item level revealed no items loaded higher on any construct but the construct the items intended to measure.

The structural model was then assessed and found to be sufficiently robust to allow for the testing of the hypotheses presented in this study. Hypotheses testing then examined the standard regression weights and t-values achieved between the constructs identified in the eight hypotheses. The results showed that four of the eight hypotheses were supported.

Chapter 5 concluded with an analysis of the mediation effect of Behavioural Expectations on the relationship between Behavioural Intentions and BI System usage. The four step process which examined changes to standard regression weights and t-values confirmed that Behavioural Expectations has a mediating effect on the relationship between Behavioural Intentions and BI System usage.

Chapter 6 discusses the results of this study in the context of the hypotheses presented and presents implications for both theory and practice.

6 Discussion and Implications

6.1 Introduction

This study found that although BI system usage positively influences senior managers perceptions regarding the quality of strategic decisions, other factors were found to be more significant. Senior managers indicated, in the survey, that a structured decision making process informed by business intelligence and the decision making Team Capital are more significant factors. This and other key findings are discussed in more detail in this Chapter.

The Chapter presents the results of the research conducted and generates insights for both theory and practice. Findings are then discussed relative to the eight hypotheses of the study, and in relation to prior research and theory as relevant to this study. The discussion of the hypotheses of this study can be grouped into four major headings. 1) Predicting BI System usage by measuring Behavioural Intentions and Behavioural Expectations (H1a and H1b); 2) Influence of Quality of Information and the Quality of the BI System on BI System use (H1c and H1d); 3) Influence of Team Capital, Architecture, and Sensemaking on the perceptions of the Quality of Strategic Decisions (H2a, H2b and H2c); and 4) BI System usage influence on the perceptions of the Quality of Strategic Decisions (H2).

The Chapter concludes by discussing the implications for theory related to the validation of the UTAUT model, development of measures for the perceptions of Strategic Decision Quality, and validation of the concepts of Sensemaking, Architecture and Team Capital.

Implications for practice are discussed in relation to the use of BI Systems for improved quality of strategic decision making quality, the importance of team diversity, and the importance of the decision making process for quality strategic decision making.

6.2 Discussion of Hypotheses

This study proposed eight hypotheses that were tested using the structural model presented in Chapter 5. In addition, Chapter 5 presented the results of the hypotheses testing, which found four of the eight hypotheses were supported. The discussion of the hypotheses first examines if BI System usage can be predicted using Behavioural Intentions and Expectations and provided confirmation of Venkatesh et al's (2008) UTAUT model for predicting information system usage behaviour. The study proposed that information quality and system quality influences BI System usage and these two constructs are discussed relative to the findings and outcomes of prior studies and theory. The discussion then considers factors influencing perceptions of the quality of strategic decisions. Here the three concepts proposed by Wood and Klass (2008) which influence the perceptions of the quality of strategic decisions are discussed. The hypotheses discussion concludes by examining the key hypotheses for this study which examined whether BI System usage positively influence perceptions of the quality of strategic decisions.

6.2.1 Predicting BI System usage by measuring Behavioural Intentions and Behavioural Expectations (H1a and H1b)

Measuring Behavioural Intentions and Behavioural Expectations as predictors of actual behaviour has been the focus of considerable academic debate in both management and behavioural psychology research. This work is grounded in Fishbein and Ajzen's (1975) Theory of Reasoned Action model, which used measures

of attitudes and subjective norms to predict the intention to perform a future behaviour. The key concept proposed by Fishbein and Ajzen was Behavioural Intentions, informed by the independent variables of attitude towards behaviour and subjective norms, provided a robust predictor of future behaviour. Further work by Warshaw and Davies (1984, 1985) found Behavioural Expectations to be a stronger predictor of future behaviour than Behavioural Intentions. Behavioural Intentions, was previously defined as "the degree to which a person formulated conscious plans to perform or not perform some specific behaviour" (Warshaw and Davis 1985, 214), whilst Behavioural Expectations was "an individual's estimation of the likelihood that he or she actually will perform some specific future behaviour" (Warshaw and Davis 1985, 215). The distinction between the two being that intentions focus on what an individual plans to do, whilst expectations is very much about the likelihood, or probability, of doing it.

Throughout this study, Behavioural Intentions and Behavioural Expectations were used to establish their predictive ability in relation to BI System use, with the work of Venkatesh et al (2003, 2008) being instrumental in informing the research for this study. The UTAUT model informed the development of the research model and provided the two constructs of Behavioural Intention and Behavioural Expectations. The data analysis performed in this study related to the structural model provided further insights into the predictive nature of the UTAUT model, and in particular, it provided further evidence on the predictive abilities of Behavioural Intentions and Behavioural Expectations. Findings relative to Behavioural Intentions and Behavioural Expectations and their influence on BI System use are now discussed relative to the related hypotheses.

6.2.1.1 H1a: Behavioural Intention will positively influence BI System usage AND H1b: Behavioural Expectations will positively influence BI System usage

Behavioural Expectations has been found to be positively associated with actual IT system usage behaviour with senior managers than Behavioural Intentions. The implication of this finding is Information System adoption models could be simplified by measuring Behavioural Expectations to predict usage behaviour. This finding and the potential insights it provides are discussed below.

Chapter 5 discussed that this study had found that the relationship between Behavioural Intentions and BI System usage is not significant and the related hypothesis was rejected. The standard regression weight between the two constructs produced a Beta of -0.156 and was not found to be significant with a t-statistic of 0.693.

Behavioural Expectations was found to positively (Beta = 0.523) and significantly (t-statistic = 2.236) influence BI System usage and the related hypothesis was supported.

Mediating effect testing revealed the relationship between Behavioural Intentions and BI System usage was mediated by Behavioural Expectations.

Understanding which of these two constructs has the stronger association with actual BI system usage is imperative, as it provides further support to existing social and behavioural psychology theory, provides insights on which factors motivate behaviours and assists developing enhanced measures for predicting behaviour. However, it is important to first recap the existing theory and previous studies that have explored the use of the two constructs of Behavioural Intentions and Behavioural Expectations.

As discussed in the literature review, eight key models for IT adoption exist. Many of these models have common aspects and the UTAUT model, developed by Venkatesh et al (2008), was created following a review of these models. Central to the UTAUT

model, which was used in this study, are the concepts of Behavioural Intentions and Behavioural Expectations. Venkatesh et al (2008) discussed the limitations of using Behavioural Intentions as a predictor of IT system usage, explaining that the research model could be strengthened by the inclusion of Behavioural Expectations. The UTAUT model was subsequently improved, and it was found Behavioural Intentions, mediated by Behavioural Expectations, positively predicted IT system usage. The findings of Venkatesh et al (2008) were supported by those of this study. However, prior to the use of these two concepts as a measure of IT system adoption, there was considerable debate in academia about whether Behavioural Intention or Behavioural Expectations were a better predictor of actual behaviour. Most of this debate occurred in the field of social and behavioural psychology. A number of studies exploring the two constructs related to non-organisational contexts, for example consumer and health behaviours. However, these provide a useful starting point for this discussion.

The most recent study by Armitage, Norman, Alganem and Conner (2015) found behavioural expectations to be a better predictor of actual behaviour than behavioural intention, and that behavioural expectations significantly mediated the effect of past behaviour on future behaviour. In addition, they argued behavioural intentions and expectations have most often been used in combination to form a series of items and scales designed to measure intention. Their research also supported the views of Warshaw and Davies (1985) who argued the two concepts are, in fact, distinct.

Gordon's (1989) research found behavioural expectations better predicted academic performance, when compared to behavioural intentions. Two groups of subjects, in this study, were asked to respond to items relating to intentions or expectations regarding the outcomes of the next test, final exam and course grade. In a subsequent study, Gordon (1990) found respondents who used the intention scales were more reliant on beliefs, whilst respondents using the expectations scales relied more heavily on past behaviour and circumstances and, as a result, concluded the two concepts were substantially different.

A longitudinal study by Mahardika (2013) explored the temporal stability of behavioural intentions and behavioural expectations. The research showed behavioural intentions more readily changed over time, whilst behavioural expectations were more stable. Mahardik concluded, from the perspective of stability over time, behavioural expectations provided greater predictability than behavioural intentions.

In summary, this exploration of key studies in the field of social psychology suggested a) the constructs of Behavioural Intention and Behavioural Expectations are distinctively different in their definition; b) they provide different predictive capabilities; c) behavioural expectations has been found to have greater predictive capabilities; and d) behavioural expectations has a mediating effect on behavioural intentions. The results of this study were consistent with these arguments. The comparison of studies in the field of social and behavioural psychology provided a useful grounding for this discussion.

The discussion below examines research on the use of the UTAUT model, to provide insights as to the how the constructs of Behavioural Intentions and Behavioural Expectations have performed in relation to the use of technology.

The key study providing insight into these two constructs was Venkatesh et al (2003, 2008). As previously discussed, these research teams found Behavioural Intentions had limitations related to the predictability of usage behaviour and that Behavioural Expectations, if included in the model, mediated the effect of Behavioural Intentions, and provided improved predictability. No other research, of relevance to this study, could be found which explored the two constructs in a technology context.

However, numerous studies were found which utilised Behavioural Intention as a key construct to predict IT system usage. These studies adopted the UTAUT model with Behavioural Intentions as the independent variable for usage behaviour, without including Behavioural Expectations as a mediating variable. The studies have found Behavioural Intentions positively influenced usage behaviour. For example, in a study which examined the effect of culture on the UTAUT model, Im, Hong and Kang

(2011) found Behavioural Intentions had a positive influence on usage behaviour while using a single item to measure frequency of technology use. However, the study did not explore the mediating effect of Behavioural Expectations, as this construct was not included in their research model. Workman's (2005) research explored the use of expert decision support systems using the UTAUT model. While it also found that Behavioural Intentions provided predictability of usage behaviour, this study did not include the construct of Behavioural Expectations. Mandal and McQueen (2012) discussed the limitations of Behavioural Intentions and in their study replaced Behavioural Intentions with an outcomes based construct claiming this provided improved predictability of actual usage. Having cited Venkatesh et al in relation to the limitations of Behavioural Intentions, Mandal and McQueen's qualitative study explored the development of an alternative construct to Behavioural Intentions, and found that a construct they named Goals, which focused on the gains to new customers, customer engagement and word of mouth marketing, provided greater predictability, although this was not proven through quantitative research.

As previously discussed, this study validated Behavioural Expectations mediating effect on Behavioural Intentions and is a better predictor of BI System use. Insights into possible explanations for this finding are now explored within the context of this study.

One possible explanation for the insignificant finding relating to Behavioural Intentions, can be found by examining its independent constructs and, in particular, the construct of Social Influence. This construct was grounded in the Theory of Reasoned Action model, which explains the concept of subjective norms. Paris and Van den Brouke (2008) explained that subjective (social) norms are an individual's perception of whether people, who have influence over that individual, think the behaviour should be performed. If this is considered in the context of the respondents' profile of this study, where 84% classified themselves as senior managers, the influence which subjective (social) norms is likely to have on them may be lower given their positions within the hierarchy of the organisation.

What is suggested is that senior managers, having reached the pinnacle of their career in some instances, may be less susceptible to the influence of social norms regarding their intention to perform a future behaviour. As Social Influence is an independent variable, in relation to Behavioural Intentions, it is possible that this influenced its effectiveness as a predictor of actual BI system usage.

Support for this inference can be found by examining the item loadings of the independent variables related to Behavioural Intentions, which is summarised in Table 6-1 below. The independent variable Social Influence, which loads onto the construct of Behavioural Intentions, contains two highlighted items which specifically asked respondents about the social influence they experience. Item Q7-4 specifically related to the notion of receiving a promotion. These three items, were found to have the lowest item loadings for Behavioural Intentions. These results provided further interesting insights when items relating to Performance Expectancy were also examined. It was evident that those items not related to social norms, have higher item loadings. One reason for this may be senior managers, many of whom are often rewarded and held accountable for organisation performance, were focused on achieving organisational results and outcomes. Likewise, if we examine item loadings for Effort Expectancy, these also provided higher loadings. One possible explanation for this may be senior managers, who might often be time poor, felt it important that a BI system should require little effort to use.

Table 6-1: Social Influence Item Loadings (Items with lower loadings and related to subjective norms highlighted)

Construct	Question Number	Items/ Questions from online survey (<0.4 highlighted)	Loading (<0.4 highlighted)
Social Influence	Q11_1	People who influence my behaviour think that I should use the BI System	0.7300
	Q11_2	People who are important to me think I should use the BI System	0.7763
	Q11_3	The administration of the University has been helpful in the use of the BI System	0.8529
	Q11_4	In, general, the University has supported the use of the BI System	0.8106
Performance Expectancy	Q7_1	I find the BI System useful in my job	0.8196
	Q7_2	Using the BI System enables me to accomplish tasks more quickly	0.9293
	Q7_3	Using the BI System increases my productivity	0.9223
	Q7_4	If I use the BI System I will increase my chances of getting a promotion	0.3660
Effort Expectancy	Q8_1	I find the BI System easy to use	0.8698
	Q8_2	My interaction with the BI System is clear and understandable	0.8472
	Q8_3	It is easy for me to become skilful at using the BI System	0.9463
	Q8_4	Learning to operate the BI System is easy for me	0.9329

Further to this, Workman (2005) found similar results in his study, and concluded that employees with more positive subjective norms had higher system usage behaviour. Therefore, it is proposed that when assessing the likely future behaviour of senior managers, the use of Behavioural Expectations, which measures an individual's likelihood or probability of performing a behaviour, may be a more appropriate predictor. In this model of IT adoption, the construct is not influenced by independent variables related to subjective norms.

In conclusion this study found, that the earlier work of Venkateshet al (2008) regarding the use of Behavioural Expectations as a predictor of system use, is confirmed. However, when measuring IT system usage, a simplified model could be adopted which uses Behavioural Expectations as a predictor of BI system usage for senior managers. The use of constructs which examined social norms appeared to have lesser influence on senior managers. Conversely, those relating to enhanced job performance, outcomes and effort required, appeared to be more significant. Thus,

using the constructs of Performance Expectancy and Effort Expectancy as independent variables to Behavioural Expectation as a predictor of BI system usage, may provide an enhanced model for measuring IT system adoption. The influence of Quality of Information and BI System Quality is discussed next.

6.2.2 Influence of Quality of Information and the Quality of the BI System on BI System use (H1c and H1d)

Two constructs were added to the structural model to explore if they had a controlling influence on BI System usage. As BI Systems deliver information to decision makers, the notion that the quality of this information could potentially have an impact on whether users adopted the system, appeared reasonable. Similarly the quality of the actual BI System was also hypothesised to positively influence usage behaviour.

6.2.2.1 H1c: Quality of information will positively influence BI System usage AND H1d: Quality of BI System will positively influence BI System usage

The results of this study suggested that senior managers do not consider the quality of the information, or the quality of the BI system, to be important factors influencing their use of a BI system. This was a surprising finding, and incongruent with the literature previously presented herein, relating to information and system quality. One reason for this result may be senior managers, many of whom did not access the system themselves, assume that the quality of information is acceptable because it has been verified by an analyst. Likewise, system quality may not be front of mind for senior managers as they did not physically engage with the system and, as such, assume it is of adequate quality to provide the information required.

As discussed in Chapter 5, this study found that the relationship between quality of information and BI System usage is not significant and thus the related hypothesis was rejected. The standard regression weight with a Beta=0.142 is not considered

strong but more importantly the associated path coefficient did not produce a result which was above 1.96 (i.e. t-statistic=1.074) indicating the relationship is not significant. As such H1c: Quality of information will positively influence BI System usage had been rejected.

The analysis regarding the relationship between BI System quality and BI System usage provided similar results. This means the path coefficient between the two constructs of BI System quality and BI System usage received a standard regression weight of 0.014 which was not considered significant with a t-statistic of 0.110. As such the hypothesis was rejected.

The importance of information quality, and system quality, in an information system context has been extensively researched and debated in academia. Literature has focused on the role information quality and system quality as a key success factors in the development and implementation of information systems and user satisfaction. These studies provided a number insights, but the correlation found between satisfaction and usage behaviour was particularly interesting as it implied dissatisfied individuals were likely to use the information system less.

Examining these studies in more detail the following findings can be summarised. One quantitative study found that data/information quality was a critical success factor for successful BI System implementation (Yeoh, Koronios and Gao 2008). However, given the quantitative nature of their study, this finding was not statistically verifiable. Gorla, Somers and Wong (2010) explored the relationship between organisation impact and system, information and service quality. What they found was that while overall system, information and service quality had a significant influence on organisational impact, system quality did not. This resulted in the team concluding items related to system quality, namely: system/technical robustness; being free from error; well documented; ease of learning; and ease of use, are not associated with organisational impact. However, the study did find a significant and positive relationship between information quality and organisational impact.

Counterintuitively, a number of studies found no positive relationship between data quality and BI System success. For example, in their study exploring the relationship between BI System capabilities and BI success, Isik, Jones and Sidorova (2012) found that data quality, user access, and integration with other systems, were key success factors for a BI System. However, their also found data quality was, in fact, negatively correlated to BI success. They speculated that the data quality was a given in organisations, that is that users accepted data in a BI System as being of sufficient quality, fit for purpose, and were not prepared to trade off accessibility or timeliness of the data, for marginal improvements in quality.

In summary, although previous studies have identified importance of data and information quality, and its positive relationship to user satisfaction, its influence on actual BI System usage to date has been untested. This study suggests that, although the importance of information quality and system quality is not being disputed, it does not appear to be a factor which is associated with senior manager's use of a BI System.

One possible explanation for this can be found by examining other constructs that significantly influence the quality of strategic decision making. Although discussed further under their related hypotheses, this study has shown the constructs of Team Capital and Architecture significantly and positively influence perceptions related to the quality of strategic decision making. As previously discussed, Team Capital is a construct related to the diversity, skills and knowledge of the decision making team, whilst Architecture is a construct focused on the existence of a structured decision making process informed by business intelligence. This study found Team Capital is significantly and positively associated with perceptions of the quality of strategic decisions. What this suggests is that Senior Managers are perhaps more confident in their own abilities, and the abilities of their team members, to make decisions driven by their experience and intuition, rather than the information from the BI system, and therefore, the quality of the BI system and the quality of the information is of lesser priority. However, it can also be seen that senior managers feel that evidence based decision making is important. This was evident in the results which show a

positive and significant relationship between both Architecture and the perceptions of the quality of strategic decision making, and BI system usage and perceptions of the quality of strategic decision making.

A further explanation for the insignificance of information and system quality in relation to the use of the BI System by senior managers might be found by considering that results of survey Question 3 as outlined in Table 5-6. Question 3 asked respondents if they accessed the BI System themselves or if they had someone else, for example a business analyst, access the system for them. Although 55% of respondents indicated that they accessed the BI System themselves, 43% indicated that someone accessed the system for them. Given seniority across the group, this was not an unexpected result. This then suggests that if these senior executive managers are not physically using the system, the importance of system quality may not be an issue for them either. Similarly, the information quality may be an issue which is already addressed by the person accessing the system for the senior executive manager, and as such this may not be a significant factor for them. In other words, senior managers may not be concerned with BI system quality and information quality, as they are receiving analysed information summarised in reports prepared by individuals who have accessed the BI system and quality is assumed. In conclusion, this study found the information quality and BI System quality do not appear to significantly influence BI System usage by senior managers.

Before the key hypotheses for this study, which examines the relationship between BI system usage and perceptions regarding quality of strategic decision making, is discussed, other factors influencing perceptions are presented.

6.2.3 Influence of Team Capital, Architecture, and Sensemaking on the perceptions of the Quality of Strategic Decisions (H2a, H2b and H2c)

This study explored the development of measures for Team Capital, Architecture and Sensemaking. To date, these specific constructs had not been measured through a quantitative study. The three constructs were included in the research model to establish their perceived influence on strategic decision quality. The constructs, grounded in the framework developed by Wood and Klass (2008), examined attributes of the decision making team, the decision making process, and the role information plays in decision making. Three separate hypotheses were developed and tested. Each of the hypotheses are discussed in turn before a more general discussion is provided with regard to the role they play on the quality of strategic decision making.

6.2.3.1 H3a: Team Capital will positively influence the perceived quality of the strategic decision

A key finding of this study is that Team Capital, senior managers' belief that the decision making team's diversity of skills, knowledge, abilities and perspectives is strongly associated with their perceptions regarding the quality of the decisions made. Perhaps not surprisingly, senior managers have a strong belief in their own abilities, along with the abilities of their team to make decisions. Although, as is discussed later, the decision making process is also a key factor, whilst the use of business intelligence systems is not considered critical. This would suggest experience and intuition may be playing a major role in the strategic decision making process. The concern here would be that an over reliance on experience and intuition in decision making could be introducing considerable risk into the decision making process. Clearly experience and intuition play an important role but could be enhanced by validating decisions made using business intelligence, thus reducing the risk associated with decisions made. The findings and the potential causes are discussed further below.

As discussed in Chapter 5, Team Capital, measured as the diversity of skills, knowledge, abilities and perspectives of the decision making team and its capability, was hypothesised to have a positive influence on the perceptions of the quality of strategic decision. The results of this study confirmed that the construct of Team Capital positively (Beta = 0.251) and significantly (t-statistic = 3.142) influenced the perceived quality of strategic decision. Thus, the hypothesis was supported.

As discussed in the literature, the diversity of decision making team (skills, knowledge and perspectives), their cognitive abilities and knowledge (capacity to make good decisions) contributed to the quality of the strategic decision making by senior managers. The body of research on the diversity of top management teams' impact on decision making and organisational outcomes is extensive and diverse. Key studies and theories, as relevant to this study, are discussed in the context of the hypothesis below.

The findings of this study were consistent with previous studies exploring the influence of team diversity on organisational performance. A study by Bantel and Jackson (1989) examined a sample of 1999 banks to establish whether social composition of senior management teams influenced the innovation in banks. Seven different attributes of team diversity were used to measure the diversity of senior management teams. The study found that a significant and positive relationship existed between diverse teams and the innovativeness of a bank. Similarly, Eisenhardt and Schoonhoven (1990) found, in their study of US semiconductor firms, that the combination of team size, diversity, and joint experience was most closely associated with positive firm growth. Further, Hambrick, Cho and Chen (1996) found that across a sample of 32 US airlines, top management teams rich in diversity of background, education, and experience led organisations that were more competitive in terms of market share and profitability.

However several studies have suggested negative relationships between team diversity and organisational performance. Murray's (1989) longitudinal study of Fortune 500 firms highlighted the complexity of researching senior management team diversity and its impact on organisational performance. His study found senior

management teams that are heterogeneous, negatively relate to short term performance, but positively relate to long term performance. If this is considered in the context of this study, which examined strategic decision making, which in its very nature is focused on the longer term, then this study's findings support Murray's.

Barkema and Shvyrkov (2007) examined whether senior management team diversity positively influenced foreign expansion. They theorised that diversity of tenure and education positively influenced the probability that a firm will expand its operations into new geographic regions. Their study found that while tenure positively influenced geographic expansion, educational diversity did not. They rationalised this by suggesting that senior managers often had extensive experience, thus reducing the importance of education. This suggests some attributes of diversity may be more important than others.

The findings of this study were also consistent with previous studies which found that diversity in a senior management team has a positive influence on a variety of organisational performance related matters. This body of literature has shown that diversity can positively impact competitive position, innovation, global expansion, and in the case of this study, perceptions regarding the quality of strategic decision making.

Insights regarding the reason for these findings can again be found by considering the profile of respondents. This study's respondents' profile suggests the majority (81%) of senior managers who responded indicated they were over the age of 46, and almost half (41%) indicated that they were in senior executive roles. This implies these respondents have extensive experience making strategic decisions. As such, they had developed a certain level of trust and reliance in their own, and their peers, skills, knowledge, capacity and diversity of perspectives to make quality strategic decisions. It could be argued, this reliance by senior managers on their own experience, is leading them to trust intuition more heavily in their strategic decision making than the business intelligence delivered to them through a BI system. Although it is not being suggested that reliance on experience and team diversity is a practice that results in poor quality strategic decisions being made, it is not

unreasonable to assume that if augmented by the use of business intelligence, better quality strategic decisions could, perhaps, be made by senior managers.

Examining the results of the next construct provides further insights related to the use of business intelligence in strategic decision making. Architecture, which focuses on the use of a structured decision making process informed by business intelligence, is discussed next.

6.2.3.2 H3b: Architecture will positively influence the perceived quality of the strategic decision

It has already been discussed that Team Capital had been identified as a key factor associated with the quality of strategic decisions made by senior managers. Not surprisingly senior managers also indicated that a structured decision making process, supported by information, also mattered. This shows how senior managers understand that decision making teams require a structured decision making process to bring order to the complexity of the decision making team. This finding would also suggest there is an appreciation that making decisions just based on experience and intuition presents a risk, and that a structured process, which provides decision problem focused information, assists in validating the decisions made by the team of senior managers. The findings and potential causes and insights are discussed further next.

Architecture, the use of a defined and structured decision making process informed by BI, was discussed in the literature review as having had a positive influence on the quality of decision making. The results of this study have shown that Architecture positively (Beta = 0.440) and significantly (t-statistic = 3.835) influences the perceived quality of strategic decisions.

Numerous studies have explored models of strategic decision making in organisations, and their impact on decision outcomes. However, Nooraie (2008) commented in his review of the literature that no empirical evidence could be found

that examined the link between strategic decision making process and strategic decision quality. Similarly, the review undertaken for this study, established that the key studies discussed in relation to this study, were found to have significant focal or contextual differences. Nevertheless, they provide some interesting findings which were supported by this study.

In particular, Arvai and Froschauer (2010) examined the interaction of the decision making process and outcomes to evaluate decision quality. Two findings of this study are of interest. Firstly, they found that when respondents rated decision quality, outcomes rated higher than the decision making process. Secondly, the study found that although respondents rated a high quality decision making process over a low quality decision making process, positive ratings attached to a high quality decision making process were dependent on an associated positive outcome. This means that the association between a high quality decision making process, and its relationship to high quality decisions, is influenced by a positive decision outcome being present. The findings of this study support this to some extent, having found that decision making using a defined process informed by business intelligence, positively influences perceptions of the quality of the strategic decisions being made, however the relationship to actual outcomes was not specifically explored.

Dean and Sharfman (1996) examined in their longitudinal study, which examined 52 decisions made in 24 companies, if the decision making process impacted on the strategic decision making effectiveness. Their literature review confirmed the decision making process and environmental factors influenced strategic decision making effectiveness. Their study found the strategic decision making process, the impact of environmental factors, and the quality of the decision implementation were important factors, which could influence strategic decision making effectiveness. Although their study had not examined the impact of the strategic decision making process on the quality of the decisions, it could be suggested, that effective strategic decision making is closely related to quality strategic decision making. As such the findings of this study were consistent with those of Dean and Scharfman's (1996).

Nooraie's (2008) study, examining decision magnitude of impact and the strategic decision making process output, suggested that he had not been able to find any empirical studies which focused on the quality of the decisions, relative to the quality of the decision making process. She tested if there was "a positive relationship between the extent of rationality in the decision making process and the quality of the decision process output" (Nooraie 2008, 646). The study provided some key findings which suggested that there may be a positive relationship between the rationality of the decision making process and the quality of the decision outcome.

A further study containing elements which aligned with the findings of this study is the research of Papadakis, Lioukas and Chambers (1998). Their research investigated the relationship between the strategic decision making process, management and contextual factors. The relevance to this study can be found in their definition of what is a formalised planning system. They defined the formalised planning system as a system which provided formal rules around how strategic decision making is conducted. One of the findings of their study was that a formalised planning system positively influenced the strategic decisions that were made. As discussed, previous studies found a structured decision making process, informed by business intelligence, was positively related to organisational performance and outcomes. However, a consistent finding was that a defined or structured strategic decision making process is not the single factor delivering decision making success. In examining other factors which influenced perceptions of the quality strategic decisions in this study, the constructs of Architecture was found to have the strongest influence indicating that senior managers at universities felt that a defined or structured decision making process, informed by business intelligence, was an important factor contributing to strategic decision quality.

Previously, it was discussed that senior managers appeared to be reliant on their own and their teams' skills, knowledge, capability and diversity of perspectives to make quality strategic decisions. The results related to the influence of a structured decision making process that uses business intelligence suggests that senior managers feel that this positively impacts strategic decision making. A possible

explanation for this finding may be found by considering that the majority of strategic decisions would be made through a decision making team environment. An acknowledgement by respondents of the importance of a structured process may be driven by the need to bring some structure or order to team dynamics. In other words a structured decision making process would ensure that the diversity of skills, knowledge and perspectives can be optimised in relation to the decisions being made. The use of business intelligence in the context of the structured decision making process may have been considered important to senior managers as it would ensure that the decision making team could achieve consistent and shared situational awareness. This means all senior managers focused on the strategic decision being made would have available and be cognisant of the information surrounding a decision making problem. The findings also suggest that senior managers appreciate the complexity that surrounds strategic decision making and that this increased complexity requires a more structured approach to ensure increased likelihood of achieving the desired outcomes.

In discussing the next construct, Sensemaking, the role of business intelligence in strategic decision making is explored further.

6.2.3.3 H3c: Sensemaking will positively influence the perceived quality of the strategic decision

The final hypothesis considered the influence of Sensemaking on the perceived quality of strategic decision making. Previously, this study defined Sensemaking as decision making utilising business intelligence or information, after reviewing the relevant literature. Surprisingly, this study found senior managers indicated the use of business intelligence or information was not important when making quality strategic decisions. However, when considered in context of the previous hypothesis, there is an apparent tension between the two. Perhaps senior managers appreciate the value of using business analyses or information in strategic decision making, but feel that this information needs to be embedded within a structured strategic decision making process to be of value

The results show that Sensemaking with standard regression weight to the with a Beta=0.115 is not considered strongly related to the perceived quality of strategic decision making, but more importantly the associated path coefficient did not produce a result which was above 1.96 (i.e. t-statistic=0.852) indicating the relationship is not significant. The hypothesis was therefore not supported.

Information has been identified as a fundamental input into decision making. For example, Harrison (1996) and Raghunathan (1999) found the availability of information a critical factor in a strategic decision making process. Further, Citroen (2011) found this information was most valuable when it contained data pertaining/relating to internal operations and the external market environment. This intelligence was then used by the executive managers to develop their rationale for decisions. However, it was important to get the amount of information 'right', as Citroen highlighted that information overload would negatively impact on decision making.

In light of this, it was surprising to find that Sensemaking was not found to have a positive influence in this study. To explore this result further, the frequency distributions for this construct were examined. Table 6-2 presents the frequency distribution across the three items making up the construct of Sensemaking using the six point Likert scale.

Table 6-2: Sensemaking Construct Item Frequency Distributions

Sensemaking Construct	Q19_1: Decisions are made in consideration of internal business intelligence or performance information		Q19_2: Decisions are made in consideration of information or business intelligence on external factors		Q19_3: Information informs decision making	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Strongly Agree	21	16%	15	11%	39	30%
Agree	55	42%	53	40%	46	35%
Somewhat agree	41	31%	45	34%	37	28%
Somewhat disagree	11	8%	14	11%	7	5%
Disagree	2	2%	2	2%	0	0%
Strongly disagree	1	1%	1	1%	0	0%
Missing	1	1%	2	2%	3	2%
Total	132	100%	132	100%	132	100%

Examining the results it was evident that 89% of senior managers agreed that decisions are made in consideration of internal business intelligence or performance information, 85% agreed that decisions are made in consideration of information or business intelligence on external factors, and 93% agreed that information informs decision making. The results of the individual items of this construct reflect the findings of previous studies, and highlight the importance of the use of information and business intelligence in decision making.

This study set out to examine whether Sensemaking had an impact on the perceptions relating to the quality of strategic decisions. The results indicated the role of information in decision making was not considered a significant factor, but that information in decision making is nevertheless an important part of strategic decision making. One possible explanation for this may be that senior managers consider business intelligence and information important, but only when it is part of a structured strategic decision making process. As discussed in 6.2.3.2, Architecture was found to positively and significantly influence the quality of strategic decision making. As Architecture was defined as a structured decision making process informed by information, the integration of process and information can be seen as an important factor. This means that on its own information is less effective in

enhancing strategic decision making quality and it is only when combined with a structured process that information optimises the decision making quality.

To conclude this discussion, the three constructs of Team Capital, Architecture and Sensemaking are now discussed together.

6.2.3.4 The influence of Team Capital, Architecture and Sensemaking on Decision Quality

This study found Architecture and Team Capital were the two most influential factors impacting senior manager's perceptions of the quality of the strategic decisions. Strategic decisions, as previously discussed, are often more complex and focused on the longer term. Such complex decisions require decision making teams which are skilful, diverse and bring knowledge and experience to the table. This study proposed that the combination of these team attributes enhances the understanding of the problem domain for which a decision is being made. The collective experience and intuition itself is enhanced and, as a consequence, the team decision making process is also improved, leading to improved decision quality. Senior Managers, with decades of strategic decision making experience, were more trusting of and reliant on their teams and their own skills, knowledge, capability and diversity of perspectives, and were possibly also more reliant on their intuition and experience whilst making strategic decisions. However, it was also found Architecture had a strong influence on the perceptions of the quality of strategic decision making. This suggested senior managers were reliant on a defined or structured decision making process which is informed by business intelligence. One possible explanation of this may be that senior managers often make strategic decisions as teams, and that a structured strategic decision making process brings order to the team dynamics ensuring all team members are on the same informational grounding before strategic decisions are made. A further explanation could be senior managers appreciated the complexity of making strategic level decisions, and that the structured decision making process used mitigates the risks associated with decision making. Surprisingly, however, this study found that Sensemaking did not influence senior managers' perceptions of strategic decision quality. Interestingly, this study found

senior managers indicated business intelligence used within a structured decision making process was important to them. However, the use of intelligence outside of the structured decision making process was deemed not. One possible explanation for this may be that senior managers felt although they rated information as an important part of the strategic decision making process, when it came to its impact on the quality of the decision being made, it was not the information being used, but rather how the information was used that made a difference.

6.2.4 Influence of BI System usage on the perceptions of the Quality of Strategic Decisions

The key focus of this study was to establish whether BI Systems contribute to the perceived quality of strategic decision making. Interestingly H3c, which focused on the concept of Sensemaking and its influence on the perceived quality of strategic decision making, was rejected. This suggests that the use of information did not influence manager's perceptions relating to the quality of strategic decision making.

6.2.4.1 BI System usage will positively influence the perceptions of the Quality of Strategic Decisions (H2)

This study found that a positive relationship between BI system usage and senior managers' perceptions regarding the quality of the strategic decisions they made. The findings related to this key hypothesis are discussed further below and insights are presented with regard to the rationale for this result.

It was discussed in the literature review that BI Systems exist to deliver information to decisions makers and that this would have a positive outcome on the quality of the decisions being made. The results indicate that BI System usage was found to positively (Beta = 0.200) and significantly (t-statistic = 3.283) influence perceptions of the quality of strategic decision making. This means the hypothesis was supported.

The finding suggested that although some conflicting results had been observed in relation to the significance of information in strategic decision making, measured through the construct of Sensemaking, that when the actual use of the BI System is examined, the relationship to perceived strategic decision making quality is both positive and significant. This is consistent with a variety of studies which have produced similar results, although often in different contexts and using slightly different constructs and measures. A discussion of prior research which supports or challenges the findings of this study are now provided.

Elbashir, Collier and Davern (2008) argued BI Systems are deployed to assist and improve strategic decision making to enhance competitive advantage. Their study examined the business process effect of BI Systems on and business performance and 53% of the variance in organisational performance could be explained. This suggests that BI Systems have a positive impact on business processes and, as such, enhance organisational performance. However, one limitation of this study was the assumption that organisations, who developed BI Systems, actually used them. The study did not examine whether the BI System were adopted or used. Nevertheless, a business process benefits view of a BI System on organisational performance suggests that BI Systems positively influence organisational performance. If we accept enhanced organisational performance is also influenced by the quality of strategic decision making, then Elbashir, Collier and Davern's study is supported by the findings of this study.

Ramamurthy, Sen and Sinha (2008) examined whether data warehouse infusion positively impacted organisational performance. They commented that many organisations who develop data warehouses, a key component of a BI System, do not actually use them. As a result they found that organisations which successfully infused the data warehouse across their organisation, experienced organisational performance gains. Data warehouse infusion was measured in terms of usage of the data warehouse system across the organisation. The positive relationship between data warehouse infusion and organisational performance was congruent with the findings of this study, if we accept organisational performance is an outcome of the

strategic decisions made. Andersson, Fries and Johannsson (2008) provided further evidence of this positive relationship. Their study used expert interviews to explore the influence of business intelligence, delivered through a data warehouse or BI System, on the decision making process and found that organisations, which had implemented BI Systems, experienced positive outcomes relating to the decision making support and process. This was argued to be because information was more accessible, more readily available, better quality and better controlled. However, not all research agreed. The qualitative study by Turpin and Marais (2004) examined how a number of theoretical models of decision making aligned with senior manager's decision making in practice. They found that senior managers usage of decision support systems, systems similar to BI Systems, was limited. This was despite a reliance on technology to support their decision making, and those interviewed identified they used desktop applications like Microsoft Excel and Word, along with web browsers.

Although this is incongruent with this study's findings related to BI System usage and perceptions of the quality strategic decisions, it is interesting, as it perhaps explains the results related to the hypothesis which examined information quality and system quality as influencers on BI System use. It was previously discussed these two constructs were not significant and a possible cause for this was 43% of respondents indicated that someone accessed the BI system for them. Turpin and Marais (2004) concluded that as senior managers are often overloaded, business intelligence needs to be presented to them in a format that is easy to understand. The implication being, that senior managers would not have the time to access information within a BI System if it required additional time and effort to learn, or it was not presented in a 'palatable' format.

This study found a positive and significant relationship between BI System usage and perceptions of the quality of strategic decisions. However, if other factors hypothesised to have a positive influence on the perceptions of the quality of strategic decisions are examined it appears Team Capital and Architecture appear to

have a positive association with perceptions of quality more than the use of the BI System.

One possible explanation for the results may be that senior managers see the BI System as an enabler to the strategic decision making process. This means that they use the system to obtain the information they need for strategic decision making, but that ultimately the actual strategic decisions are made by the team of senior managers facilitated by the decision making process. A critical insight was that that Senior Managers acknowledge the importance of BI systems because without a BI system the decision making process is not provided the information needed to allow decisions to be made.

Other possible causes may be found by examining the demographic characteristics of senior managers. Many are time poor, older and in positions where the majority of work is meeting based, suggesting they may be less inclined or able to engage with new technologies. This suggests senior managers were perhaps unable to invest the time to learn new information systems and, as such, unless a system was intuitive to use, provided the required information for specific decision making, they may be less inclined to use it. As such, it appears senior managers were reliant on others to access the system, extract information, summarise it and present it. As such, the direct result of this is senior managers have a reduced reliance on BI systems themselves. These findings suggest Australian universities which want to improve their strategic decision making capacity, might benefit from training senior managers, improving culture, building human capital, and ensuring they have a BI system which underpins and informs a structured decision making process.

This concludes the discussion of the eight hypotheses of this study. The discussion has illuminated some of the findings observed and the implications for theory and practice are now discussed in the context of findings.

6.3 Implications for theory

This research provides further building blocks to existing and emerging theories, theoretical frameworks and research models and instruments. The findings of this study further advance academic research and build the body of knowledge in this field. In particular this study provides a validation of the UTAUT model for predicting information system usage behaviour, developed a series of items which can be used to measure perceptions around strategic decision quality, and provided empirical insights and measures for the theoretical framework of Team Capital, Architecture and Sensemaking.

6.3.1 Models of IT System Adoption: Validation of the UTAUT Model and the strength of Behavioural Expectations as a Predictor of System usage.

This study supports the findings of Venkatesh et al (2008), whereby Behavioural Expectations mediates Behavioural Intentions and provides a stronger predictor of BI System usage behaviour. The study has also found that the Quality of Information and Quality of BI System are not predictors of usage behaviour with senior managers. As previously explained, this may be a function of senior managers not accessing the BI System directly themselves. A key contribution to the theories and models for measuring IT system adoption is the validation that Behavioural Expectations provides a stronger predictor of BI System usage than Behavioural Intentions. The findings may also be generalizable into the field of social and behavioural research as the research provide an example of how behaviour can be predicted by measuring Behavioural Expectations.

6.3.2 Measuring Perceptions of Strategic Decision Quality

During the literature review it became evident that no existing measurement tools could be found to measure perceptions of strategic decision quality, as they relate to strategic decision made by senior managers in universities.

Prior research had examined the quality of decisions relative to organisational performance or outcomes. Although it is not being suggested that this is not a valid means of assessing decision quality, it does present some issues in terms of external factors that may be mediating performance or outcomes.

This study developed a set of perception based measures for decision quality, which allow for a more generalised measurement across organisations and industry sectors. Rather than examining performance on specific decisions or organisational performance or outcomes.

Using the theoretical constructs provided by Kopkeikina (2005), who had suggested that decision quality could be measured through the three dimensions of: 1) the quality of the decision making process; 2) the decision making content; and 3) the alignment of the decision to organisational vision, as well as an item suggested by Wood and Klass (2008) around the perceptions of desired outcomes being achieved, this study has developed four measurement items which could be used in other research to measure perceptions of the quality of strategic decision making. The four items used achieved strong item loadings and achieved construct validity, as presented in table 5-8 in Chapter 5, and the construct passed internal consistency tests, as presented in table 5-9, and as such provide some confidence in relation to their future use.

6.3.3 Measuring the Concepts of Sensemaking, Architecture and Team Capital

The three constructs of Sensemaking, Architecture and Team capital were developed using qualitative research and presented as a theoretical framework of three interrelated concepts but not yet empirically tested. This study has confirmed quantitatively that two of the three constructs, Team Capital and Architecture, positively and significantly influence perceptions on the quality of strategic decisions being made. The third construct Sensemaking was not found to be a significant influencer, however results did show that strong agreement (92%) existed amongst the respondents that information was used in decision making.

This study developed measures for these three constructs from the theory identified during the literature review. The items which made up the three constructs were proven to be valid and reliable measures of the three constructs. Very strong item loadings were observed, the constructs passed internal consistency tests, and construct level and item level discriminant validity was achieved.

6.3.4 Factors Influencing the Quality of Strategic Decisions

This study provided further insights into the factors influencing the perceived quality of strategic decisions. Results have shown that a defined or structured decision making process informed by business intelligence (Architecture), team diversity and capacity (Team Capital), and the use of a BI System significantly and positively influence perceptions around the quality of strategic decisions. These findings support the majority of similar research which explored factors which have enhanced organisational performance or outcomes. Of theoretical interest is the order of importance of the three factors. Architecture followed by Team Capital were found to provide greater and more significant influence on perceptions of strategic decision quality. This finding could support the development or enhancement of existing theoretical frameworks for strategic decision making and the strategic decision making process.

6.4 Implications for practice

The higher education environment is facing significant change and emerging as a more competitive environment in which quality strategic decision making may mean the difference between organisational failure and sustained competitiveness. This study provided a series of findings that will assist practitioners in higher education institutions, but also other sectors, where BI Systems have been developed to support strategic decision making. More specifically this section provides insights for practitioners to assist in achieving greater success for BI System development and deployment, which will assist in the development of strategies and initiatives to optimise use of business intelligence by senior managers for strategic decision making.

The factors contributing to strategic decision making are contextualised for practitioners providing a better understanding of which factors play a greater role so that these may be improved in relation to the decision making team and process. But also which factors did not play a significant role but perhaps should and therefore could be improved to provide improved strategic decision quality.

6.4.1 BI Systems providing evidence to support Strategic Decision Making

Although this study found that BI System use is not the key factor influencing perceptions around strategic decision quality, it was nevertheless found to be a significant factor. As such the value of developing BI Systems to assist senior managers in their strategic decision making is confirmed. What can be seen from this study is that senior managers may not directly access the BI System to obtain information for strategic decision making but rather are reliant on support to access the information. The importance of this support to access the system is an important implication for practice. This means organisations should ensure that a human resource, such as a business analyst, is available to access the system and undertake

analysis. This may enhance the value organisations will get from their BI system when used for strategic decision making.

This study also provided insights into the BI System adoption by senior managers which will be of interest for organisations developing BI Systems and for the successful deployment of these systems in relation to adoption by senior managers as system users. These are discussed next.

6.4.2 Enhancing BI System usage amongst Senior Managers

The study found that factors, used to predict BI System use in the UTAUT model, and which have in previous studies been found to provide significant insight into IT system adoption, did not factor as strongly for senior managers in this study. When the constructs of Performance Expectancy, Effort Expectancy, Social Influence and their relationship and significance to Behavioural Intentions and in the influence of Facilitating Conditions on Behavioural Expectations was examined it was found that the only construct which shows a significant positive relationship is Performance Expectancy. This finding, although out of scope for this study, does provide some insight into the factors which may contribute to enhanced BI System usage amongst senior managers. Performance Expectancy is measured using items related to the BI System being: a) useful in my job; b) ability to achieve tasks more quickly and c) increased productivity. The implication for practice is that professionals who are trying to achieve greater BI System usage with senior managers should ensure that their BI System is in the first instance able to demonstrate how it will enhance organisational performance. The constructs of Effort Expectancy (an individual's ability to use the BI System), Social Influence (the influence others of significance have on the individual to use the BI System) and Facilitating Conditions (support available to use the system) did not achieve results which were considered statistically significant in the context of the research model. This means these factors are unlikely to impact the adoption of a BI system with senior managers.

6.4.3 Factors supporting Strategic Decision Making

It was found that Architecture, the use of a defined or structured decision making process informed by business intelligence and Team Capital, senior management teams diversity of skills, knowledge, perspectives and capability and were the most influential factors impacting the perceptions of whether strategic decisions were quality.

The study provided empirical evidence that a senior management team with diversity of skills, knowledge, perspectives and capability is a key factor influencing the perceptions regarding the quality of strategic decisions being made. Consideration should be given by practitioners around the diversity of their own senior management team, and how diversity could be further achieved through recruitment or development of senior managers. It is also proposed that senior managers should develop their capabilities to make strategic decisions as part of a high performing strategic decision making team. Understanding team dynamics, values and how to effectively work together are considered key aspects of this.

The study also shows that the use of a defined or structured decision making process informed by business intelligence positive influenced the perceptions of the quality of the strategic decisions being made. Practitioners should consider how their senior management teams make strategic decisions, and if these are made using a defined or structured process and if business intelligence is utilised as part of the decision making. Utilising a defined or structured decisions making process could lead to improved strategic decision making. For organisations with a defined strategic decision making process, the process should be reviewed to ensure that it aligns with better practice principles. The strategic decision making process should have good formal integration of business intelligence into the process at various stages to ensure evidence based decision making is maintained.

6.5 Summary

This Chapter discussed and provided insights stemming from the data analysis provided in Chapter 5. The eight hypotheses of this study were discussed in relation to the findings and relevant prior research and theory. Key discussion and insights covered in this Chapter included:

The UTAUT model developed by Venkatesh et al (2008) was validated as being predictive of BI System usage. In particular, the findings of their study were confirmed in relation to Behavioural Intentions being mediated by Behavioural Expectations and that Behavioural Expectations provided superior predictability of BI System usage than Behavioural Intentions.

The quality of information and the quality of the BI System was found not to influence BI System usage. It was discussed that given the seniority of the respondents that this result may have been impacted by respondents using staff to access the system for them. As such their experience with the quality of the information and system may not have been first hand, and quality may have been assumed, and as such non-significant results were recorded.

The influence of Team Capital, Architecture and Sensemaking on the perception of the quality of strategic decision making was discussed. The three concepts had previously only ever been presented as a theoretical framework developed by Wood and Klass (2008) through a qualitative exploration. This study has provided empirical evidence that Architecture, the use of a defined or structured decision making process and use of business intelligence as part of the process and Team Capital, the diversity and skills of the decision making team and positively and significantly influenced perceptions of the quality of the strategic decisions. Whilst Sensemaking, the use of information in decision making, was not found to have a significant influence. However, results on individual items showed that respondents felt information was important in decision making but perhaps, although important, the use of information does not necessarily lead to quality strategic decisions on its own.

Significantly it was shown, that the importance of information re-emerges when it is part of the structured decision making process.

The key hypothesis of the study examined if senior managers were using the BI System, and if this usage positively influenced their perceptions of the quality of strategic decisions. This hypothesis, which was supported, was discussed and it was suggested that BI System usage enhanced the strategic decision making quality as it delivered key business intelligence with stronger insight to the decision problem.

In concluding, it was discussed that the key factors influencing the perceived quality of strategic decision making were (in order of strength of the influencing relationship): Architecture, Team Capital, and BI System usage. Sensemaking was not found to be significant. This lead to the conclusion that to enhance strategic decision quality senior managers should consider the diversity and skills of their decision making team, follow a defined structured decision making process which is informed by business intelligence supplied by a BI System.

The Chapter concluded by providing implications for both theory and practice.

The final Chapter of this dissertation provides some concluding remarks in relation to reflections on the findings relative to the research questions, a summary of the study and a discussion of its limitations and opportunities for further research.

7 Conclusions

7.1 Introduction

Over the last decade the rapid change in universities' market environment resulted in a greater need for business intelligence to aid strategic decision making. To adapt to these changes universities have engaged strategic planning processes (Rowley, Lujan and Dolence (1997), Anderson, Johnson and Milligan (1999) and Hughes and White (2006)). A key aspect of strategic planning is strategic decision making, the quality of which is enhanced by the use of business intelligence (BI). However, very little empirical evidence to support this connection, especially for the tertiary education sector exists.

This study examined how Australian universities, through the implementation of BI Systems, enhanced the quality of the strategic decisions made.

The study is of significance as it provided evidence regarding the perceived impact BI Systems have had on the quality of strategic decisions in Australian universities. This information will allow universities to improve their investment decisions regarding BI Systems and assist in evaluating the likely return on investment as it relates to the impact on strategic decision making.

The study also provides theoretical contributions. Insights into the use of the UTAUT model for predicting BI System usage were provided. And the influence senior management team diversity and capability, the strategic decision making process and the use of information in decision making have on the perceptions of the quality of strategic decisions being made were explored.

7.2 Overview of the Study

In formulating this research topic a review of the literature was undertaken to establish what related research had previously been conducted and how this research could contribute to this study. Although extensive research has been conducted on the adoption of Information Technology (IT) and also specifically on the adoption of BI Systems, limited research appears to exist on measuring the quality of strategic decision making (Kopeikina, 2005 and Buchanan and O'Connell, 2006), and no exact information emerged regarding the impact of BI System adoption on the quality of strategic decisions for universities.

The literature review established the importance of good quality strategic decision making in a complex and dynamic higher education environment. Increased competition in the market, disruptive technologies, unstable regulatory environment and reduced financial sustainability were outlined as key challenges impacting the higher education sector. The use of BI Systems in universities to support decision making was discussed. And the question was raised as to whether strategic decision makers are in fact utilising the BI Systems and the associated information provided in their strategic decision making. This presented the key focus for this study.

The literature review also highlighted that strategic decision making is a complex issue with many divergent views around process and other factors that influence the process for decision making and decision outcomes. It was established that information and in particular business intelligence is an important part of the strategic decision making process. However little research was found which explored the role of information in strategic decision making.

The use of BI Systems to disseminate information to senior managers for strategic decision making was highlighted and it was discussed that the availability of a BI System alone does not ensure it is used. This lead to an overview of IT adoption theories and models to develop a base for the development of a model for measuring BI System adoption and use.

Understanding what constitutes a good quality strategic decision, and how good quality decision making could be measured, was an important concept which was explored. Team diversity, a quality decision making process, alignment to vision and perceptions regarding achieving desired outcome, were identified as key concepts to be explored in this study and were used to define what a quality strategic decision is. Other factors were also identified which positively influenced strategic decision making, and the three concepts suggested by Wood and Klass (2008) of Sensemaking (information in decision making), Architecture (defined or structured decision making process) and Team capital (diversity and capability of decision making team) were introduced.

The literature concluded by outlining the research model for this study, designed to aid in answering the following three research questions:

1. How the adoption of BI Systems influenced the perceptions associated with the quality of strategic decisions in Australian universities?

2. How does the diversity of a decision making team, the use of a defined decision making process and the use of information in decision making influence the quality of strategic decisions in Australian universities?

3. Is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008), useable as a predictive model for BI System use?

The research methodology was then outlined in Chapter 3.

The selection of a positivist paradigm was substantiated as the most appropriate choice for this study, given that an objective reality existed which could be measured. Ontology and epistemology for the study were defined, and the methodological choice was outlined to be quantitative.

Research procedure and method were described in their various steps in Chapter 3. Providing an overview of the process followed, from identification of the research questions and research proposal, to the review of the literature to develop a theoretical grounding, to the development of the research model and hypotheses, survey instrument development, pre-testing of the instrument, data collection, data quality review and analysis to the interpretation and discussion of the results of this study.

The data analysis methods used in this study were described in detail. This included the process of testing the measurement model in terms of reliability and validity. The rational for measurement model tolerances, in relation to item reliability, composite reliability and average variance extracted was described. Item level and construct level discriminant validity tests were explained.

How the structural model was tested in relation to the strength and nature of relationships between constructs (using PLS-SEM) and the significance of these relationships (using Bootstrapping process) was described. A description of how mediating variables, in the structural model, were tested for mediating effects concluded the section of testing the structural model.

Chapter 4 defined the hypotheses for this study. Each hypothesis was expressed in terms of the constructs which made up the research model, and the potential relationships between constructs in the research model. The rational for each hypothesis was provided. The use of the 6 point Likert agreement scale was discussed. For each of the constructs of the structural model measurement items were presented and referenced back to the theory or previous research they were grounded in. This provided an overview of the measurement model and research instrument for this study.

The Chapter concluded by presenting the results of the pre-test, which was conducted on the research instrument and the enhancements to the instrument and process were discussed. Pre-test identified some minor wording and survey logic

issues, which were improved prior to the survey being administered to survey population.

Chapter 5 saw the data collected through the online survey of senior managers in Australia universities analysed to establish non-response bias. This was achieved by comparing the means of two waves of respondents for any statistically significant differences. The response data was found not to suffer from any significant non response bias. Data quality and review procedures described in Chapter 3, were followed to test both the measurement model and structural model. Item reliability testing resulted in strong item loadings being observed across all but three of items, which resulted in their removal. Constructs were tested for internal consistency, and all constructs used achieved the required Average Variance Extracted of greater than 0.5 and a composite reliability of above 0.7. This demonstrated that the constructs used in the structural model had achieved internal consistency. Discriminant validity was examined at the item and construct level. At a construct discriminant validity was achieved. Examining cross loadings, at an item level, revealed that no items loaded higher on constructs other than the constructs they intended to measure. As such item level discriminant validity was also achieved.

The structural model was then assessed and it was found to be robust enough to allow for the testing of the hypotheses for this study. Hypotheses testing then examined the standard regression weights and t-values achieved between the constructs mentioned in the eight hypotheses. The results showed that four of the eight hypotheses could be supported.

Chapter 5 concluded with an analysis of the mediation effect of Behavioural Expectations on the relationship between Behavioural Intentions and BI System usage. The four step process, which examined changes to standard regression weights and t-values, confirmed that Behavioural Expectations has a mediating effect on the relationship between Behavioural Intentions and BI System usage.

The eight hypotheses of this study were discussed, in relation to the findings and relevant prior research and theory. Key discussion and insights identified included:

- The UTAUT model developed by Venkatesh et al(2008) was validated as being predictive of BI System usage. In particular, their findings were confirmed in relation to Behavioural Intentions being mediated by Behavioural Expectations, and that Behavioural Expectations provided superior predictability of BI System usage than Behavioural Intentions

- The quality of information and the quality of the BI System were found not to influence BI System usage. It was discussed, that given the seniority of the respondents, that this result may have been impacted by respondents using staff to access the system for them. As such their experience with the quality of the information and system may not have been first hand, and quality may have been assumed, and as such non-significant results were recorded

- The influence of Team Capital, Architecture and Sensemaking on the perceptions of the quality of strategic decision making was discussed. The three concepts had previously only ever been presented, as a theoretical framework developed by Wood and Klass (2008) through a qualitative exploration. This study provided empirical evidence, that Team Capital (diversity and skills of the decision making team) and Architecture (use of a defined or structured decision making process and use of business intelligence as part of the process), positively and significantly influenced perceptions of the quality of the strategic decisions. Sensemaking (the use of information in decision making) was not found to have a significant influence. However, results on individual items showed, that respondents felt, information was important in strategic decision making. But perhaps although important the use of information, on its own, does not necessarily lead to quality strategic decisions

- The key hypothesis, of the study, examined if senior managers were using the BI System, and if this usage positively influenced their perceptions of the quality of strategic decisions. The results for this hypothesis, which was supported, suggested that BI System usage enhanced the strategic decision

making quality, as it delivered key business intelligence with stronger insight for the decision problem, for which decisions are being made

In concluding the discussion on the hypotheses, it was identified that the key factors influencing the perceived quality of strategic decision making were, in order of strength of the influencing relationship: Architecture, Team Capital, and BI System usage. Sensemaking was not found to be significant. This lead to the conclusion, that to enhance strategic decision quality, senior managers should consider the use of a defined structured decision making process which is informed by business intelligence supplied by a BI System, and ensure that their decision making team has the diversity and skills required to make quality strategic decisions.

7.3 Conclusions about Research Questions

With an increasingly competitive higher education market, a better understanding needed to be developed about the impact BI Systems were having on the quality of strategic decision making. This spawned a series of research questions for this study:

1. How the adoption of BI Systems influenced the perceptions associated with the quality of strategic decisions in Australian universities?

2. How does the diversity of a decision making team, the use of a defined decision making process and the use of information in decision making influence the quality of strategic decisions in Australian universities?

3. Is the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as developed by Venkatesh, Brown, Maruping and Bala (2008), useable as a predictive model for BI System use?

These research questions were further refined through the development of eight hypotheses which were discussed in detail in Chapters 5 and 6. In a more general sense this study has provided some insights in relation to the use of BI Systems by senior managers in the Australian university sector. The key findings and insights of the study included:

- That the majority of respondents (72%) indicated that their university had developed a BI System

- Using the BI System positively influenced respondents perceptions around the quality of the strategic decisions they made but was not the most significant factor

- Forty-three percent of senior managers did not access the BI System directly but had someone access the system for them

- The quality of information and the quality of the BI System did not appear to significantly influence usage of the BI System

- A defined or structured decision making process which used business intelligence and Senior management team diversity and capability had a greater positive influence on perceptions of the quality of strategic decisions than using the BI System

- Measuring Behavioural Expectations provides a stronger predictor of BI System usage, and the UTAUT model for measuring information system adoption provides a valid and reliable model

To conclude this Chapter, the limitations and opportunities for future research are now outlined.

7.4 Limitations

The findings of this study have validated prior research and built on theory, however some limitations exist, which need to be taken into consideration when interpreting the findings of this study.

Some minor, unavoidable, methodological issues related to the use of the population list meant that not less than a 100% of the population may have been reached by the online survey. Mailing lists are rarely completely accurate at any point in time never be 100% up to date, or often have other accuracy related issues, and as a consequence there is a possibility, that not all senior managers in Australian universities will have been included on the mailing list used. This is considered a minor limitation as required sample sizes, as discussed in Chapter 4, were still achieved, and validity and reliability testing produced strong results.

When interpreting the findings of this study, caution needs to be applied in terms of generalising the results across other industries and respondent profiles. This study has focused on the Australian university sector, and as such results may not readily transfer to other countries or industry contexts, which presents a limitation. The survey respondents profile suggests that, as intended, the large majority of respondents were senior managers. Generalising the results, in particular in relation to IT adoption, across more general staff populations of organisations again, presents some limitations.

The Venkatesh's et al (2008) UTAUT model suggested that age, gender and experience have a mediating effect on Facilitation Conditions, Performance Expectancy, Effort Expectancy and Social Influence. This study has not explored their mediating effect, as it was not considered to be a primary focus of the study, and as such considered out of scope. The variables were included into the research model, to establish if they impacted the results of the PLS-SEM analysis, and very minimal effect was observed in relation to the investigation of the hypotheses for this study.

Nevertheless if the results are interpreted in relation to the UTAUT model, then some consideration should be given to this exclusion.

Finally, the questions which provided response data for the items which have made up the constructs of Perception of Strategic Decision Quality, Team Capital, Architecture and Sensemaking have been developed from the theoretical groundings of Wood and Klass (2008). Although good item reliability and validity was achieved, this study is limited in as far as no other studies have confirmed their use. It is hoped that these questions and related items could be used and refined in future studies to confirm their reliability and validity.

7.5 Opportunities for Further Research

The following future opportunities for research have been identified, and it is hoped that these will be explored by others, at some stage, to build on the work which has been done:

1. This study provided the first empirical investigation of the decision quality framework developed by Wood and Klass (2008), which developed the three concepts of Architecture, Team Capital and Sensemaking. Two opportunities for future research emerge. Firstly the Wood and Klass (2008) decision quality framework would benefit from further empirical validation across other industry sectors and at different levels of decision making. Secondly, Sensemaking was found not to significantly influence perceptions on the quality of strategic decisions. Other results of the study however confirmed the importance of information in decision making. Future research could investigate this finding further to establish why Sensemaking, in this context, was not significant.

2. This study has focused on the Australian university sector, however the higher education sector is a global market place. It would be interesting to establish if the findings in relation to strategic decision making, would differ if a sample of universities across the world was considered, or if research compared and contrasted the results of this study to those of another country or countries.

3. Finally this study developed a series of perception based measures for strategic decision quality. Future research could confirm the validity and reliability of the measures developed, perhaps considering other constructs which impact this construct beyond BI System use, Team Capital, Architecture and Sensemaking.

7.6 Last word

Thank you for reading this thesis, like many before me, much time, effort and patience has gone into its development, not only by me, but also from my supervisors, Professor Margot Wood and Professor Mohammed Quaddus. I have learnt much about how to conduct research, and enjoyed analysing the data from the survey, and discovering new theoretical and practical implications. Having completed this doctoral research whilst working full time, and experiencing some of the ups and downs that life presented during this time, I hope that this work is of use to academics and practitioners.

8 Bibliography

Ahmed, A., H. Bwisa, R. Otieno, and K. Karanja. 2014. Strategic Decision Making: Process, Models and Theories. *Business Management and Strategy Journal* 5 (1): 79 - 104.

Alshawi, S., F. Missi, and Z. Irani. 2011. Organisational, technical and data quality factors in CRM adoption – SMEs perspective. *Industrial Marketing Management* 40: 376 – 383.

Amason, A. C. 1996. Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: Resolving a paradox for top management teams. *Academy of Management Journal* 39 (1): 123 - 148.

Ancona, D.G. and D.F. Caldwell. 1992. Demography and design: Predictors of new product team performance. *Organization Science* 3 (3): 321 - 341.

Anderson, D., R. Johnson, and B. Milligan. 1999. *Strategic Planning in Australian Universities.* Department of Education, Training and Youth Affairs, Commonwealth of Australia. http://www.dest.gov.au/archive/highered/eippubs/99-1/report.pdf. (accessed: 14th June, 2008)

Andersson, D., H. Fries, and P. Johansson. 2008. Business intelligence: The impact of decision support and decision making processes. Bachelor's Thesis, Joenkoeping International Business School. http://www.diva-portal.se/smash/get/diva2:3599/FULLTEXT01.pdf (accessed March 14, 2015).

Armitage, C. J., P. Norman, S. Alganem, and M. Conner. 2015. Expectations are more predictive of behavioural intentions: Evidence from two prospective studies. *Society of Behavioural Medicine* 49: 239 - 246.

Aruldoss, M., M.L. Travis, and V.P. Venkatesan. 2014. A survey on recent research in business intelligence. *Journal of Enterprise Information Management* 27 (6): 831 – 866.

Arvai, J.L. and A. Froschauer. 2010. Good decisions, bad decisions: the interaction of process and outcomes in evaluations of decision quality. *Journal of Risk Research* 13 (7): 845 – 859.

Australia. Department of Education and Training. 2013. *Report of the Review of the Demand Driven Funding System.* Canberra: Australian Government Publishing Services.

Australian Bureau of Statistics. 2014. *International Trade in Services, by Country, by State and by Detailed Services Category, Financial Year, 2013-14.* Cat. No. 5368.0.55.003. Canberra: ABS. http://www.abs.gov.au (accessed December 20, 2014).

Australian Bureau of Statistics. 2012. Gender Indicator Report. Cat. No. 4125.0. Canberra: ABS. http://www.abs.gov.au (accessed December 20, 2014).

Ajzen, I. and M. Fishbein. 1974. Factors influencing intentions and the intentions-behaviour relation. *Human Relations* 27 (1): 1 – 15.

Bagozzi, R. P. and J. R. Edwards. 2000. On the nature and direction of relationships between constructs and measures. *Psychological methods* 5 (2): 155 – 174.

Bantel, K. and S. Jackson. 1989. Top management and innovations in banking: Does the composition of the top team make a difference? *Strategic Management Journal* 10:107–124.

Barclay, D., C. Higgins, R. Thompson. 1995. The Partial least squares approach to causal modelling: Personal computer adoption use as an illustration. *Technology Studies* 2 (2): 285 – 324.

Barkema, H. G. and O. Shvyrkov. 2007. Does top management team diversity promote or hamper foreign expansion. *Strategic Management Journal* 28: 663 – 680.

Baron, M. R. and D. A. Kenny. 1986. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology* 51 (6): 1173 – 1182.

Boerner, S., Linkohr, M., and S. Kiefer. 2011. Top management team diversity: positive in the short run, but negative in the long run? *Team Performance Management* 17 (7/8): 328 – 353.

Brautigam, D., S. Gerlach., and G. Miller. 2006. *Business Intelligence Competency Centre.* Hoboken: Wiley and Sons.

Brown, R. V., A. S. Kahr, and C. Peterson. 1974. *Decision Analysis and Overview.* New York: Holt, Rinehart and Winston.

Buchanan, L. and A. O'Connell. 2006. A brief history of decision making. *Harvard Business Review* 84 (1): 32 – 41.

Carmeli, A., A. Tishler, and A.C. Edmondson. 2011. CEO relational leadership and strategic decision quality in top management teams: The role of team trust and learning from failure. *Strategic Organization* 10 (1): 31-54.

Carmeli, A. and J. Schaubroeck. 2006. Top management team behavioural integration, decision quality and organisational decline. *The Leadership Quarterly* 17: 441 – 453.

Cardella, E. 2011. Learning to make better strategic decisions. *Journal of Economic Behavior and Organization* 84: 382-392.

Chang, L. 1994. A psychometric evaluation of 4-point and 6-point Likert-type scales in relation to reliability and validity, *Applied Psychological Measurement* 18 (3): 205 – 215.

Citroen, C.L. 2011. The role of information in strategic decision-making. *International Journal of Information Management* 31: 493 - 501.

Cohen, L., L. Manion, and K. Morrison, K. 2007. *Research methods in education.* 6th ed. London: Routledge.

Compeau, D. R. and C. A. Higgins. 1995. Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly* 19(2): 189 - 211.

Cascio, W. 2012. Methodological issues in international Hr management research. *The International Journal of Human resources Management* 23 (12): 2532 – 2545.

Casey, T. and E. Wilson-Evered. 2012. Predicting uptake of technology innovations in online family dispute resolution services: An application and extension of the UTAUT. *Computers in Human Behavior* 28: 2034 – 2045.

Certo, S. T., Lester, R. H., Dalton, C. M., and Dalton D. R. 2006. Top management teams, strategy and financial performance: A meta-analytic examination. *Journal for Management Studies* 43 (4): 813 – 839.

Creswell, J.W. 1998. *Qualitative inquiry and research design: Choosing among five traditions.* London: Sage Publications.

Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. 1989. User acceptance of computer technology: A comparison of two theoretical models. *Management Science* 35: 982 - 1003.

Dean, J.W. and M. P. Sharfman. 1996. Does decision process matter? A study of strategic decision making effectiveness. *Academy of Management Journal* 39 (2): 368 – 396.

Diaz-Fernandez, M.C., Gonzalez-Rodriguea, M. R., and M. Pawlak. 2014. Top management demographic characteristics and company performance. *Industrial Management and Data Systems Journal* 114 (3): 365 – 386.

Ding, L., W. Velicer, and L.L.Harlow. 2009. Effects of estimations methods, numbers of indicators per factor, and improper solutions on structural equation modelling fit indices. *Structural equation modelling: A multidisciplinary Journal* 2 (2): 119 – 143.

Denizn, N.K. and Y.S. Lincoln. 2000. *Handbook of qualitative research.* 2nd ed. Thousand Oaks: Sage Publications.

Devens, R.M. 1865. *Cyclopaedia of Commercial and Business Anecdotes*. London: D. Appleton and Company.

Donnelly, J.H., J.L. Gibson, and J.M. Ivancevich. 1998. *Fundamentals of Management.* 10th ed. New York: Irwin Inc.

Downey, R.G. and C.V. King. 1998. Missing data in Likert ratings: A comparison of replacement methods. *Journal of General Psychology* 125 (5): 175 – 191.

DuBrin, A.J. 1997. *Essentials of management.* Melbourne: South-Western College Publishing.

Eisenhardt, K.M. and M.J. Zbaracki. 1992. Strategic decision making. *Strategic Management Journal* 13 (Winter): 17 – 37.

Eisenhardt, K. M. and C. B. Schoonhoven. 1990. Organizational growth: Linking founding teams, strategy, environment and growth among U.S. semiconductor ventures 1978 – 1988. *Administrative Science Quarterly* 35: 504 – 529.

Elbanna, S. 2006. Strategic decision making: Process perspectives. *International Journal of Management Reviews* 8 (1): 1 - 20.

Elbashir, M. Z., P. A Collier, and M. J. Davern. 2008. Measuring the effects of business intelligence systems: The relationship between business process and organisational performance. *International Journal of Accounting Information Systems* 9: 135 – 153.

Elshafie, M. 2013. Research paradigms: The novice researcher's nightmare. *Arab World English Journal* 40 (2): 4 – 13.

Fan, W. and Z. Yan. 2010. Factors affecting response rates of the web survey: A systematic review. *Computers in Human Behavior* 26: 132 – 139.

Foster, G. 2011. *Better data key to evidence-based policy in higher ed.* http://theconversation.com/better-data-key-to-evidence-based-policy-in-higher-ed-267 (accessed: 8 April, 2015)

Fornell, C. and D. F. Larcker. 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Market Research* 18 (1): 39 – 50.

Gangadharan, G. R. and S. N. Swami, (2004). Business Intelligence Systems: Design and Implementation Strategies. *Paper presented 26th International Conference for Informational Technology Interfaces ITI* Croatia: 139 - 144.

Grapentine, T. 2000. Path analysis vs. structural equation modelling. *Market Research Journal* Fall: 14 – 20.

Gefen, D., E. E. Rigdon, D. Straub. 2011. An update and extension to SEM guidelines for administrative and social science research. *MIS Quarterly* 32 (2): 3 – 14.

Giles, L. and S. Tzu. 2012. *Sun Tzu's The art of war: bilingual edition complete Chinese and English text / translated by Lionel Giles; with a new foreword by John Minford*. Boston: Tuttle Publishing.

Gordon, R.A. 1989. Intention and expectation measures as predictors of academic performance. *Journal of Applied Social Psychology* 19 (5): 405 – 415.

Gordon, R.A. 1990. Informational bases of behavioral intentions and behavioral expectations or self-predictions. . Journal of Basic and Applied Social Psychology 11 (4): 433 – 442.

Gorla, N., T.M. Somers, and B. Wong. 2010. Organizational impact of system quality, information quality and service quality. *Journal of Strategic Information Systems* 19: 207 – 228.

Guba, E. G., and Y. S. Lincoln. 1994. *Handbook of Qualitative Research*. London: Sage.

Gruzd, A., K. Staves, and A. Wilk. 2012. Connected scholars: Examining the role of social media in research practices of faculty using UTAUT model. *Computers in Human Behavior* 28: 2340 – 2350.

Hambrick, D.C. 2007. Upper echelons theory: An update. *The Academy of Management Review* 32 (2); 334 – 343.

Hambrick, D.C., T. S. Cho, and M. Chen. 1996. The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly* 41 (4); 659 – 684.

Hair, J.F., C.M. Ringle, and M. Sarstedt. 2012. Partial least squares: The better approach to structural equation modelling. *Long Range Planning* 45: 312 – 319.

Hair, J.F., C.M. Ringle, and M. Sarstedt. 2013. Partial least squares structural equation modelling: Rigorous applications, better results and higher acceptance. *Long Range Planning* 46: 1 – 12.

Harrison, F.E. 1996. A process perspective on strategic decision making. *Management Decision* 34 (1): 46 – 53.

Hodgkinson, G.P., E. Sadler-Smith, L.A. Burke, G. Claxton and P.R. Sparrow. 2009. Intuition in organizations: Implications for strategic management. *Long Range Planning* 42: 277 - 297.

Hofer, C.W. and D. Schendel. 1978. *Strategy formulation: analytical concepts.* St. Paul: West Publishing Company.

Homberg, F and H. T. M. Bui. 2013. Top management team diversity: A systematic review. *Journal for Group and Organizational Management* 38 (4): 455 – 479.

Hough, J.R. and D.T. Ogilvie. 2005. An empirical test of cognitive style and strategic decision outcomes. *Journal of Management Studies* 42 (2): 417 – 448.

Hughes, S. and R. White, (2006) Competitive Intelligence in Higher Education: Opportunities and Threats. *Academy of Educational Leadership Journal* 10:2. 67 – 82.

Hulland, J. 1999. Use of partial least squares in strategic management research: A review of four recent studies. *Strategic Management Journal* 20 (2): 195 – 204.

Im, I., S. Hong, and M. S. Kang. 2011. An international comparison of technology adoption testing the UTAUT model. *Information and Management* 48: 1 – 8.

Isik, O., M.C. Jones, and A. Sidorova. 2012. Business Intelligence success and the role of BI capabilities. *Systems in Accounting, Finance and Management* 18: 161 – 176.

Jasperson, J.S., P.E. Carter, and R.W. Zigmud. 2005. A Comprehensive Conceptualization of Post-Adoptive Behaviours Associated with Information Technology Enabled Work Systems. *MIS Quarterly* 29 (3): 525 - 557.

Jehn, K.A., G.B. Northcraft, and M.A. Neale. 1999. Why Differences Make a Difference: A Field Study of Diversity, Conflict and Performance in Workgroups. *Administrative Services Quarterly* 44: 741 - 763.

Kemp, D. and Norton, A. 2014. Review of Demand Driven System. Canberra: Department of Education.

Kopeikina, L. 2005. The Right Decision Every Time. How to reach perfect clarity on tough decisions. New York: Prentice Hall.

Lambert, D. M. and T. C. Harrington. 1990. Measuring nonresponse bias in customer service mail surveys. *Journal of Business Logistics* 12 (2): 5 – 25.

Likert, R. 1932. A technique for the measurement of attitudes. *Archives of Psychology* 140: 5 - 55.

Luhn, H.P. 1958. A business intelligence system. *IBM Journal* October: 314 – 319.

MacKinnon, D. P., M. S. Fritz, J. Williams and C.M. Lockwood. 2007. Distribution of the product confidence limits for indirect effect: Program PRODCLIN. *Behavior Research Methods* 39 (3): 384 – 389.

Mahardika, H. 2013. Intention versus expectation: Comparing the temporal stability of two distinct predictors of behaviour. *Mini Economica* 42 (December): 19 – 29.

Mandall, D. and R. J. McQueen. 2012. Extending UTAUT to explain social media adoption by microbusinesses. *International Journal of Managing Information Technology* 40 (4): 1 – 11.

Mason, J. G. and I. I. Mitroff. 1981. *Challenging strategic planning assumptions.* New York: Wiley-Interscience.

Marginson, S. 2006. Dynamics of National and Global Competition in Higher Education. *The International Journal of Higher Education and Educational Planning* 52 (1): 1 - 39.

Marginson, S., S. Kaur, and E. Sawir. *Higher Education in the Asia-Pacific: Strategic Responses to Globalization.* 2011. Dordrecht: Springer Netherlands.

Michie, S., R. S. Dooley, and G. E. Fryxell. 2006. Unified diversity in top-level teams: Enhancing collaboration and quality in strategic decision-making. *International Journal of Organizational Analysis.* 14 (2): 130 – 149.

Miller, C.C. and R.D. Ireland. 2005. Intuition in strategic decision making: Friend or Foe in the fast-paced 21st century?. *The Academy of Management* 19 (1): 19 – 30.

Mintzberg, H. 1994. *The rise and fall of strategic planning*. Sydney: Prentice Hall.

Mintzberg, H., D. Rasinghani, and A. Theoret. 1976. The structure of unstructured decision processes. *Administrative Science Quarterly* 21: 246 - 275.

Moore, G.C. and I. Benbasat. 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research* 2(3): 192 - 222.

Murray, A.I. 1989. Top management group heterogeneity and firm performance. *Strategic Management Journal* 10 (Summer): 125 – 141.

Negash, S. 2004. Business Intelligence. Communications of the Association of Information Systems 13: 177 – 195.

Nelson, R.R., P.A. Todd, and B.H. Wixon. 2005. Antecedents of Information and System Quality: An empirical Examination Within the Context of Data Warehousing. *Journal of Management Information Systems* 21(4): 199 - 225.

Nemati, H. R. and C. D. Barko. 2001. Issues in organisational data mining: a survey of current practices. *Journal of Data Warehousing* 6 (1): 25 – 34.

NHMRC. 1999. National Statement on Ethical Conduct in Research Involving Humans. Commonwealth of Australia.

NHMRC. 1999. Joint NHMRC/AVCC Statement and Guidelines on Research Practice. Commonwealth of Australia.

Nooraie, M. 2008. Decision magnitude of impact and strategic decision-making process output – The mediating impact of rationality of the decision making process. *Management Decision* 46 (4): 640 – 655.

Nooraie, M. 2012. Factors Influencing Strategic Decision-Making Processes. *International Journal of Academic Research in Business and Social Science* 12 (7): 405 - 429.

Nunnally, J. C. 1978. *Psychometric theory.* 2nd ed. New York: McGraw-Hill.

Paris, H. and S. Van den Brouke. 2008. Measuring cognitive determinants of speeding: An application of the theory of planned behaviour. *Transportation Research* 11: 168 – 180.

Papadakis V.M., S. Liokas, and D. Chambers. 1998. Strategic decision-making processes: The role of management and context. *Strategic Management Journal* 19: 115 – 147.

Pope, J. and Klass, D. 2010. *30th Annual Meeting of the International Association for Impact Assessment, April 6-11, 2010: The Role of Impact Assessment in Transitioning to the Green Economy.* Geneva, Switzerland: International Association of Impact Assessment.

Popovic, A., R. Hackney, P.S. Coelho, and J. Jaklic. 2012. Towards business intelligence systems success: Effects of maturity and culture on analytical decision making. *Decision Support Systems* 54 (1): 729 – 739.

Power, D. J. 2007. *A brief history of Decision Support Systems.* http://dssresources.com/history/dsshistory.html (accessed June 12, 2009)

Priem, L. R., D. A. Harrison and N. K. Muir. 1995. Structured Conflict and Consensus Outcomes in group Decision Making. *Journal of Management* 21 (4): 691 – 710.

Raghunathan, S. 1999. Impact of information quality and decision-maker quality on decision quality: a theoretical model and simulation analysis. Decision Support Systems 26: 275 - 286.

Ramamurthy, K., A. Sen, A. P. Sinha. 2008. Data Warehousing Infusion and Organizational Effectiveness. *IEEE Transactions on Systems, Man, and Cybernetics* 38 (4): 976 - 994.

Ranjan, J. 2008. Business justification with business intelligence. The Journal of Information and Knowledge Management Systems 38 (4): 461 – 475.

Ridley, D. 2008. *The Literature Review – A Step by Step Guide for Students.* London. Sage Publishing.

Rogers, E. *Diffusion of Innovation.* 1995. New York: Free Press.

Rowely, D. J., H. D. Lujan, and M. G. Dolence. 1997. *Strategic Change in Colleges and Universities*. San Francisco: Jossey-Bass.

Russo, J. E. and P. J. H. Shoemaker. 2002. *Winning Decisions.* New York: Currency Doubleday.

Shepard, N.G. and J.M. Rudd. 2014. The influence of context on the strategic decision-making process: A review of the literature. *International Journal of Management Reviews* 16: 340 – 364.

Sheppard, B. H., Hartwick, J., and P. R. Warshaw. 1988. The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research* 15(3): 325 – 343.

Shrivastava, P. and J.H. Grant. 1985. Empirically derived models of strategic decision-making processes. *Strategic Management Journal* 6: 97 – 113.

Sommer, D. and B. Sood. 2014. Market Share Analysis: BI and Analytics Software 2013. http://www.gartner.com/doc/2723017 (accessed 8 April, 2015).

Sobel, M. E. 1990. Effect analysis and causation in linear structural equation models. *Psychometrika* 55 (3): 495 – 515.

Schweiger, D.M., W.R. Sandberg, and J.W. Ragan. 1986. Group approaches for improving strategic decision-making: a comparative analysis of dialectical inquiry, devil's advocacy and consensus. *Academy of Management Journal* 29: 51 - 71.

Silva, M. N., D. Markland, P.N. Vieira, S.R. Coutinho, E.V. Carraca, A.L. Palmeira, C.S. Minderico, M.G. Matos, L.B. Sardinha, and P.J. Teixeira. 2010. Helping overweight woman become more active: Need support and motivation regulations for different forms of physical activity. *Psychology of Sport and Exercise* 11: 591 - 601.

Smith, K.G., K.A. Smith, J.D. Olian, H.P. Sims, D.P. O'Bannon, and J.A. Scully. 1994. Top management team demography and process: The role of social integration and communication. *Administrative Science Quarterly* 39 (3): 412 – 438.

Santosa, P. I., K. K. Wei and H. C. Chan. 2005. User involvement and user satisfaction with information-seeking activity. *European Journal of Information Systems* 14: 361 – 370.

Talk, K., Salomo, S., and A. Kock. 2011. Top management team diversity and strategic innovation orientation: The relationship and consequences for innovation and performance. *Journal for Product Innovation Management* 28: 819 – 832.

Taylor, S. and P. Todd. 1995. Assessing IT usage: the role of prior experience. *MIS Quarterly* 19(4): 561 – 570.

Tilles, S. 1963. How to evaluate corporate strategy. *Harvard Business Review* 41: 111 - 121.

Thomas, J. H. 2001. Business intelligence – why?. *eAI Journal* July : 47 – 49.

Thompson, R.L., C.A.Higgins, and J.M. Howell. 1991. Personal computing: Toward a conceptual model of utilization. *MIS Quarterly* 15(1): 124 - 143.

Triandis, H.C. *Interpersonal behaviour*. Brooke/Cole, Monterey, CA, 1977.

Turpin, S.M. and M.A. Marais. 2004. Decision-making: Theory and practice. Orion 20 (2): 143 – 160.

Venkatesh, V., M. G. Morris, G. B. Davies and F. D. Davies. 2003. User acceptance of Information technology: Towards a unified view. *MIS Quarterly* 27 (3): 425 – 478.

Venkatesh, V., S. A. Brown, L. M. Maruping and H. Bala. 2008. Predicting different conceptualisations of system use: the competing roles of behavioural intention.

Facilitating conditions, and behavioural expectations. *MIS Quarterly* 32 (3): 483 – 502.

Venkatesh, V. and F.D. Davis. 2000. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science* 45(2): 186 - 204.

Workman, M. 2005. Expert decision support system use, disuse, and misuse: a study using the theory of planned behaviour. *Computers in human behaviour* 21: 211 – 231.

Warshaw, P. R. and F. D. Davis. 1984. Disentangling behavioural intentions and behavioural expectations. *Journal of Experimental Social Psychology* 21: 213 – 228.

Warshaw, P. R. and F. D. Davies. 1985. Disentangling behavioural intentions and behavioural expectation. *Journal of Experimental Social Psychology* 21 (3): 213 – 228.

Watson, H., D. Abraham, D. Chen, D. Preston, and D. Thomas. 2004. Data Warehousing ROI: Justifying and assessing a data warehouse. *Business Intelligence Journal* Spring: 6 - 17.

Werner, V. and C. Abramson. 2003. The critical need to reduce elapsed time. *Business Intelligence Journal* 8 (2): 4 - 9.

Wood, M. and D. Klass. 2008. 22nd Annual Australian and NZ Academy of Management Conference, 2-5 December, 2008: Innovation in decision quality: Case application of the IDQ Framework. Auckland, NZ: Australian and New Zealand Academy of Management.

Yeoh, W., A. Koronios, and J. Gao. 2008. Managing the implementation of Business Intelligence Systems: A critical success factor framework. *International Journal of Enterprise Information Systems* 4 (3): 79 – 94.

Zikmund, W.G. 2003. *Business Research Methods.* 7th ed. Australia: Thomson.

9 Appendix A – Original invitation and reminder emails

Original Email Invitation

Dear {first name}

I am currently undertaking research for a Doctorate in Business Administration at Curtin University.

My research focuses on the effect Business Intelligence systems have on decision quality.

I would greatly appreciate your assistance with this research.

Through your response **you will also be helping seriously ill children and their families as a $2 donation will be made to the Starlight Children's Foundation for every response received.**

This survey should take no more than 10 minutes of your time.

A copy of my Doctoral Thesis will available through the Curtin University Library online thesis collection. I anticipate the research outcomes will be useful to you when making decisions regarding the development of your BI Systems and for improving your decision making processes.

No individuals or Universities will be identified through your response, in the analysis or in the Doctoral Thesis. All results will be presented as an aggregate of the Australian University sector and all data and personal information collected will treated as a confidential and anonymous record and securely stored.

This research has been approved by the Curtin University Human Research Ethics Committee (approval number GSB 13-11) and abides by the National Statement on Ethical Conduct in Research Involving Humans. Should you wish to make a complaint regarding this research on ethical grounds, please contact the Human Research Ethics Committee on 089266 2784 or hrec@curtin.edu.au.

Please follow the link below to participate in this study:

http://BusinessIntelligence.questionpro.com

Once again thank you.

Regards

Marco Schultheis

Executive Director – Office of Strategy and Planning

Curtin University

Reminder Email sent on 29 September

Dear {FirstName}

I recently contacted you requesting your participation in my doctoral research study which is examining the effect Business Intelligence systems have had on decision quality.

Although I have had a terrific response from across the sector, I would be very interested in getting your views as well.

If you have already responded, thank you very much.

As per my previous email, through your response you will also be helping seriously ill children and their families as a $2 donation will be made to the Starlight Children Foundation for every response received.

The survey should take no more than 8 minutes of your time.

Please follow the link below to participate in this study:

http://BusinessIntelligence.questionpro.com

A copy of my Doctoral Thesis will available through the Curtin University Library online thesis collection. I anticipate the research outcomes will be useful to you when making decisions regarding the development of your BI Systems and for improving your decision making processes.

No individuals or Universities will be identified through your response, in the analysis or in the Doctoral Thesis. All results will be presented as an aggregate of the Australian University sector and all data and personal information collected will treated as a confidential and anonymous record and securely stored.

This research has been approved by the Curtin University Human Research Ethics Committee (approval number GSB 13-11) and abides by the National Statement on Ethical Conduct in Research Involving Humans.

Should you wish to make a complaint regarding this research on ethical grounds, please contact the Human Research Ethics Committee on 089266 2784 or email to hrec@curtin.edu.au.

Once again thank you.

Regards

Marco Schultheis

Executive Director, Office of Strategy and Planning

Curtin University

10 Appendix B – Survey Instrument

Q1 – Does the University have a BI System (Screening question)

Do you have data and information available to you through a data warehouse, dashboard, and information portal, Management Information System, Decision Support System or BI System?

1. Yes
2. No
3. Do not know

Q2 – BI System name

This section asks questions regarding your usage of the BI System. At my University we refer to our BI System as a (choose all that apply):

1. Business Intelligence System
2. Decision Support System
3. University dashboard
4. Data warehouse
5. Corporate or University reporting System
6. Management Information System
7. Information Portal
8. Other, please specify (Open ended response option)

Q3 – Access to BI System

When accessing business intelligence (e.g.: data):

1. I access the BI System directly myself
2. Someone accesses the BI System for me and provides me with the BI
3. Don't know

Q4 – Frequency of use (Related Construct: BI System usage)

Frequency of use: I use the BI System:

1. daily
2. weekly
3. monthly
4. every second month
5. quarterly
6. twice a year
7. annually
8. Other

Q5 – Duration (Related Construct: BI System usage)

Extent of use: I have been using the BI System for:

1. Less than 6 months
2. 6 months to less than a year
3. 1 year to less than 2 years
4. 2 year to less than 3 years
5. 3 year to less than 4 years
6. 4 year to less than 5 years
7. 5 year to less than 6 years
8. More than 6 years

Q6 – Intensity of use (Related Construct: BI System usage)

When I use the BI System I usually use it for:

1. Less than an hour
2. 1 hour to less than 2 hours
3. 2 hours to less than 3 hours
4. More than 3 hours

Q7 - PERFORMANCE EXPECTANCY

What have your experiences been in using your BI System? Using the six point agreement scale please indicate to what extent you agree to the statements provided.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. I find the BI System useful in my job	❑	❑	❑	❑	❑	❑
2. Using the BI System enables me to accomplish tasks more quickly	❑	❑	❑	❑	❑	❑
3. Using the BI System increases my productivity	❑	❑	❑	❑	❑	❑
4. If I use the BI System, I will increase my chances of getting a promotion	❑	❑	❑	❑	❑	❑

Q8 - EFFORT EXPECTANCY

What have your experiences been in using your BI System? Using the six point agreement scale please indicate to what extent you agree to the statements provided.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. I find the BI System easy to use	❑	❑	❑	❑	❑	❑
2. My interaction with the BI System is clear and understandable						
3. It is easy for me to become skilful at using the BI System	❑	❑	❑	❑	❑	❑
4. Learning to operate the BI System is easy for me	❑	❑	❑	❑	❑	❑

Q9 - BEHAVIOURAL EXPECTATION

We would like to know to what degree you expect to use the BI System in the future .To do this we have a series of items which measure your behavioural expectations. The statements may sound very similar but are designed to establish different levels of expected usage.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. I expect to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑
2. I am likely to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑
3. I am going to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑
4. I will use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑

Q11 - SOCIAL INFLUENCE

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. People who influence my behaviour think that I should use the BI System	❑	❑	❑	❑	❑	❑
2. People who are important to me think that I should use the BI System	❑	❑	❑	❑	❑	❑
3. The administration of the University has been helpful in the use of the BI System	❑	❑	❑	❑	❑	❑
4. In general, the University has supported the use of the BI System	❑	❑	❑	❑	❑	❑

Q12 - FACILITATING CONDITIONS

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. I have the resources necessary to use the BI System	❑	❑	❑	❑	❑	❑
2. I have the knowledge necessary to use the BI System	❑	❑	❑	❑	❑	❑
3. The BI System is not compatible with other systems I use	❑	❑	❑	❑	❑	❑
4. A specific person (or group) is available for assistance with BI System difficulties	❑	❑	❑	❑	❑	❑
5.						

Q13 - SELF-EFFICACY

Now we are looking at your interaction with the BI System. I could complete a job or task using the BI System:

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. On my own without help	❑	❑	❑	❑	❑	❑
2. If I could call someone for help if I got stuck	❑	❑	❑	❑	❑	❑
3. If I had a lot of time to complete the job for which the software was provided	❑	❑	❑	❑	❑	❑
4. If I had just the built-in help facility for assistance	❑	❑	❑	❑	❑	❑

Q15 - BEHAVIOURAL INTENTIONS

The next few questions focus on intentions. Again the statements may appear very similar but are designed to establish different degrees of intention.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. I plan to continue to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑
2. I predict I would continue to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑
3. I intend to continue to use the BI System in the next 12 months	❑	❑	❑	❑	❑	❑

Q16 - BI SYSTEM QUALITY

This section is concerned with the perceived quality of your BI System, the quality of the information generated as well as how the BI has influenced the quality of the decision making process. The BI System:

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. Is easily accessible	❑	❑	❑	❑	❑	❑
2. Is reliable	❑	❑	❑	❑	❑	❑
3. Provides information in a timely manner	❑	❑	❑	❑	❑	❑
4. Provides flexibility in how it provides information	❑	❑	❑	❑	❑	❑
5. Is integrated with other management processes (e.g.: Performance Review process, monitoring of KPIs, budget and load planning)	❑	❑	❑	❑	❑	❑

Q17 – QUALITY OF INFORMATION

….. systems and decisions continued...The BI System provides:

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. Accurate information	❑	❑	❑	❑	❑	❑
2. Information which is complete	❑	❑	❑	❑	❑	❑
3. Information which is current	❑	❑	❑	❑	❑	❑
4. Information in the format I require	❑	❑	❑	❑	❑	❑

Q18 - DECISION QUALITY

Quality of information, systems and decisions continued...As a result of the BI System:

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. The decision making process has improved	❑	❑	❑	❑	❑	❑
2. The decision making content has improved	❑	❑	❑	❑	❑	❑
3. The decisions are aligned to the Vision of the University	❑	❑	❑	❑	❑	❑
4. The decisions being made are more likely to achieve the perceived desired outcome	❑	❑	❑	❑	❑	❑

Q19 - SENSEMAKING

This section will ask you questions regarding other factors which affect the quality of decision making.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. Decisions are made in consideration of internal business intelligence or performance information	❑	❑	❑	❑	❑	❑
2. Decisions are made in consideration of information or business intelligence on external factors	❑	❑	❑	❑	❑	❑
3. Information informs decision making	❑	❑	❑	❑	❑	❑

Q19 (continued) - ARCHITECTURE

This section will ask you questions regarding other factors which affect the quality of decision making.

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
4. Decision making is undertaken using a defined or structured process	❑	❑	❑	❑	❑	❑
5. Decision making process is informed by the BI System	❑	❑	❑	❑	❑	❑

Q20 – TEAM CAPITAL

Factors affecting decision quality continued ...Here we are trying to measure the attributes of your decision making team. When we make decisions as a team, the decision making team has:

	Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1. a diverse set of skills	❑	❑	❑	❑	❑	❑
2. a diverse set of knowledge	❑	❑	❑	❑	❑	❑
3. the capacity to make good decisions	❑	❑	❑	❑	❑	❑
4. a diverse set of perspectives	❑	❑	❑	❑	❑	❑

DEMOGRAPHIC QUESTIONS:

Q22 - GENDER
Please indicate your gender:
1. Male
2. Female

Q23 - AGE
Please indicate which age range you belong to:
1. 18 - 25
2. 26 - 35
3. 36 - 45
4. 46 - 55
5. 56 - 65
6. 65+

Q24 - SENIORITY
Please indicate the type of position you hold within the University:
1. Senior Executive (e.g.: Vice-Chancellor, President, Deputy Vice-Chancellor, Pro Vice-Chancellor, Executive Dean, Executive Director, Vice President, CFO, CIO)
2. Senior Manager (e.g.: Director of an area, Head of School)
3. Manager (e.g.: Manager of an operational unit, Head of Department)
4. Academic staff member engaged in teaching and or research
5. Professional/general staff member
6. Other

Q25 - FUNCTION
Please indicate the type of area you work in your University:
1. Teaching area
2. Research area
3. Teaching and research area
4. Support or administrative area
5. Other

FINAL PAGE