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Assessment of Pre- and Post-adoption Factors of Business Intelligence and Analytics Systems in Saudi SMEs

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Certificate of Original Authorship

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Maryam Almusallam, declare that this thesis is submitted in fulfilment of the requirements for the award of PhD in information system], in the School of Professional Practice and Leadership / Faculty of Engineering and Information Technology at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

In Small and medium-sized enterprises (SMEs), the usage of data has been rapidly increasing. Thus, the need to implement and use Business Intelligence and Analytics (BI&A) systems is crucial in order to enhance organisational performance. BI&A has attracted the attention of decision-makers, as these systems significantly impact forecasts of current and prospective views of the decision process in business operations. This impact will be realised only when BI&A is widely used. The literature suggests that more than 87% of BI&A projects in organisations fail to achieve their expected returns and benefits. However, literature reviews show that there is a need for more studies on BI&A systems adoption and use both in general and in SMEs in particular. Also, there is a dearth of studies relating to developing nations. Furthermore, little is known about how well the factors that influence the intention to adopt (pre-adoption) also predict extensive use (post-adoption) of the same technology.

There have been huge changes in Saudi Arabia's (SA's) economic perspective in recent years. Instead of relying on oil alone as a source of income, there is now more than ever a growing need for SA to diversify into other economic sectors. SMEs have received special attention from the Saudi government, as this sector makes a great contribution to the gross domestic product (GDP). Therefore, much of the government funding and support is directed to tech-related sectors to enhance technology usage at Saudi SMEs.

This study aims to examine the pre- and post-adoption factors that influence owners'/managers' decisions to adopt and use BI&A systems in SMEs in SA and compare these factors' effects on both sides. To achieve this, an integrated model is proposed and empirically tested. This model integrates established theories, including the TOE framework, IS adoption for small businesses, and DOI theory. Ten factors are proposed under these theories, which are relative advantage, complexity, compatibility, observability, owners'/managers' IT knowledge, owners'/managers' innovation, organisational resource availability, enterprise size, competitive pressure, and external support.

Using an explanatory sequential mixed method approach, data have been collected, starting with a survey and followed by an interview with the owners/managers of SMEs located in SA. The results showed that Saudi SMEs are still in the initial stage of adopting and using BI&A systems. Relative advantage, complexity, observability, enterprise size, resource availability,

external support, IT knowledge, and innovativeness are proven to be significant factors in the pre-adoption stage. while compatibility and competitive pressure are not significant in the survey results, yet inconclusive results for these two factors appear in the interviews. In the post-adoption stage, our results show that observability, resource availability, competitive pressure, external support, and innovativeness are significant factors, while a relative advantage, complexity, enterprise size, and IT knowledge are not. Also, compatibility in the post-adoption stage appears insignificant in our survey results, but inconclusive interview results appear for these factors.

The present study's unique contribution can be found in its context. SMEs play a major role in economic progress. However, it is widely acknowledged that the use of advanced technology in SMEs, such as BI&A systems, is rare and has received limited attention in the literature. Moreover, this study investigates pre- and post-adoption for BI&A systems in SMEs, matters which are rarely discussed in the same context. In addition, this study provides support regarding the pertinence and usability of the TOE framework and DOI theory in predicting and explaining owners'/managers' adoption and use of BI&A systems in Saudi SMEs. The findings of this study can be used to help introduce BI&A systems adoption strategies with the goal of achieving a more extensive use of BI&A systems, which will result in a higher return on SME investment in SA and other developing countries. It creates a reliable and valid BI&A systems adoption model that can be used by IT vendors, governments, and SME owners to increase BI&A systems adoption and usage in their businesses.

Table of Content

List of Tables

List of Figures

List of Abbreviations

AVE	Average Variance Extracted
BA	Business Analytics
BI&A	Business Intelligence and Analytics
BI	Business Intelligence
β	Standardized Coefficients Beta
CFA	Confirmatory Factor Analysis
CR	Composite Reliability
DOI	Diffusion of Innovation
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
IS	Information Systems
IT	Information Technology
KAUST	King Abdullah University of Science and Technology
OLAP	Online Analytical Processing
P	Levels of Significance
QA	Quality Assessment
R	Correlation Coefficients
ROI	Improving Return on Investment
SA	Saudi Arabia
SLR	Systematic Literature Review
SME	Small and Medium-sized Enterprises
SPSS	Statistical Package for the Social Sciences
SVC	Saudi Venture Capital
TAM	Technology Acceptance Model
TOE	Technology-Organisation-Environment
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UTS	The University of Technology Sydney
VC	Venture Capital

1 Chapter One: Introduction

1.1 Introduction:

Pertaining to the adoption and use of the BI&A system in SMEs in Saudi Arabia (SA), there is a current knowledge gap in this area. This study will fill this gap in the literature. An exploratory sequential mixed method is in the present research by carrying out two stages: the questionnaires and the interviews. The data were collected from the owners/managers of the SMEs that are located in Saudi Arabia. Then the data were analysed by using suitable analysis techniques. The objective of this chapter is to present a summary of the thesis, structured as follows. The research background and research problem are provided. Following that, the research aims, and objectives are listed. Then, the research questions are presented. Afterwards, the significance of the study is discussed in detail. Finally, the scope of the study and the thesis layout are presented.

1.2 Background and Research Problem

A Business Intelligence and Analytics (BI&A) system comprises a collection of technical solutions that enables an organisation to collect, combine, and analyse massive volumes of data in order to better understand its prospects, strengths, and shortcomings (Harrison et al. 2015). BI&A is an essential tool to help the decision-making process in companies. In fact, the increase in competition from online and conventional business has made BI&A extremely important for companies to enhance their efficiency and services (Wee et al., 2022; Ain et al., 2019). BI&A solutions have become more vital for organisations in enhancing their management practice and performance, as well as their goods and services (Aldossari & Mokhtar, 2020; Trieu, 2017).

A BI&A system is more than a technique; it is a strong management strategy that, when properly implemented, will provide information that will improve decision making and profit for practically any organisation, even SMEs (Williams & Williams 2007) . BI&A system is a strategic enabler required to take advantage of market opportunity, or to deal with the enterprise crisis (Wixom & Watson, 2010). Previous studies have found that the likelihood of a successful BI&A system implementation is significantly increased by matching the BI&A system design with the business' strategic vision (Yeoh & Popovicˇ, 2016; Wixom & Watson, 2010). When the enterprise clearly defines its strategy vision and requirements, then the BI&A system will positively change how the enterprise is run (Wixom & Watson, 2010).

According to Chaudhuri, Dayal and Narasayya (2011) these days, it is difficult to find a successful company that does not use a BI&A system. As a result, many businesses, even small and medium size enterprises (SMEs), have used a BI&A system to gain a competitive advantage. BI&A system innovation is one of the main sources of organisational competitive advantage for a long-term survival (Grublješič, Coelho & Jaklič 2019). These innovations cannot be fully perceived unless BI&A systems are used and the information that is provided by BI&A systems become fully embedded into the users' routines (Grublješiˇ & Jakliˇ 2015). The impact of information acquired by decision makers on the organisation's ultimate performance will be low if they do not adopt BI&A systems and use them effectively for decision making (Wee et al., 2022b; Popovič et al., 2012).

Although a myriad of research has already been conducted on IS technology adoption and use in firms and individual levels, in general, there is a dearth of information regarding the adoption of BI&A systems (Bach, Čeljo & Zoroja 2016; Grublješič, Coelho & Jaklič 2019) specifically in the SME sector (Ahmad et al. 2020; Almusallam & Chandran 2020a). A systematic literature review (SLR) of BI&A research in SMEs published between 2000 and 2018 was carried out by Llave (2019) examined topics such as the benefits of BI&A, cloud BI&A, mobile BI&A, and BI&A solutions and adoption. This study found that there is no clear indication of success even though several frameworks and models have been developed for big companies. Also, Llave (2019) highlighted how models designed for large businesses should not be the only ones used; rather, consideration should be given to the features of SMEs. Also, Llave (2019) stressed the need for additional research on BI&A adoption in developing countries. Moreover, Wee et al. (2022) considered the process of driving value from BI&A by SMEs as they used the Business Analytics Success Model (BASM) which was developed by Seddon et al. (2017) for big companies but they modified it to be compatible to use in SMEs. Popovič et al. (2012) state that "Different types of IS require specific success models and users prefer different success measures depending on the type of system being evaluated" (p.730). BI&A systems have specific features that are different from other types of IS (Grublješič & Jaklič 2015; Popovič et al. 2012; Puklavec, Oliveira & Popovič 2018). For example, in comparison to the information and processes used in operational ISs, BI&A systems use less structured data and procedures (Puklavec, Oliveira & Popovič 2014), which could affect the user's perception of BI&A system complexity. Also, using BI&A systems is typically optional (Grublješiˇ & Jakliˇ 2015). Researchers who have examined users' behaviour in the past have recognized the significance of the voluntariness of system use (Venkatesh et al. 2003). Furthermore, in comparison to the

benefits of an operational IS, the majority of BI&A system benefits are more indirect, long-term, and harder to measure (Popovič et al. 2012), which could affect the user's perception of the benefit of the BI&A system. These differences, which are discussed thoroughly in Chapter 2 section 2.2.5, have an impact on all dimensions of BI&A systems' success including system adoption and use. These differences are the primary reasons why BI&A system adoption and use need to be examined independently from traditional IS adoption, with better knowledge of the factors and their impacts on the BI&A system adoption and use process (Puklavec, Oliveira & Popovič 2018).

In terms of BI&A systems in SME studies, Aldossari and Mokhtar (2020), in their research, addressed the problems associated with SMEs' Intention to use ERP and BI. They spoke with thirty SME specialists through interviews, and as a consequence of their research, elements related to technology, organizations, and the environment were determined. Also, BI&A adoption determinants in Philippine SMEs have been studied by Simon and Suarez (2022). A five-point list of factors, competitive pressure, perceived relative advantage, complexity, top management support, and innovativeness, was used to predict behaviour intentions to use BI&A. Also, Boonsiritomachai et al. (2016), in their research suggest a model of BI&A maturity for SMEs that analyses the factors influencing their present levels of BI&A adoption and differentiates between different levels of BI&A maturity. According to their analysis, the company's maturity level increased from the operating level, where it used basic BI&A, to the innovate level, where it used advanced BI&A. To investigate the present level of BI&A adoption, 427 Thai SMEs were asked to complete a survey using a quantitative methodology. According to their research, BI adoption among Thai SMEs is still in its infancy, with a large number of them falling into the lowest level of adoption. Also, Puklavec et al. (2018) on their research developed a model to comprehend the aspects influencing the adoption of BI&A at its many stages, which include evaluation, adoption, and use stages. They have considered the organizational, technological, and environmental elements that have an impact on SMEs' adoption and utilization of BI&A systems. Their findings demonstrated that, of the nine parameters, five have a significant impact on the BI&A evaluation and use phases, and four have a significant impact on the adoption stage. However, none of the mentioned studies have considered the technology, organizations, environment, and individual factors that affect the BI&A system in pre- and post-adoption stages. Some of the mentioned studies have ignored individual factors such as (Aldossari & Mokhtar 2020; Puklavec et al., 2018). Also, none of the mentioned studies have used mixed methods in their research.

However, little is known about how well the factors that influence intention to adopt (pre-adoption) also predict extensive use (post-adoption) of the same technology. Earlier studies found that previous experience would make a difference between the IT adoption factors for pre-adopters and post-adopters (Karahanna, Straub & Chervany 1999; Thong 1999). Studying the adoption of computer-aided software engineering (CASE) technology, Rai and Patnayakuni (1996) found that although top management support was not necessary for pre-adoption, it was crucial to understanding post-adoption behaviour. Also, Ghobakhloo et al. (2011) on their study considered the pre- and post-adoption of Ecommerce in Iranian manufacturing SMEs, and they found that the factors that influence the decision to adopt the Ecommerce are different from the factors that influence the extensive use of the same technology. Moreover, study conducted by Gefen and Straub (2000) focused on examining the relationship between users' perceptions of a technology before adoption and their subsequent actual usage behaviour after adoption. This study utilized a longitudinal research design, which allowed the researchers to track participants' adoption intentions and actual usage behaviour over time. Overall, Gefen and Straub's study contributes to our understanding of the factors influencing technology adoption and usage behaviour, particularly the continuity between pre-adoption perceptions and post-adoption usage patterns. It underscores the importance of considering both pre-adoption factors and post-adoption outcomes in research on technology adoption. Therefore, studying the same factors of the same technology at two adoption stages, pre and post, will give a clear idea about these differences. Also, Closing the gap between factors influencing pre-adoption intentions and post-adoption use is an important area for research. By understanding how initial adoption decisions translate into actual usage patterns over time, organizations can better design interventions, support mechanisms, and strategies to promote sustained technology use and maximize the benefits of technology investments. In term of BI&A system in SMEs, the studies that mentioned in previous paragraph were conducted in one adoption stage only, none of these studies have considered the pre- and post-adoption factors of BI&A in SMEs together. For example, some studies have considered only the pre-adoption stage such as (Aldossari & Mokhtar 2020; Simon & Suarez 2022). While other studies have considered the post-adoption stages only such as (Boonsiritomachai et al.,2016). According to the researcher's knowledge there is no previous studies have considered the pre- and post-adoption of BI&A in SMEs together. Therefore, there is significant need to address this gap.

In the recent years, there are huge changes in Saudi Arabia (SA) economic perspectives. Now, there is more than ever a growing need for SA to diversify into other economic sectors to overcome its challenging dependency on a limited source of economy, that is oil (Guendouz & Ouassaf, 2020).. Therefore, in 2016 the Saudi Vision 2030 was launched, with the aim of reducing SA's dependence on oil by investing in different sectors (Vision 2030 2022a). The SMEs have received special attention from this vision, as this sector makes good contribution to Gross Domestic Product (GDP) in SA (Investment 2019; Statistics 2017). Also, in order to achieve the Saudi Vision 2030, much of government funding was directed to tech-related sectors according to Monsha'at (2021) (more details can be found in Chapter 2 section 2.5.4). This makes BI&A system use and adoption crucial in Saudi SMEs to achieve the greatest possible advantages from such rich data environment.

The majority of BI&A system users are owners or managers in high-level positions in the organisational structures of SMEs. Hence, the owners/managers in SMEs are more likely to have a dual identity in describing the technology adoption: the potential sponsor and the actual adopter of BI&A systems (Luo 2016). Thus, the present study seeks to probe the pre- and post-adoption factors that influence the owners'/managers' decision to adopt and extensive use BI&A systems in Saudi SMEs. The factors in this study are categorised based on Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer 1990) and IS adoption model for small business (Thong 1999). These categories include Technological characteristics, Organisational characteristics, Environmental characteristics, and Individual characteristics. The first three categories are obtained from the TOE framework while the Individual characteristics are from the IS adoption model for small business. Technological characteristics refer specifically to the attributes and features of technology-related factors that influence the adoption and implementation of innovations within an organization (Tornatzky & Fleischer 1990; Alrousan & Jones 2016; Alrousan & Al-Adwan 2020). Technological characteristics focus on the specific attributes of the technology being adopted and how they interact with the organization's capabilities and external environment. Organizational characteristics refer to the internal attributes and features of an organization that influence its capacity to adopt and implement technological innovations effectively (Tornatzky & Fleischer 1990; Alrousan & Jones 2016; Alrousan & Al-Adwan 2020). These characteristics focus on how the organization's structure, culture, resources, and processes interact with technological factors to shape the adoption process. By considering these organizational characteristics within the TOE framework, organizations can better understand their internal strengths and

weaknesses regarding technology adoption and develop strategies to optimize their capacity for innovation and change (Tornatzky & Fleischer 1990). Environmental characteristics refer to the external factors and conditions that influence an organization's adoption and implementation of technological innovations (Tornatzky & Fleischer 1990). These characteristics focus on how the broader external environment interacts with the organization's technological and organizational capabilities to shape the adoption process. By considering these environmental characteristics within the TOE framework, organizations can better understand the external opportunities and challenges related to technology adoption and develop strategies to navigate the external environment effectively. In the Information Systems (IS) adoption model for small businesses, individual characteristics refer to the personal attributes, attitudes, beliefs, and behaviours of individuals within the organization that influence the adoption and use of information technology (IT) or information systems (IS) (Thong 1999). These characteristics focus on how individual users perceive, interact with, and respond to technology within the context of their work environment. More details about these categories and the reasons behind choosing these categories are in Chapter 2 section 2.7 to 2.11.

To summarise, in order to encourage the adoption and use of BI&A systems in SMEs, there is a need to identify and understand the factors that affect owners'/managers' decision to adopt and extensive use BI&A systems in Saudi SMEs. However, literature reviews show that there is a shortage of studies of BI&A systems adoption and use in general and in SMEs specifically. Also, there is dearth of studies in the context of developing countries such as SA. Furthermore, most studies only capture a snapshot of consumer attitudes at a certain point of user exposure to technology, adoption, or continuing usage behaviour. The findings of these snapshots show that the barriers to and drivers of IS adoption differ from those relating to extensive technology use (Bhattacherjee & Lin 2015). Consequently, there is significant need to address these gaps. This thesis' study topic is to identify the major influences that have significant effects on the formation of BI&A systems adoption and use in the Saudi context.

1.3 Research aims and objectives.

This study aims to investigate the pre- and post-adoption factors that influence owners'/managers' decisions to adopt and use BI&A system by SMEs in Saudi Arabia.

The following are the research objectives:

- To determine the critical factors that impact BI&A pre-adoption by Saudi SMEs.
- To determine the critical factors that impact BI&A post-adoption by Saudi SMEs

- To investigate how these critical factors influence SMEs differently between pre- and post-adoption stages.
- To develop a model to improve SMEs adoption and use level of BI&A systems.
- To empirically validate and test the proposed research model.

To contribute to fill the knowledge gap around BI&A adoption and use in SMEs.

1.4 Research Questions

With the research objectives in mind, the research questions are proposed as follows:

What are the critical factors influencing BI&A pre- and post-adoption by Saudi SMEs?

- *How do the technology characteristics (Relative Advantage, Complexity, Compatibility, and Observability) affect BI&A systems pre- and post-adoption in Saudi SMEs?*
- *What role do the organisational characteristics (Resource Availability and Enterprise Size) play with regard to BI&A systems pre- and post-adoption in Saudi SMEs?*
- *How do environmental characteristics (Competitive Pressure and External Support) impact BI&A system's pre- and post-adoption in Saudi SMEs?*
- *How do owners'/managers' characteristics (IT knowledge and Innovativeness) at SMEs affect BI&A pre- and post-adoption in SA?*
- *How do these critical factors influence SMEs differently in the pre- and post-adoption stages?*

To answer the research questions and achieve the research aim and objectives, an integrated model has been proposed and examined. This model integrates established theories, which include the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer 1990), IS adoption model for small business (Thong 1999), and Diffusion of Innovation (DOI) Theory (Rogers 1983).

1.5 Significance of the study

SMEs have made a significant contribution to economic progress as they make up approximately 90% of businesses and employ in excess of 50% of workers worldwide (Llave 2019). Moreover, the global market for BI&A systems is expected to increase from USD 23,940 million in 2020 to USD 33,770 million in 2026 (PR Newswire 2022). The demand for the implementation of BI&A systems has increased because of their affordability (Bhatiasevi & Naglis 2018). This feature gives small and mid-size enterprises (SMEs) the ability to implement BI&A systems just as large companies do. SMEs, which make up over 50% of all employment worldwide and almost 90% of all businesses, play important and major financial

roles (Llave, 2019). SMEs contribute significantly to the economy because they employ the greatest number of workers (Ayyagari, Beck & Demirguc-Kunt 2007). It is crucial to emphasize that this sector should not be disregarded as growing it will increase prospects for governments to create jobs. Also, the requirement for sophisticated information systems, like BI&A, to handle data in Saudi Arabia's SMEs has grown. It is anticipated that in 2030, SA's GDP contribution from SMEs will increase from 20% to 35% due to their expansion (Vision 2030 2022b). With this increase, SA's economy will catch up to that of the top 15 nations in the world (Investment 2019; Statistics 2017). As a result, SA provides SMEs with a large potential market for growth. Consequently, the purpose of the present study is to better illuminate the contributory factors that impact the choice to adopt BI&A systems and factors that impact decisions to make extensive use of BI&A systems in order to give knowledge of the factors most pertinent to the adoption and use of BI&A in Saudi SMEs. These main factors help BI&A system interested parties to best avail themselves of the possibilities by concentrating on the important points that have a better chance of enhancing BI&A system adoption and use. The findings of this study may be utilised to build BI&A system adoption strategies with the aim of attaining more extensive usage of BI&A systems, which will result in a greater return on SME investment in SA and in other countries. Also, the study's findings may be used as a reference for SME owners/managers and consultants in leading effective BI&A system adoption and utilization. Moreover, it will create a reliable and valid BI&A adoption model that can be used by IT vendors, governments and SME owners to increase BI&A adoption and usage in their businesses.

1.6 Scope of the Study

The scope of the present project surrounds the investigation of the pre- and post-adoption factors that influence owners'/managers' decisions to adopt and use BI&A systems at SMEs in Saudi Arabia. The study data was obtained from Saudi SMEs. Also, this study was limited to SA SMEs registered in the Chambers of Commerce database. Consequently, the outcomes are not easy generalised or applied to other companies from different countries. In addition, the focus of the study is on BI&A adoption at the firm level rather than at the individual level. Most BI&A systems users are owners or managers in high-level positions in the organisational structures of SMEs. Hence, the owners /managers in SMEs are more likely to have a dual identity in describing the technology adoption: the potential sponsor and the actual adopter of BI&A systems (Luo 2016). Therefore, only the owners/managers of SMEs have been considered as target participants for this study.

1.7 Potential Stakeholders of the Study

The designation of stakeholders is based on their contribution to the undertaking's objectives. As a result, this study's constituents include any individual or group who can influence or can be influenced by its outcome (Freeman, 1984).

Considering the focus area and scope of this study, the study has the following stakeholders: Government, IT vendor, SMEs owners/managers, Researchers and IT consultants.

The government will benefit from the identified factors affecting the adoption and use of BI&A system in SMEs in enhancing and promoting the adoption and use of such advanced technology. When the governments enhance and promote this technology in SMEs, a valuable sector economically, this step will contribute positively to the country's economy. Additionally, IT vendors will consider these factors in developing or improving BI&A systems for this vast sector (SMEs) which would increase their sales for this type of business. SMEs owners/managers are very important players and will gain benefit when they know these factors affecting their outcomes from adopting BI&A; thus, they would improve their knowledge and skill in using this sophisticated technology. Researchers will utilise the outcomes of this current study for further studies and investigation in this field; they do not need to reinvent the wheel. Of course, IT consultants will broaden their knowledge and experience by considering these factors when they consult their customers.

1.8 Thesis Layout

The present thesis contains six chapters, as shown in Figure 1.1:

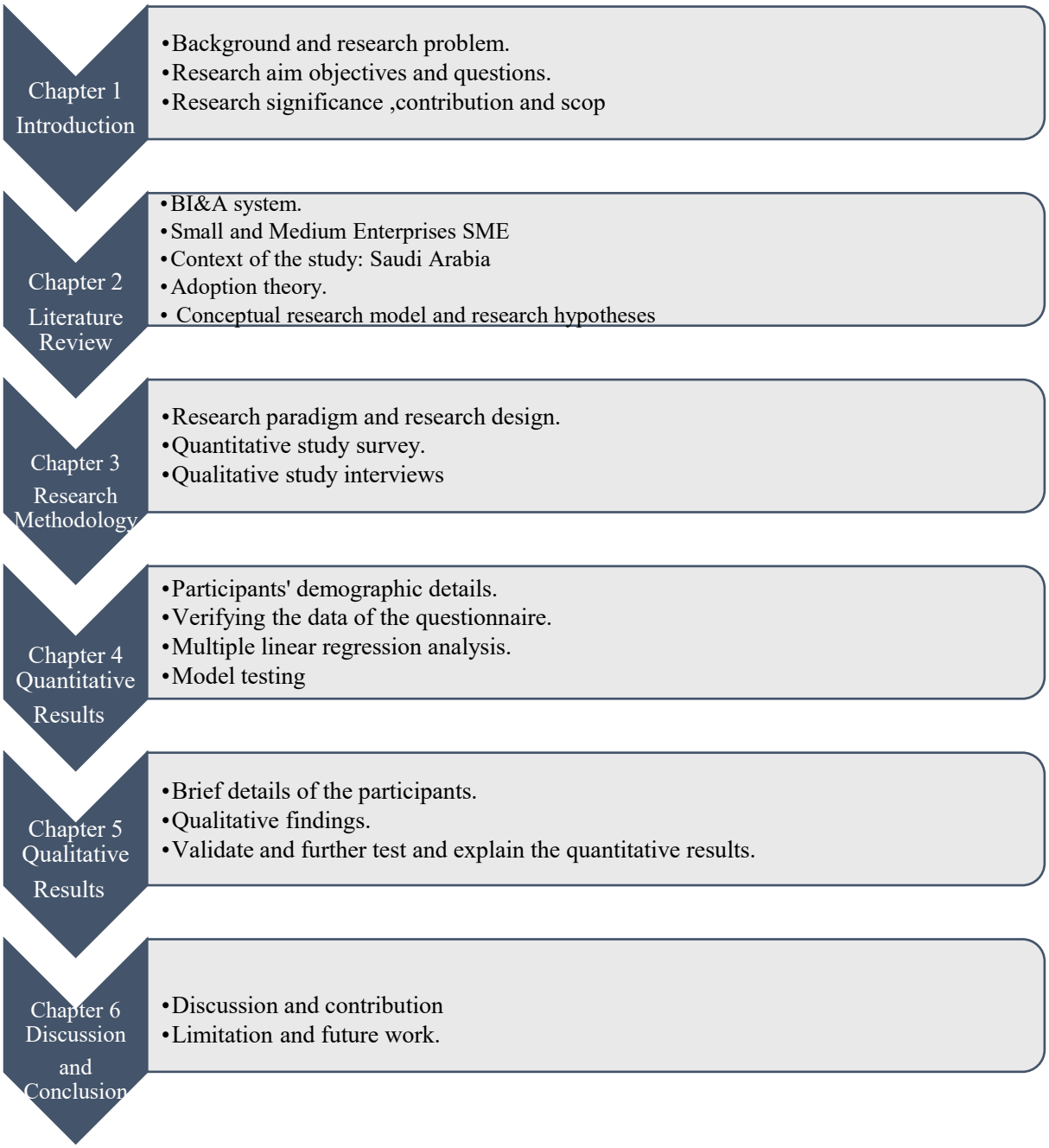

Figure 1. 1 Thesis Layout

Chapter 1:

This chapter presents the study background and focus. It discusses the aim, objectives, and questions of the research. In addition, the significance of the study is discussed. Additionally, the scope of the study and Potential Stakeholders are presented. Finally, the thesis structure is outlined.

Chapter 2:

Chapter 2 presents the literature review. This introduces BI&A systems, comparison between BI&A system characteristics and Information Systems (IS), the benefits of BI&A systems and the challenges of BI&A systems. This is followed by Small and Medium Enterprises, Definition of SMEs, and then the SMEs' characteristics. Then can be seen a brief description of the pre-adoption and post-adoption stages of information system. Afterwards, literature review of BI&A in SMEs studies is discussed. Then, the context of the study which is Saudi Arabia have been discussed in detail that include background, SMEs in Saudi Arabia, Saudi SMEs and IT capabilities and BI&A in Saudi SMEs. Afterwards, a review of the adoption theories, which includes a review of the notable innovation adoption theories and covers the three important models chosen for this research, is presented. Then, an overview of the technology adoption factors that includes technological, organisational environment, and owner-manager characteristics is presented. Finally, from comprehensive review, the conceptual research model and the proposed research hypotheses proposed.

Chapter 3:

This chapter presents the study's research methodology. The first section of this chapter describes the research paradigm, research method justification, and research design. The second section provides a description of research model development that includes the literature review and the SLR. Next, in the third section, details of the quantitative phase in order to test the proposed hypotheses are presented. The quantitative phase includes details of the survey questionnaire method, survey content research questionnaire development, survey translation process, population and sampling, data collection procedure, assessment of normality, reliability, and validity, quantitative data analysis approach, descriptive data analysis, and multi linear regression analysis. Then, details of the qualitative phase are presented in section four. The qualitative study aims to explain and further contextualize the quantitative results. Therefore, details of qualitative phase are presented, which include an overview of the interview method, interview guide development, interview population and sampling, interview data collection procedure, and qualitative data analysis procedure. Finally, the ethics consideration details for this research are provided.

Chapter 4:

This chapter presents the quantitative data results that include the participants' demographic details followed by verifying the questionnaire data and then the outcomes of the research hypotheses, which were tested by using multiple linear regression analysis.

Chapter 5:

This chapter presents the qualitative data analysis results of the data collected from interviews with participants. This chapter aims to explain and further validate the quantitative results. This chapter is broadly divided into two sections: brief details of the interview participants, and the qualitative findings. The qualitative findings are in three sections. The first section aims to validate and further test the quantitative results. The second section explain the unexpected quantitative results, and the third section aims to identify new factors that could affect the adoption and use of BI&A systems in SMEs in SA.

Chapter 6:

This chapter begins with a summary of the research problem, research questions, and hypotheses, followed by a discussion of the significant results and how they are related to essential factors that impact the adoption and use of BI&A systems in Saudi SMEs. Later in the chapter, the research contributions and implications are discussed. The chapter ends by noting the study's limitations and suggesting future research opportunities.

2 Chapter Two: Literature Review

2.1 Introduction:

The first chapter of the present thesis presented an overview by describing the important aspects of the study topic, problems, objective, scope, and methodology. This chapter describes a general literature review which helps in designing the conceptual research model and research hypotheses. This chapter is divided into seven sections. The first section provides an overview of BI&A systems, BI&A definition, BI&A system characteristics and operational information system (IS), the benefits of BI&A systems, the challenges of BI&A systems, The second section gives an overview of SMEs, SME definition, SME characteristics and the BI&A in SMEs. Then, the context of the study which is Saudi Arabia is discussed in detail that includes background, SMEs in Saudi Arabia, Saudi SMEs and IT capabilities and BI&A in Saudi SMEs. Afterwards, a description of pre-adoption and post-adoption stages of information system is provided in the fourth section. The fifth section provides a review of the adoption theories, including a review of the notable adoption theories and then a discussion of the three important models chosen for insertion within the model in this research. The sixth section provides an overview of the technology adoption factors, including technological, organisation environment, and owner-manager characteristics. Finally, in section seven, the conceptual research model and this thesis' hypotheses are proposed.

2.2 BI&A system

2.2.1 BI&A Definition

In 1958, the expression Business Intelligence (BI) was first mentioned by Hans Luhn in his article in the IBM Journal (Olexova, 2014). Hans defined the term BI through two components: business and intelligent; he defined BI as an automatic system for disseminating business information. However, the phrase "business intelligence" is mainly ascribed to a Gartner analyst who invented it in 1989 (Watson 2009). Afterwards, this term was wildly adopted by several experts in different fields (Tutuneaa & Rusa, 2012). The term BI currently does not have a commonly agreed definition among researchers. It has several definitions in academic literature review according to its context, judged by its ability to serve an organisation's requirements (Md Hatta et al. 2015). For example, Seddon and Constantinidis (2012) have described BI as a collection of tools that includes statistical and quantitative methods, explanatory and predictive models, data warehouses, online analytical processing (OLAP), visualization, and data mining, while Negash and Gray defined BI as a system that integrates data collection, storage, and knowledge management with analytical tools to provide planners

and decision makers with complicated internal and competitive information. Moreover, Inmon (2005) defined the BI as a concept that offers a way to gather vital information to enhance strategic decisions and hence plays a significant role in the present systems that assist decision-making. While Williams and Williams (2007) defined BI as management approach that practically every organization that adopts it may use to gain knowledge, efficiency, make better decisions, and profit. Popovič et al. (2012) defined BI as processes that help make efficient and timely managerial decisions and finally Watson (2009) defined BI as broad category of applications, technologies, and processes for collecting, storing, retrieving, and analysing data to assist business users in making better decisions.

Despite the lack of a generally accepted definition of BI, there are two prevalent features of current definitions. The first is the fundamental element of BI, which involves the collection, storage, analysis, and delivery of data accessible internally and externally. The second is BI's objective of supporting the company's strategic decision-making process (Boonsiritomachai , McGrath & Burgess 2014). Over time, increasingly critical problems relating to the business value of the overall BI strategy, such as strategic business alignment, BI team expertise, and further development of a BI architecture and infrastructure, supplant technical implementation challenges. Therefore, Gartner (2018) has redefined BI to include applications, tools, and infrastructure.

In the late 2000s, a new term of Business Analytics (BA) was coined to describe the analytical component of BI (Davenport & Harris 2007). Some researchers illustrated that IT professionals prefer the BI term while the BA term is more commonly used by the business community (Sircar 2009). Also, Pratt (2017) proposed that BI provides insights into previous activity, while BA forecasts potential future outcomes under various scenarios.

Due to the blurring of lines between BI and BA, the terms "business intelligence" and "analytics" (BI&A) were coined to characterise information-intensive notions and procedures for bettering corporate decision making, which now has a cohesive definition that encompasses all of BI's and BA's features (Llave 2017). Chen, Chiang and Storey (2012) defined BI&A as *"the techniques, technologies, systems, practices, methodologies, and applications that analyse critical business data to help an enterprise better understand its business and market and make timely business decisions"* (p.1166), as this definition is wide enough to encompass the analysis process and its consequences for management decision-making in SMEs in

practice. Therefore, Chen, Chiang and Storey (2012) definition of the BI&A system has been adopted in this research.

Although the definitions are varied among researchers the BI&A architecture components are common (Ranjan, 2009; Jain et al., 2020). Section below describes the main components of the BI&A system.

2.2.2 Business intelligence architecture components

BI&A system encompasses a set of basic components that together support the multiple stages of the BI&A process, from data collection, integration, storage and analysis to data visualization, information dissemination and the use of BI&A data in business decision-making (Pratt, 2020).

As depicted in the below diagram of business intelligence architecture, the key components as describe by Pratt (2020) consist of the following elements:

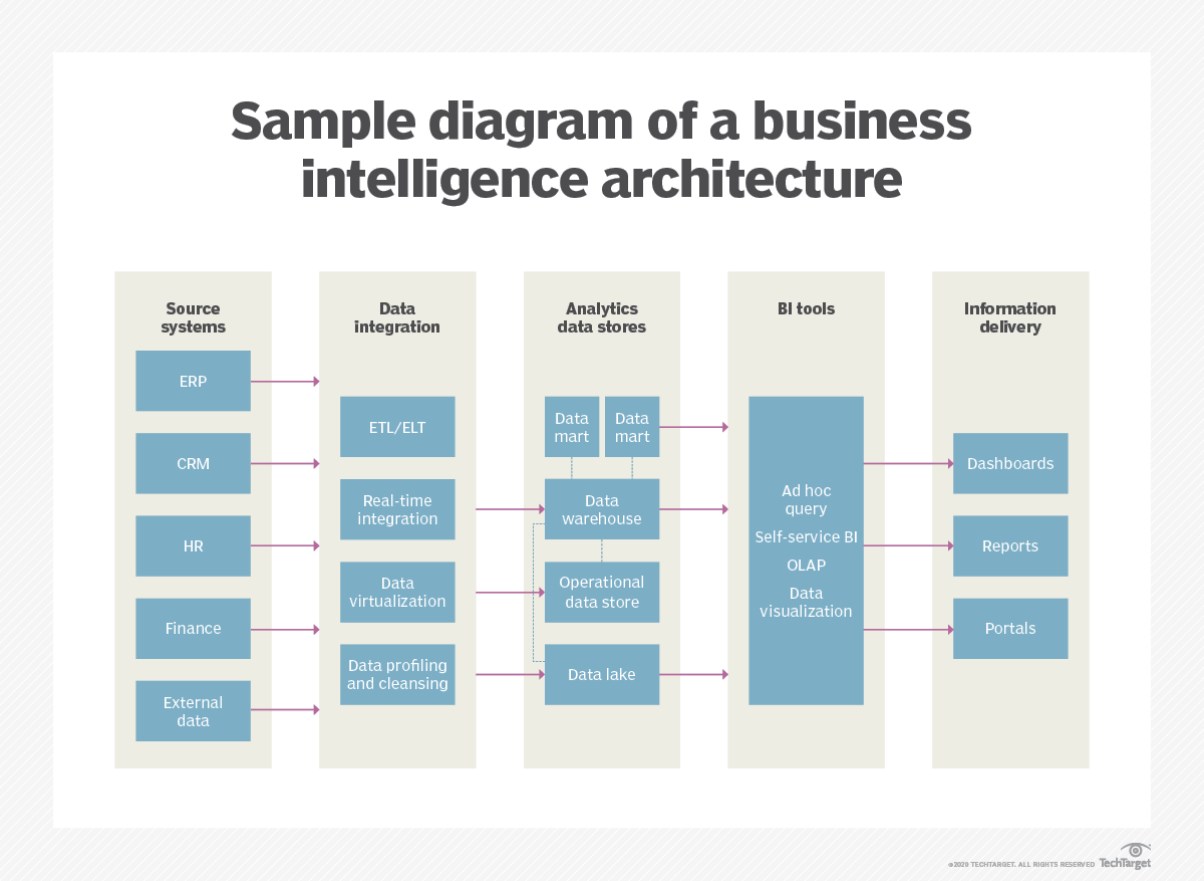

Figure 2. 1 BI Architecture

Source: TechTarget

- **Source systems.** include Enterprise Resource Planning ERP, financial, manufacturing, and supply chain management systems, among others, which capture, and store transactional and operational data deemed critical for the corporate BI&A system. Secondary sources may also include market data and customer databases from external information suppliers (Pratt, 2020; Ranjan, 2009). Hence, internal and external data sources are frequently integrated into BI&A architectures (Vitt et al., 2010; Pratt, 2020). Data relevance, data freshness, data quality, and the amount of granularity of the accessible data sets are crucial factors in the data source selection process. Moreover, a combination of structured, semi structured, and unstructured data formats may be necessary to suit the data analysis and decision-making requirements of executives and other business users.

- **Data integration and cleansing tools.** In order to properly evaluate the data acquired for a BI&A system, a company must combine and consolidate various data sets to develop unified perspectives of them (Pratt, 2020). The most generally used data integration technique for BI&A applications is extract, transform and load (ETL) software, which pulls data from source systems in batch processes. Extract, load, and transform (ELT) is a version of ETL in which data is extracted and loaded as-is before being converted for specific BI&A applications. Real-time data integration, such as change data capture and streaming integration to support real-time analytics applications, and data virtualization, which merges data virtually from several source systems, are other techniques (Vitt et al., 2010).

- **Analytics data stores:** This comprises the many repositories where BI&A data is kept and managed. The principal one is a data warehouse, which normally stores structured data in a relational, columnar or multidimensional database and makes it available for querying and analysis (Vitt et al., 2010). An enterprise data warehouse can also be coupled to smaller data marts built up for individual departments and business units with data that is specific to their BI&A needs (Pratt, 2020).

- **BI&A and data visualization tools.** The range of technologies used to analyse data and display information to business users, such as ad hoc query, data mining, and online analytical processing (OLAP) software, can be integrated into a BI&A architecture (Vitt et al., 2010; Ranjan, 2009). In addition, the increasing adoption of self-service BI&A solutions enables business analysts and managers to run their own queries rather

than relying on BI team members. BI&A software also contains data visualization tools that can be used to generate graphical representations of data, such as charts, graphs, and other types of visualizations intended to demonstrate trends, patterns, and outlier aspects in data sets (Pratt, 2020).

- **Dashboards, portals and reports.** These information delivery solutions allow business users visibility into the outputs of BI&A and analytics applications, with built-in data visualizations and, typically, self-service options to undertake additional data analysis (Pratt, 2020; Vitt et al., 2010). For example, BI&A dashboards and online portals can both be developed to enable real-time data access with flexible views and the ability to drill down into data. Often, reports display data in a more rigid style.

These components describe the main concept and architecture of the BI&A system in organizations regardless of the organization's size. Even the SMEs have the same BI&A system components but in more simple way (AltexSoft, 2019). SMEs usually do not have large volumes of data; therefore, there is no need to use an advanced data warehouse or structural elements like data marts. The simple data warehouse will be enough for small businesses or enterprises that operate relatively small amounts of data and will lead to the desired benefit for the enterprises (AltexSoft, 2019).

2.2.3 The benefit of BI&A system:

Many researchers have discussed the advantages of using a BI&A system in the organisation (Divatia, Tikoria & Lakdawala 2021; Popovič, Turk & Jaklič 2010; Rouhani et al. 2016; Watson & Wixom 2007; Williams & Williams 2007) BI&A is described as a turning point for organisations to improve their performance; also, there is a positive relationship between firms' performance and BI&A adoption (Maroufkhania et al. 2020). BI&A has evolved from a technological category to a managerial approach of organisation via collecting, storing, processing, analysing, and utilising information (Olszak & Ziemba 2012). The benefits of BI&A on firms are, but not limited to, improved decision-making process, shorter time for decision making, human resources utilization, empowering relationship between different department, instant reports accessibility, cost reduction, improved stock managing and more importantly customers satisfaction.

The impact of BI&A on decision making has been studied thoroughly by a number of researchers such as Rouhani et al. (2016) who state that BI&A helps the decision-making process, improves knowledge processing, and reduces time and cost of decision. It is always

challenging for managers to make decisions with complexity and uncertainty of information processing within a short period of time. Indeed, time saving is considered a key contributing factor for successful decision-making process (Delen & Pratt 2006; March & Hevner 2007). Lin et al. (2009), state that faster information processing can speed up decision making. Also, study conducted by Eckerson (2003) concludes that time saving is an utterly vital and crucial goal for firms that have invested in BI&A systems in term of tangible benefits. According to Khan, Amin and Lambrou (2010), many companies invest in BI&A implementation to improve their decision making because BI&A offers automation of some decision procedures, for example, calculating the greatest price at which a product can be sold while maintaining market position (Collins, Ketter & Gini 2010). Prior to introducing BI&A, businesses often rely on a single information source, for example transactional systems, to operate their daily functions, and the systems in place can only generate operational reports. These reports do not meet the needs of managers who require forecasting and superior reports to make the right decision.

Companies are urged to integrate decision-making support systems in their business to save on the costs of decision making (Hung et al. 2010). Decision-making cost reduction is deemed a main goal of firms investing in BI&A systems (Martinsons & Davison 2007). Hocevar and Jaklic (2010), claimed that the BI&A analysis technique can reduce costs in different ways such as analysis of current stock status and stock turnover. This helps firms in stock cost reduction. Similarly, a company can compare the average stock level with production level then adjust their level of production accordingly. Additionally, BI&A can decrease IT infrastructure cost through removal of superfluous mechanisms of data extraction and duplicating data stored in separate data departments throughout the business (Watson & Wixom 2007). Furthermore, BI&A reduces IT staff headcount as the system enables users to create their own queries and reports; thus the organisation becomes more independent of the IT department and the IT people can then be assigned to higher tasks which generate more value for the company or laid off (Liautaud & Hammond 2001).

Searching for information by BI&A is much faster than traditional methods. When BI&A users are looking for information about sales over a certain period or on a specific date, they can get the information instantly. This rapid search by BI&A can provide tangible benefits such as reductions in headcount (Watson & Wixom 2007). Moreover, time of communication between departments can be shortened, which improves accountability and efficiency of the organisation. To illustrate this, if a finance department has frequent issues with other

departments overdue reports, this issue can be eliminated by BI&A as it speeds up querying and reporting time. Ultimately, the relationships between different departments improve (Liautaud & Hammond 2001).

The analysis technique of BI&A is capable of analysing long- and short-term business scenarios using data acquired from company information systems that is accessible and readily available. This can assist business users to gain more specific information for creating best- and worst-case planning scenarios (Chou, Bindu Tripuramallu & Chou 2005). In addition, BI&A systems can generate a variety of business perspectives and disclose notable trends and reveal patterns to managers, enabling them to construct an appropriate strategy plan and devise appropriate ways forward (Hannula & Pirttimaki 2003). Continental Airlines is an example to illustrate the effect of BI&A on planning and decision-making such as hypothetical scenarios including adverse weather and customer-impacting flight cancellations (Anderson-Lehman, Watson & Wixom 2004).

Customer benefits are most frequently discussed in the BI&A research area. According to many academics, BI&A systems can help businesses better understand their consumers' purchasing patterns and anticipate their demands, enabling them to launch novel offerings that match up to their requirements (Fuller-Love 2006). A corporation can use BI&A to analyse a specific customer's purchases over a range of time periods, including months, quarters, and years. With the help of this effective analysis, connections with suppliers and contractual arrangements with carriers can be optimised, which will speed up delivery and raise customer and supplier satisfaction (Hocevar & Jaklic 2010). Ranjan (2005) states that BI&A can detect the causes of a problem when a consumer complains about a service or product by searching the pertinent data, facilitating a quicker resolution of complaints. Additionally, a prompt and proper reaction can enhance clients' relationships with the business.

The abovementioned benefits were discussed in general despite the organisation size. Scholz et al. (2010) on their research have discussed the benefit of implement BI&A system in SMEs specifically. They discussed three main benefit that include improvements in data support, improvements in decision support and saving in personnel and cost.

Thus, BI&A systems may enhance the efficiency and benefit of decision-making processes, deliver actionable data, facilitate improved forecasting, streamline operations, cut down on wastage of resources, labour expenses, and inventories, and boost customer satisfaction, among

other operational advantages (Chaudhuri, Dayal & Narasayya 2011; Yoon, Jeong & Ghosh 2017).

2.2.4 The challenges of BI&A systems:

Although BI&A systems offer numerous benefits, there are obstacles to their widespread adoption by businesses (Gudfinnsson & Strand 2017; LaValle et al. 2011; Watson & Wixom 2007).These obstacles include data sharing and ownership. This issue may be seen in the organisation's inter-departmental information exchange (Khan, Amin & Lambrou 2010). Inter-departmental disputes concerning data ownership can create BI&A systems implementation failure and cause adoption hurdles since every department maintains information in its own databases and these are not linked or shared with each other (Khan, Amin & Lambrou 2010; LaValle et al. 2011).

Moreover, the BI&A system price is a point in the way of its widespread adoption by businesses (Boonsiritomachai et al. 2016; Sahay & Ranjan 2008). BI&A systems are expensive, which could put them out of reach of enterprises with limited resources (Sahay & Ranjan 2008). Other research finds that even in businesses with high resources, BI&A systems are seen as expensive (Khan, Amin & Lambrou 2010). An owner/manager would adopt and use the system when capital and human resources were available (Boonsiritomachai et al. 2016). However, some researchers found inconsistent results, implying that the demand for the implementation of BI&A systems has increased because of their affordability (Bhatiasevi & Naglis 2018). New technologies, such as Cloud Computing and Open Source Software, can lower the intricacy of BI&A systems and the costs of their deployment (Bhatiasevi & Naglis 2018).

Data storage in single repository is another obstacle to BI&A system adoption. According to Folinas (2007), the difficulty of developing a BI&A system is significant since a BI&A system requires data to be extracted from a variety of sources before being converted and put into a single repository. Setting up a BI&A system environment takes time and requires well trained and devoted personnel.

The abovementioned obstacles were discussed in general despite the organisation size. (Gudfinnsson & Strand 2017) summarise 12 obstacles to adopting BI&A in SMEs in specific. These obstacles include:

- The company procedures were not adequately supported by the current IT infrastructure.
- Executives and owners have shown little interest in using a BI&A system as a decision-making tool.
- When organisations outsource their IT, they have trouble obtaining the assistance they require.
- There is a lack of understanding about how BI&A system analytics may help with production objectives.
- Data that requires human entry is difficult to obtain.
- Inadequate knowledge on how to apply BI&A system analytics in general.
- Lack of use of key performance indicators.
- Inability to see how BI&A systems may assist in improving income due to a lack of skill.
- Family-owned businesses appeared to be less interested in adopting BI&A systems for decision assistance.
- Data overflow risk.
- Having accurate information.
- Relying on intuition rather than data.

Knowing the benefits and challenges of using the BI&A system in enterprises will help understand the factors that significantly impact the adoption and use of the BI&A system in SMEs. In addition to the benefits and challenges of the BI&A system, the BI&A characteristics is another topic that should be considered while studying the adoption and use of the BI&A system in SMEs. As mentioned in the chapter1, different types of IS require different success models, depending on the type of system being evaluated (Popovič et al., 2012). BI&A system is a type of IS, but it has unique characteristics which make the BI&A system different from operational ISs. Therefore, there is a need to study the factors affecting the adoption and use of the BI&A system separately from any other types of ISs. More details about these differences are in the section below.

2.2.5 BI&A System Characteristics and Operational Information System (IS)

information system (IS) "is a set of interrelated components that collect, manipulate, store, and disseminate data and information and provide a feedback mechanism to meet an organization objective." (Stair & Reynolds, 2010, p.4). The value of information now depends on the

organization's ability to retrieve and transform data quickly and accurately in a way that provides insights for strategic and operational decision making. To achieve this value, the organizational and technical components must interact with each other (Poleto et al., 2015). The organizational components relate to the daily operation of the decision-making processes and strategy alignment; the technological components support the decision process through information systems and data analysis (Poleto et al., 2015). The interaction between organizational and technical components in order to provides insights for strategic and operational decision making is the main objective of using advanced IS such as BI&A system compared to the operational IS. Operational IS such as human resource systems and supply chain systems, enterprise resource planning (ERP) applications, or customer resource management (CRM) systems are very efficient at supporting transactional activities, but they are ineffective at enabling business analysis, particularly when the analysis needs the compilation of data from various data sources (Vitt et al., 2010).

Despite the similarities that the different types of ISs share, previous researchers have revealed key differences among BI&A systems and operational ISs (Grublješič & Jaklič 2015; Popovič et al. 2012; Puklavec, Oliveira & Popovič 2018). To define the BI&A systems adoption factors, the particular features of a BI&A system compared to operational ISs need to be recognised (Grublješič & Jaklič 2015). There are several differences between operational ISs and BI&A systems. The processes and information used in BI&A systems are less structured than the processes and information used in operational ISs; the reason behind this is that the use of this information and processes in BI&A system is usually more explorative whereas the use of the processes in operational ISs is more exploitative (Puklavec, Oliveira & Popovič 2014). Also, BI&A system use is in most cases voluntary (Grublješiˇ & Jakliˇ 2015). The importance of the voluntariness of using systems has been previously identified by researchers while studying users' behaviour (Venkatesh et al. 2003). Moreover, most benefits of BI&A systems are more indirect and long-term and difficult to measure compared to those of an operational IS (Popovič et al. 2012) . Additionally, the BI&A systems users tend to be decision makers at higher levels of the organisation, while the ISs can be used by any employee at any level of the organisation (Puklavec, Oliveira & Popovič 2018). Also, the BI&A system users are typically more educated and mostly have great experience and skills regarding the system applications (Grublješič, Coelho & Jaklič 2019; Luo 2016). Based on the above differences, it is clear that the importance of understanding the determinants of BI&A systems adoption completely is

evident, and to achieve this, we must undertake an integrative view that starts with prior IS adoption research and develops it to comply with the nuances of BI&A systems.

Characteristics	BI&A system	operational ISs
The processes and information (Puklavec et al., 2014)	less structured	More structured
Level of voluntariness (Grublješič & Jaklič, 2015)	lower	Higher
The benefits of using system (Popovič et al., 2012)	Indirect and long-term and difficult to measure	direct and easier to measure
Users (Popovič et al., 2019)	Decision makers at higher levels of the organisation	Any employee at any level of the organisation
User education level, experience and skills (Grublješič et al., 2019; Luo, 2016)	Higher	lower

Table 2. 1 The different between IS and BI&A

2.3 Small and Medium Enterprises:

Small and medium-sized enterprises (SMEs) play significant and major social and economic roles as they account for about 90 percent of businesses and more than 50 percent of workers globally (Llave, 2019). The SMEs in developed countries represent 60-70% of employment and 55% of gross domestic product GDP, while in developing countries, the SMEs represent 60% of total employment and up to 40% of GDP (Bayraktar & Algan 2019). The high economic contribution of SMEs is because this sector employs the highest number of employees (Ayyagari, Beck & Demirguc-Kunt 2007). Therefore, developing this sector will create more opportunities for job creation in countries, and it is important to stress that this sector should not be overlooked.

2.3.1 Definition of Small and Medium Enterprises

There is no standard definition for small and medium enterprises. It has a different definition across different countries relative to the size of the domestic economy. The most common upper limit specifying an SME is 250 employees, with an annual turnover not exceeding €50 million or an annual balance sheet total not exceeding €43 million, such as in the European Union (Commission 2016). Nevertheless, the United States includes enterprises with less than 500 employees, while some countries set the limit to 200 employees (Hammer et al. 2010). In SA, SMEs are defined as companies with less than 250 staff and yearly revenue not more than 200 million SAR (Monsha'at 2022). In SA, the enterprise is categorised based on its size and its compliance with the requirements for the number of full-time workers and total revenue. (Monsha'at 2022). The table below shows the Saudi SME categories depending on the employees and annual turnover:

Sizes of Business	No. of employees	Revenues
Micro	1 to 5 full-time	0-3 Million SR
Small	6 to 49 full-time	3-40 Million SR
Medium	50 to 249 full-time	40-200 Million SR

Table 2. 2 Saudi SME Categories

Source: Monsha'at

2.3.2 SMEs Characteristics

The SMEs structural characteristics are different from those of larger enterprises, which affect implementation and use of advanced technology in these enterprises. The SME is not a large company in microcosm, it has differences in term of its structure, policy, and resources (Wee et al., 2022; Man et al., 2002). Deros, Yusof and Salleh (2006) classify these differences in terms of structures, systems, and processes, culture, behaviours, markets, and consumers. Gronum, Verreynne and Kastelle (2012) draw conclusions from various research, concluding that large companies are more likely to have greater resources, expertise, and specialisation, as well as stronger branding and market share. They also benefit from larger economies of scale, increased efficiency, increased net income growth, and lower prices.

Many researchers address the idea that the lack of resources is one of the main differences between large and small enterprises (Wee et al., 2022c; Bhaird & Lucey, 2010; Boonsiritomachai et al., 2016; Deros et al., 2006; Karkoviata, 2001). These resources are matters such as technology, knowledge, finance, and human resources. In SMEs there is a limit

financially because they are mostly funded by the owner alone (Bhaird & Lucey 2010). Also, due to low numbers of employees in SMEs, the employees are forced to perform multiple tasks even if they are not specialists in these tasks, which could affect their performance (Boonsiritomachai , McGrath & Burgess 2014). Furthermore, because of the inexperienced staff and lack of technical specialisation, SME managers are cautious when embracing advanced technology (Karkoviata 2001).

According to Gronum, Verreynne and Kastelle (2012), SMEs' flexibility leads to a high level of responsiveness in customer service delivery. SMEs, as opposed to giant corporations, are closer to their clients and may give them exactly what they desire, allowing them to make decisions faster (Gronum, Verreynne & Kastelle 2012). Close customer relationships may also motivate SMEs to provide value-added offerings that provide them a competitive advantage over larger companies (Kenneth & Henry 2005).

Another distinguishing feature of SMEs is owner/manager characteristics. The majority of decision makers in SMEs are owners or managers in a high-level position in the organisation Hence, the owners/managers in SMEs are more likely to have a dual identity in describing the technology adoption: the potential sponsor and the actual adopter of any technology (Luo 2016). This is because large companies have an IT department and IT specialists who deal with systems. In contrast, in SMEs the IT users are usually the owners, who may not have the IT knowledge necessary for dealing with the system (Boonsiritomachai et al. 2016; Md Hatta et al. 2015). SME owners frequently have a thorough familiarity with their sectors, but they usually lack managerial and marketing skills (Gurau 2004). Because of their lack of experience in the former, SMEs frequently neglect the need for strategic planning. In consequence, SMEs' choices are frequently taken as a reaction to immediate challenges or opportunities instead of being via the outcome of careful anticipation (Gurau 2004). Therefore, using BI&A system in SMEs will lead the owner/manager to take conscious decision based on the data they have, which will lead to great returns to the enterprises.

2.4 BI&A in SME

Although in recent years there are repeated calls by researchers to do more research in the topic of BI&A in SMEs, research in this topic is still in its infancy and immature (Llave, 2019; Md Hatta et al., 2015; Wee et al., 2022c; Simon & Suarez, 2022).

For example, Llave (2019) conducted a systematic literature review SLR of research on BI&A in SMEs published between 2000 and 2018, which covered subjects like the advantages of BI&A, cloud BI&A, mobile BI&A, and BI&A solutions and adoption. While numerous frameworks and models were put out to aid SMEs in the successful implementation of BI&A, she discovered that there is no definitive sign of success. She also emphasizes the necessity to take into account the unique characteristics of SMEs rather than relying solely on models created for large organizations. Also, she emphasizes the necessity to conduct more studies addressing BI&A adoption in developing countries.

Therefore, as mentioned before because of the contribution of SMEs in global economies and the great advantages of using BI&A in SMEs, researchers have approached BI&A in SMEs from different angles.

Some researchers have considered BI&A and organizational agility, performance, competitive advantage, and how BI&A drives value for SMEs (Ali et al., 2018; Bhatiasevi and Naglis, 2018; Dereli et al., 2022; Wee et al., 2022). For example, Ali et al. (2018) conducted a theoretical investigation to pinpoint the causes of BI&A implementation in the setting of small businesses to enhance organizational agility. They pointed out that understanding the effects of changes and acting pro-actively to adjust to those changes are crucial. They found that the organizational, technological and personnel capabilities for BI&A implementation are important antecedents to enhance organizational agility. Moreover, Bhatiasevi and Naglis (2018) have investigated the determinants of BI&A in Thailand SMEs and how these determinants affect the organizational performance. They conducted mixed method with 180 SMEs and interview with 10 experts. They found that compatibility, technology readiness, top management support and competitive pressure are important determinants that affect the organizational performance. Dereli et al. (2022) examine how SMEs might use BI to obtain a competitive advantage. A conceptual framework is presented in their study in order to acquire in-depth insights on how SMEs use BI assets and BI capabilities to achieve competitive advantage. They found that medium-sized SMEs can enable competitive advantage more than micro and small-sized SMEs. This is because micro and small-sized SMEs mostly use the BI for achieving operational objectives rather than achieving strategic objectives (competitive advantage) while medium-sized SMEs use the BI for achieving strategic objectives. Also, Wee et al. (2022) in their research have discussed the process of driving value from BI&A by SMEs. They modified the Business Analytics Success Model (BASM) developed by Seddon et al.

(2017) for big companies to be compatible to use in SMEs. A qualitative study approach based on semi-structured interviews with five SMEs in Australia was used in their study. This involved examining the ways in which business owners and managers guide their staff in obtaining insights from data and analytical procedures in order to make business decisions. According to their findings, SMEs who employ BI&A generate insights for applying business processes through a quick and straightforward three-step iterative BI&A process. In addition to the quick procedure, a longer three-phase method that advances SMEs from resolving operational problems to tackling strategic concerns has been found.

Moreover, the benefit, risk and challenges of implementing BI&A system in SMEs are other topics which have been highlighted by researchers. Scholz et al. (2010) on their research have discussed the benefit and challenges of implementing BI&A system in SMEs, also they highlighted the properties of BI&A adopters among SMEs. They discussed three main benefit that include improvements in data support, improvements in decision support and saving in personnel and cost. Also, they highlighted three challenges in regard to adoption of BI&A in SMEs that include usage issues such as the complication of using BI&A or the individuals utilizing the BI solution lack the necessary skills and, challenge related to the data quality and interfaces. Stjepic et al. (2021) have investigated the adoption risks of BI&A in Croatian SMEs. They found that SMEs should consider internal risks related to organizational dimensions such as organizational readiness and data management for decision-making processes, also SMEs should consider external risks connected to environmental dimensions such as competitive pressure and BIS vendors' quality.

Some researchers have considered the adoption and success factors of BI&A in SMEs. Boonsiritomachai et al. (2016) on their research suggest a model of BI&A maturity for SMEs that distinguishes between different levels of BI&A maturity and analyses the factors that currently affect their levels of BI&A adoption. The maturity level on their study graduated from operate level where the company use basic BI&A to innovate level where the company use advance level of BI&A. A quantitative methodology through a survey questionnaire with 427 Thai SMEs was used to explore the current state of BI&A adoption. Their findings demonstrated that Thai SMEs are only now beginning to implement business intelligence, with many of them falling into the lowest level of BI&A adoption. Also, the significant factors that affect the BI&A adoption were identified in detail. Also, Siemen et al. (2018) on their article uses qualitative interviews with ten SME managers to examine the status of current BI use in

SME in the retail industry. After that, organized literature review is used to determine the adoption and success factors of BI systems and interorganizational information systems. Also ,Puklavec et al. (2018) on their research proposed model to understand the factors that affect the different stages of BI&A adoption that include evaluation, adoption, and use stages. They have considered the technological, organizational, and environmental factors that affect the adoption and use of BI&A system in SMEs. Their result illustrated that five factors out of nine have a significance impact in evaluation and use stages of BI&A and four factors have a significance impact in adoption stage. Aldossari and Mokhtar (2020) on their research have discussed the issues related to the intention to adopt the ERP and BI in Saudi SMEs. They conducted interviews with 30 experts in SMEs, as a result of their study technological, organizational and environmental factors have been identified. Finally, Simon and Suarez (2022) have investigated the adoption factors of BI&A in Philippine SMEs. Five factors were determinants of behavioural intention to adopt BI&A that include perceived relative advantage, complexity, top management support, competitive pressure, and innovativeness.

All studies mentioned above were conducted in the context of BI&A system in SMEs, but with different aims and objectives. Some of the studies considered BI&A and organizational agility (Ali et al., 2018), BI&A and organizational performance (Bhatiasevi & Naglis, 2018), BI&A and competitive advantage (Dereli et al., 2022), and how BI&A drives value for SMEs (Wee et al., 2022). Other mentioned studies highlighted the benefit, risk, and challenges of implementing BI&A system in SMEs (Scholz et al., 2010; Stjepić, 2017; Stjepic et al., 2021). The final mentioned studies, which are very related to this this study's main objective that covers the adoption and success factors of BI&A in SMEs topics (Boonsiritomachai et al., 2016; Puklavec et al., 2014; Siemen et al., 2018; Aldossari & Mokhtar, 2020; Simon & Suarez, 2022). Although academics showed an increasing interest in the adoption of BI&A in SMEs, there is still not much research dedicated to this field, especially in context of developing countries. Popovič, Puklavec, and Oliveira (2018) have conducted study that aims to shed light on the relationship between firm performance and the post-adoption use of BIS in British SMEs. They created and empirical tests of conceptual model for evaluating the effect of routine and creative BIS usage on firm performance. Some factors have been identified such as the impact of marketing and sales which could have different effect in developing countries. As the marketing in developed countries might heavily rely on digital platforms, social media, and e-commerce. While in developing countries, traditional marketing methods, local media, and direct engagement might be more effective due to limited internet penetration or technological

access (Popovič, Puklavec, & Oliveira, 2018). Similarly, Grublješič, Coelho and Jaklič (2019) in their study have employed a mixed-methods approach to drive acceptance in the BI&A context. It included a survey, case studies, and a review of the literature. Their findings indicate that individualistic considerations resulting from the visibility and recognition of BI&A use in an organization have lost ground to socio-organizational considerations. However, they have applied their study in EU countries which could have different result in developing countries. Societal norms, values, and cultural differences can influence organizational structures and practices. In some developing countries, familial or community ties might significantly impact business decisions compared to the more individualistic approach in developed countries (Chawla & Joshi, 2020; Shao et al., 2019). Thus, the researchers emphasize the need to conduct more studies for BI&A in SMEs in the developing countries. (Boonsiritomachai et al., 2016; Aldossari & Mokhtar, 2020; Simon & Suarez, 2022).

Moreover, due to of the simplicity of the organisational structure of SMEs the individual factors have been proven as critical factors in determining innovation adoption in SMEs (Md Hatta et al., 2015; Thong et al., 1996; Fogarty & Armstrong, 2009; Boonsiritomachai et al., 2016) as the owners/managers in SMEs have great influence on making decisions to adopt and use the innovation technology . However, these individual factors were not thoroughly studied or evaluated in the earlier mentioned studies. Also, some of those studies have considered the pre-adoption intention toward BI&A (Aldossari & Mokhtar, 2020; Simon & Suarez, 2022).For example, Aldossari and Mokhtar (2020) on their research have considered the factors affecting the adoption of enterprise resource planning and business intelligence among SMEs. They have proposed a model and examined it using qualitative approach. In this study, researchers considered the factors influencing the adoption of enterprise resource planning and business intelligence in pre-adoption stage only. Also, Simon and Suarez (2022) in their reserch have studied the factors infulance the behavioral intention to adopt BI&A in SMEs. Similarly they propsed model that can be used in pre-adoption stage only. While others studies have considered the post-adoption maturity level such as (Boonsiritomachai et al., 2016) . Boonsiritomachai et al. (2016) proposed a BI maturity model that empirically tested using survey. They examined the factors that affec the adoption of BI system in different level of post-adoption stage. Nevertheless, no study has discussed the pre- and post-adoption factors of the BI&A in the same context. Therefore, this study will contribute to fill these gaps in literature. Table below summarizes the studies that have been conducted in BI&A in SMEs topic.

Topic	Reference	Theory / Frameworks	Methodology	Factors	limitations	Contribution
BI&A and organizational agility, performance, competitive advantage and driving value for SMEs	(Ali et al., 2018)	None	Conceptual Study Theoretical analysis	**Technological**: Physical Resources, Technological capability **Organisational:** Intrinsic strength, Personnel capability and BI Implementation. **Environmental:** Environmental facilities.	• The proposed antecedents need empirical testing.	Antecedents of BI&A implementation in small business have been identified to enhance organizational agility.
	(Bhatiasevi & Naglis, 2018)	TOE	Model-based on survey with 180 Thailand SMEs and interview with 10 experts.	**Technological**: Compatibility, Technological Readiness **Organisational:** Top management support, Organizational performance. **Environmental:** Vendor support, Competitive pressure.	• The model doesn't consider the individual characteristics. • This paper didn't examine the model in different adoption stages.	Providing a greater understanding of the determinants of BI&A in Thailand SMEs and how these determinants affect the organizational performance
	(Dereli et al., 2020)	Resource-Based View (RBV)	Conceptual Study Resource-Based View	**Technological**: Value, Rarity, Imitability, Non-substitutability **Organisational:** BA resources and BA capability.	• The framework needs empirical testing.	Conceptual framework is presented to acquire in-depth insights on how SMEs use BA assets and BA capabilities
	(Wee et al., 2022)	Business Analytics Success	Model-based on interviews with five Australian SMEs	**Individual:** Use of analytic resources by owner/manager,	• Few numbers of interview.	They modified the BASM by considering the unique characteristics of SMEs

		Model (BASM)		Decision made by owner/manager, and Value creation.	• Quantitative method will add more value for the study.	
BI&A benefit, risk, and challenges in SMEs	(Scholz et al., 2010)	None	Survey questionnaire with 214 German SMEs	Data support, Improvements in decision support, Saving in personnel, Cost, Complication of using BI&A, lack the necessary skills, and Data quality and interfaces	• Environmental challenges have not been considered in this study.	The benefit and challenges of implement BI&A system in SMEs have been identified
	(Stjepic et al., 2021) (Stjepić, 2017)	TOE	Model-based on survey with 100 Croatian SMEs.	**Technological**: Comparative advantage, Complexity, BIS's compatibility with enterprise information system. **Organisational:** Key personnel ability to assess the BIS benefits, Top management support, Organizational readiness. **Environmental:** Competitive pressure and BIS vendors' quality.	• Individual challenges have not been considered in this study. • Qualitative analysis needed to achieve the depth of understanding obtained results and more detailed of the relationship between the established variables	The keys risks of BI&A in Croatian SMEs have been highlighted
BI&A adoption in SMEs	(Boonsiritomachai et al., 2016)	TOE and IS Adoption Model for Small Business and	Model-based on survey with 427 Thai SMEs	**Technological**: Relative advantage, Complexity, Absorptive capacity. **Organisational:** Organisational resource availability **Environmental:**	• Qualitative method will add more value for the study.	Providing a greater understanding of the rates of BI&A adoption and the factors influencing BI&A adoption in Thai SMEs.

				Competitive pressure, Vendor selection **Individual:** Owner-managers' innovativeness and Owner-managers' IT knowledge		
	(Puklavec et al., 2014) (Puklavec et al., 2018)	TOE and DOI	interview with 10 BI&A adopters and professionals of SME Model-based on survey with 181 SMEs	**Technological**: Relative advantage, Cost, BIS being part of ERP, Management support. **Organisational:** A rational decision-making culture, The presence of a project champion, High-quality organizational data environment, Organizational readiness **Environmental:** External support	• The model doesn't consider the individual characteristics.	The factors that affect the different stages of BI&A adoption that include evaluation, adoption, and use stages have been identified in the first study and empirically tested in the second study.
	(Aldossari & Mokhtar, 2020)	UTAUT and TOE	Model-based on interviews with 30 experts in SMEs	**Technological:** System quality, Information quality, Service quality. **Organisational:** Change management, Effective communication, Training, Clear Vision and Planning, **Environmental:** Competitiveness pressure, and Government role.	• This study doesn't consider the individual characteristics. • Mixed method will add more value for understanding the relation of these factors.	Key Factors that have been highlighted in relation to the intention to adopt ERPBI in the SMEs.

	(Simon & Suarez, 2022)	TOE and DOI	Model-based on survey with 202 Philippine SMEs	**Technological:** Relative advantages, Complexity, Cost. **Organisational:** Top management support, Absorptive capacity, Organizational resource availability. **Environmental:** Competitive pressure. Vendor support and Innovativeness.	• This research covered modern BI only such as desktop and cloud-based BI&A.	The keys intention adoption factors of BI&A in Philippine SMEs have been highlighted

Table 2. 3 BI&A in SMEs studies

2.5 Context of the study: Saudi Arabia

2.5.1 Saudi Arabia contextual background

The kingdom of Saudi Arabia occupies three-quarters of Arabia. It possesses considerable economic heft, aided by its situation between three continents: Europe, Asia, and Africa. The economy of SA depended at one stage on the oil industry to the exclusion of all else, but lessons have been learned from occasions when falls and volatility in oil prices were difficult to manage, such that the government has decided to address this undue economic focus and diversify the country's revenues (Vision 2030, 2022). To set this in context, the Saudi petroleum reserves amount to about 25% of proven recoverable oil globally. The corresponding industry has underpinned the country's finances for many years, and still provides 89% of budget revenues and 90% of export revenues, with the country producing in excess of 12.2% of the world's oil (Statista, 2021)

The country's total population stood at 35,340,680 in 2021(DataCommons, 2022), of whom 97.9% had internet access as of that year (DataCommons, 2022), putting SA at number 41 in terms of internet usage worldwide (Statissta, 2022). These figures have prompted both public and private sectors to be enthusiastic about investing in moves towards innovative technologies such as those that will take advantage of greater quantities of data, to ensure improvements to economic growth and development. The Saudi government has with this end in mind devoted a great deal of effort to development, diversification, and improvement in quality of, and reducing the costs of, IT in general, to render the IT infrastructure effective and productive (MCIT, 2022).

The SA is, as indicated above, determined to diversify away from the use of such exhaustible reserves in light of the instability of oil prices (Vision 2030, 2022). The Saudi government is at present prioritising improvements in the performance of SMEs to improve their development

and sustainability by using advanced technologies. With this aim in mind, the Saudi government has of late taken the initiative to stimulate significant improvements in the business environment so as to attract both domestic and inbound investment, effecting a substantial improvement in the Saudi global ranking. Recent views from the International Institute for Management Development (IMD) are that Saudi Arabia's market competitiveness is rising more rapidly than that of any other countries. The country rose from number 39 to number 26 globally in 2019 (IMD 2019) and then to 24 in 2022 (Development 2022). These improvements are more prominent in establishing new business sectors and using technologies according to the World Bank Group (World-Bank-Group, 2020). Accordingly, a large fraction of the government's endeavours has been geared towards support for the SME sector.

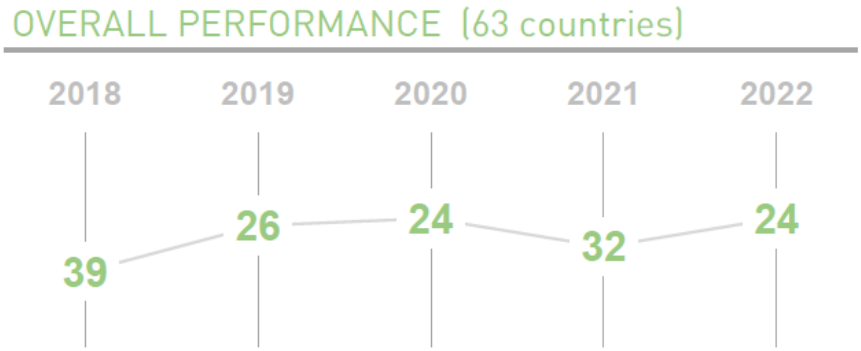

Figure 2. 2 Saudi Arabia's Market Competitiveness

2.5.2 Small and Medium Enterprises in Saudi Arabia:

In Saudi Arabia, the Saudi Vision 2030 predicts growth for non-petroleum SMEs in terms of their contribution to GDP to be 35 percent in 2030 as against 20 percent for 2016. This rise will render the kingdom's GDP, all else being equal, that of one of the 15 most substantial economies in the world (Investment 2019; Statistics 2017). According to the type of economic activity, about half of these SMEs are 47.70% engaged in wholesale and retail followed by Manufacturing with 10.90%. Table and graph below display the number of SMEs in Saudi Arabia according to the type of economic activity.

Economic activity	Frequency	Percentage
Wholesale and retail trade	452932	47.70%
Manufacturing	103652	10.90%
Accommodation and food	100282	10.60%
Agriculture and fishing	94601	10.00%
Collective and personal services	67358	7.10%

Construction	30864	3.20%
Real Estate Activities	28076	3.00%
Professional and technical activities	24669	2.60%
Transport and storage	15419	1.60%
Other	31978	3.3%

Table 2. 4 Number of SMEs in Saudi Arabia according to the type of economic activity

Source: General Organization for Statistics

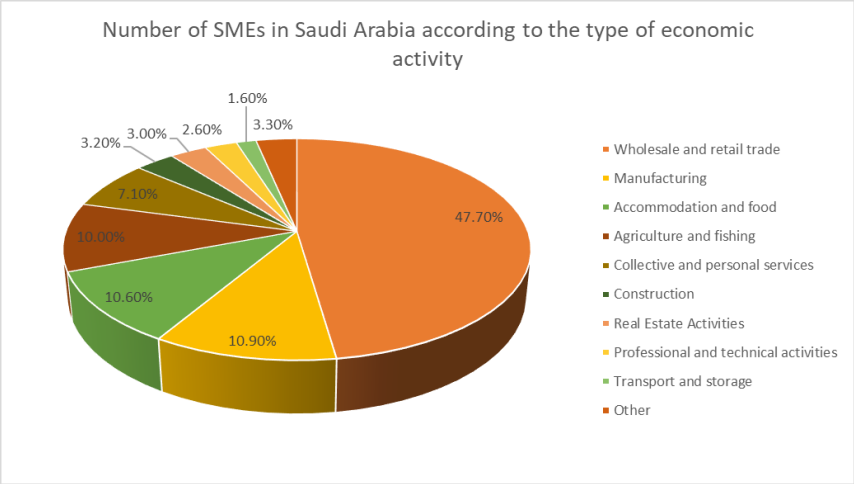

Figure 2. 3 Number of SMEs in Saudi Arabia according to the type of economic activity

The country's SMEs make up approximately 99.6% of private sector entities and employ in excess of 60% of private sector workers (Roomi et al., 2021). This is why the Saudi government launched the Saudi Vision 2030 in 2016: to reduce SA's dependence on oil via injecting money into different sectors (Vision 2030 2022b). SMEs are particularly placed under the microscope by this vision, based on their substantial contribution to the kingdom's GDP (Investment 2019; Statistics 2017). In October 2016, SA's SMEs were greatly stimulated via the establishment of a small and medium enterprises general authority, dubbed Monsha'at. Its mission is to enable Saudi SMEs to function better by eliminating the challenges they face, with a view to increasing both employment and economic activity (Monsha'at 2022a). Saudi SMEs face many different challenges. For one, since the introduction of Value Added Tax (VAT) in 2018 (Authority, 2018), SMEs have borne most of its burden, due in substantial degree to relatively high compliance costs. A second point is that the levels of non-Saudi workers in the kingdom fell by 6.2 percent in 2018 relative to the year before, leaving 9.98 million expats in the country in 2018. High living costs and strict governmental restrictions are the primary reasons for the reduction in the number of expats choosing SA as their destination. A third point observed is

the closure of SMEs as a consequence of Saudization. There is a misalignment between the wages on offer and the skills needed in the corporate sector. Furthermore, a major obstacle for SMEs can be seen in the results of regulation. To continue with a fourth point, most of the aspiring SMEs that are seen to have produced economic progress have done so in what appears to be a haphazard manner when needed for loan or support applications, something which is seen as an additional major issue influencing the failure of many projects. Next, one major challenge confronting SMEs is a dearth of innovation, poor coordination, and difficulty with the quality standards expected by large organizations. In addition, there are times when their solvency is an issue, affecting their timely payment of their dues and causing them to suffer when their costs are squeezed, as well as issues with procurement, audit procedures, and difficulty complying with the aforementioned larger organizations' quality standards; all these are matters which inhibit the expansion of SMEs. Another financial point is that SMEs often fail to have their finances audited. The financial sector, when serving them, thus needs to devote more time and effort, meaning higher operational costs for the latter, only for these to be passed on to the SMEs themselves in the form of higher fees. A penultimate point is the lack of a proven legal environment that allows for proper registration and processes in the event of a default. Finally, the Riyadh Chamber of Commerce (2016) would have it that the most frequent hurdles for SMEs involve information in 32 percent of cases, managerial matters for 33 percent, marketing for 53 percent marketing, and bureaucracy for 65 percent (Tripathii, 2019).

Monsha'at thus has a key role in aiding SMEs through greater awareness within society of their important contribution, liaising with appropriate government authorities to align their efforts, and assisting in bringing about an international role for SMEs, as well as generating and disseminating up-to-date studies, information, and data, aiding funding for SMEs, and encouraging competitiveness and possible exports for such companies (Monsha'at, 2022). To this end, some chambers of commerce and industry in the kingdom have acted in various ways, including: attempting to reduce barriers and challenges of whatever nature (production/marketing/legal/organizational) that SMEs may encounter; arranging research that will be helpful in removing these obstacles; presenting and organizing training and assistance in adapting for the owners of such companies to help them improve on administrative, organizational, and legal fronts, as well as with introducing modern management techniques and the deployment of technology in the management of their businesses, the introduction of regulations and by-laws regarding accounting, control, and costs, along with management of inventory, procurement, and sales; convening seminars, meetings, and lectures on subjects of

importance to SMEs; making use of the experiences gained by other countries to aid and inform SMEs; and publishing useful written materials (AL-Hussain, 2016). Thus, it seems clear that Saudi government bodies are rendering real support to SMEs, be it managerial, financial, or technological, to enable them to improve their performance and contribution to the kingdom's economy and to perpetuate their existence and advancement in the country and more widely. The national bodies of significance to SMEs have thus come to be aware of the importance of support for them, involving the advancement of modern management and assisting enterprises in acquiring appropriate administrative skills. They have circulated materials and information to aid such enterprises and to those wishing to enter the SME arena. In consequence, the SME element of GDP rose to 28.75% in 2020 as against 20% for 2016 (Monsha'at 2020). As reported by Global Entrepreneurship Monitor (GEM), the kingdom saw a 65% rise in business ownership in the most recent three years (Roomi, Kelley & Coduras 2021). The increasing quantity of SMEs in the country, as can be seen in Figure 2.1, has led to a rise in the call for and deployment of advanced technology such as BI&A in SA, to continue SMEs' growth.

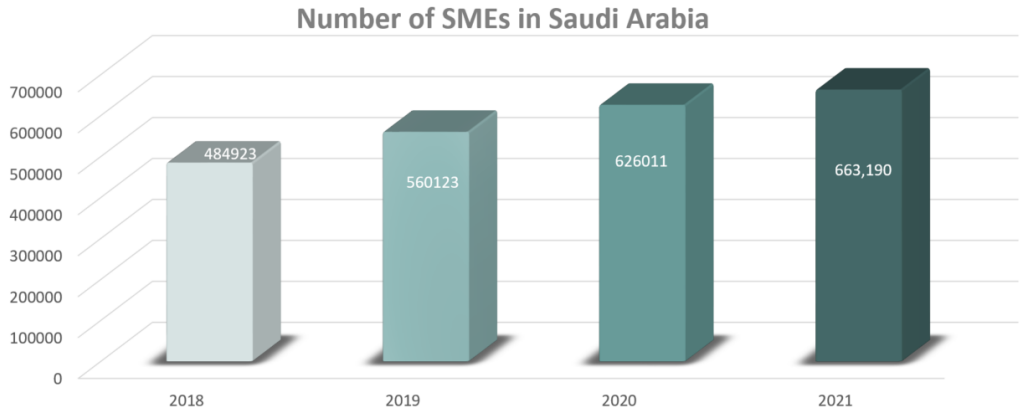

Figure 2. 4 Numbers of SMEs in SA

Source: Monsha'at

2.5.3 Saudi SMEs and IT capabilities

The Saudi Government very early on realised the importance of the IT aspect of the SME sector, and therefore strove to support and encourage it. Over and above this, it developed and put into effect appropriate plans and strategies to keep abreast of new developments, in order to be able to avail itself of modern technology for the achievement of its intended development objectives (KAUST Innovation, 2022). The government has demonstrated great assurance as regards IT's potential and its consequent contribution to the development of the economy (KAUST Innovation, 2022). So as to attain the government's wish to improve the business

sector and the IT infrastructure, it was considered essential to set out the roles of institutions in the kingdom relating to conducting business and use of IT. The Ministry of Information is in control of all intellectual property rights in the Saudi Arabia (CITC, 2010). The King Abdul Aziz City for Science and Technology (KACST) holds accountability for the effecting of the kingdom's patent laws, whereas the Ministry of Commerce takes responsibility for trademarks in the country. The Communications and Information Technology Commission, which operates under the Ministry of Information, must also be highlighted for its important role in creating an environment that is progressive and thus able to support investment in the kingdom in recent years. The Commission and the Ministry of Information have succeeded in opening up the IT sector, successfully introducing modern technology services, and developing the requisite infrastructure across the kingdom, as well as funding IT projects to guarantee that broadband Internet is accessible even in distant regions (CST, 2022).

2.5.4 BI&A in Saudi SMEs:

In SA, business management in SMEs has changed dramatically as technology has allowed and enabled business operations to expand across all business functions (Faridi & Malik 2019). The use of a smartphone, IT, software systems, and internet in all areas of the working life has been drastically increased in SMEs (Faridi & Malik 2019). In parallel, there is increasing data. Therefore, nowadays, focus on data management, the potential of predictive analysis, and emphasis on data quality supersede the system performance that was the earlier top priority (Faridi & Malik 2019). Therefore, there is an increased need to use an advanced information system, such as BI&A to manipulate data in Saudi's SMEs. As mentioned in section 2.2.2, it is expected that the growth of SMEs will make their GDP contribution rise from 20% to 35% in 2030 in SA (Vision 2030 2022b). This growth will put SA on the level of the 15 largest global economies countries (Investment 2019; Statistics 2017) . Therefore, SA is a potential market with significant prospective growth for SMEs. Continuous government support and advice allows SMEs to take advantage of this opportunity (Faridi & Malik 2019). The reforms initiated by the Saudi Vision 2030 program have established SA as a regional leader in equity financing, notably Venture Capital (VC). The VC sector is also strengthened by the government's direct support through two fund-of-fund ventures, one of them being the Saudi Venture Capital Company (SVC), established by Monsha'at, which strongly supports the SMEs sector (Monsha'at 2021). Most VC funding - 73% - was directed to tech-related sectors, as shown in Figure 2.2.

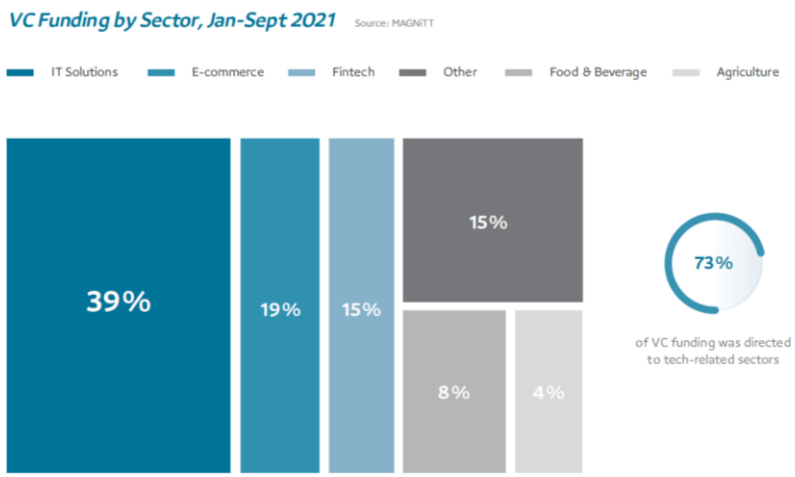

Figure 2. 5 VC funding by sector

Source: (Monsha'at 2021)

Moreover, the King Abdullah University of Science and Technology (KAUST), which is one of the leading research universities in the SA, presents the KAUST SME Maharat programme that assists small and medium businesses in developing technical skills in critical areas including artificial intelligence, internet of things, data analysis, intellectual property, and design thinking (KAUST Innovation 2022). In the previous two years, nearly 1,300 small business professionals have enrolled in the programme. Moreover, Monsha'at has established the Thakaa Centre (meaning intelligent centre in English), that aims to help SMEs improve their efficiency and productivity, as well as their comparative value, by using innovative technologies (Monsha'at 2022b). This centre provides many technological solutions for SMEs such as data analysis, artificial intelligence, internet of things, and cyber security. Thakaa Centre targets the owners of SMEs and entrepreneurs by providing free consultations, workshops, and other services (Monsha'at 2022b). Therefore, it can clearly say that in the recent years Saudi government has provided initiatives to encourage the use BI&A system and other advanced technologies in SMEs, therefore knowing the factors that affect the adoption decision and extensive use of BI&A system will help Saudi government to achieve their goals.

2.6 Pre-adoption and post adoption of information system

Various theories in Information Systems (IS) research attempt to explain why people embrace or resist technology adoption. At various phases of technology adoption and use, several models examine the factors that shape user intentions. However, little is known about how the elements that influence adoption intention evolve into long-term usage intentions when users gain (more) experience with the technology (Kupfer et al. 2016). Earlier studies found that previous experience would make the difference between the IT adoption model for pre-

adopters and that for post-adopters (Karahanna, Straub & Chervany 1999; Thong 1999). For example, Rai and Patnayakuni (1996) examined national computer-aided software engineering (CASE) technology adoption and discovered that, while top management support was not essential for pre-adoption, it was important for understanding post-adoption behaviour. Newer studies' outcomes are consistent with the preceding studies (Boonsiritomachai et al. 2016; Ghobakhloo & S.H 2011; Mollaa & Lickerb 2005).

The success or failure of an IS application is determined by whether or not customers are prepared to adopt and engage with it (Anda & Temmen 2014). IS research has produced a number of models to better explain the elements that lead consumers to either oppose (Kim & Kankanhalli 2009) or adopt (Venkatesh et al. 2003), and use a technology intensively (Bhattacherjee & Lin 2015). Technology adoption research, in particular, has developed into one of the most mature disciplines of IS research (Venkatesh, Thong & Xu 2012; Williams et al. 2009). Nonetheless, each of the adoption, resistance, and extensive usage models only captures a snapshot of consumer attitudes at a certain point of user exposure to technology. Adoption or continuing usage behaviour – or technological resistance at a specific level of experience – have been explored in previous research. The findings of these snapshots reveal that the barriers and drivers of IS adoption differ from those of continuous technology use (Bhattacherjee & Lin 2015). However, little is known about how well the factors influencing the intention to adopt (pre-adoption) also predict extensive use (post-adoption) of the same technology. According to Thakur and Srivastava (2014), there is an argument that simply summarizing the phenomenon of consumers' initial perceptions and their indicated readiness for a newer technology may not be sufficient to influence technology adoption. Users' opinions of this technology may vary depending on pre- and post-adoption dynamics (Gupta et al., 2020), as well as depending on the cultural and sociodemographic groups that are represented by varying age, gender, and income levels (Chawla & Joshi, 2020; Shao et al., 2019). The pre-adoption stage of technology usage is indicated by the fact that users' expectations are primarily formed from performance and effort expectancy before to actual usage, according to Upadhyay et al. (2022). Therefore, this study sheds light on pre- and post-adoption of BI&A system as the factors affecting the user behaviour of new system are different in these two stages.

2.7 Adoption theory

2.7.1 Adoption Theory of BI&A systems

Researchers have discussed several issues that define the user adoption of new technology by determining specific factors. As such, there is a growing body of literature attempting to probe the factors determining the adoption and use of certain technological solutions in the workplace (Venkatesh, Brown & Sullivan 2016). In general, looking for a single determinant of technology adoption would not yield any success. Therefore, several models and theories of technology adoption exist to find the contributing elements in technology adoption and use (Venkatesh et al. 2003).

Md Hatta et al. (2015), in their research divided the IS adoption theories into several aspects depending on the purpose of study of the research. The first aspect is research used to study the concept of acceptance in innovation diffusion such as Diffusion of Innovation (DOI) theory and Technology-Organization-Environment (TOE) theory. The second one is to explore the psychology of user acceptance, such as The Technology of Acceptance Model (TAM), The Theory of Reasoned Action (TRA), and the Theory of Planned Behaviour. The final one is to explore the design acceptance in technology such as the Usability Engineering Approach to Acceptance and Human-Computer Interaction (Md Hatta et al. 2015).

In order to build the theoretical foundation for this study, widely adopted theories were reviewed and examined for relevance. Also, the theories that have been applied in BI&A systems in particular were systematically reviewed in the context of big companies and in SMEs. Also, what influences BI&A has been reviewed in the SLR. The studies used a number of different types of theories, frameworks, and models for BI&A system adoption in general. As shown in Table 2.5, in large companies the TAM model is the most commonly used model, followed by the TOE framework and the IS success model of DeLone and McLean. In contrast, in SMEs, as shown in Table 2.3, the TOE framework is the most commonly used framework, followed by DOI theory. The reason for using the TAM model more in large companies as opposed to the TOE framework in SMEs is that most existing studies in SMEs considered the challenges before adopting BI&A systems such as cost, complexity, organisational resources, and government support. This makes the TOE framework more suitable for the aim of their study. In contrast, in large companies the studies moved from the pre-adoption stage to the

post-adoption stage in order to use BI&A systems more intensively inside the organisations, which makes the TAM model more suitable. The TOE framework is mostly used in exploring the concept of adoption in innovation diffusion while TAM is used in understanding the psychology of user acceptance (Md Hatta et al. 2015). As a result and to fit with this study purpose, an integrated model is proposed that includes Diffusion of Innovation (DOI) Theory (Rogers 1983), the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer 1990), and IS adoption model for small business (Thong 1999). Ten factors have been proposed under these theories, which include relative advantage, complexity, compatibility, observability, owners'-managers' IT knowledge, owners'-managers' innovation, organisational resource availability, enterprise size, competitive pressure, and external support. In order to select the most suitable technology adoption theories for this study, the well-known technology adoption theories were reviewed and criticized. Starting with the oldest theory which is the Theory of Reasoned Action (TRA) follow by the Theory of Planned Behaviour (TPB) and the Technology Acceptance Model (TAM). Also, the justification for the selected theories is provided in the following sections.

NO	Reference	Theory/Model/ Frameworks	Factors	Methodology	Limitation
1	(Fourati-Jamoussi & Niamba 2016)	TAM and Technology-Task Fit	**Technological**: Functionalities of BI tools, Data quality, Localization of data, Authorization of access, Relevance of the system, Ease of use, Perceived utility, Satisfaction and Intention of BI tool's use	Questionnaire with 78 professionals and 56 engineering students.	• This study has covered only the technology perspective of BI, there is no consideration of organizational, individual, and environmental perspective of BI. • Using qualitative methods could add more value by interviewing the professionals and students.
2	(Grublješič & Jaklič 2015) (Grublješič, Coelho & Jaklič 2019)	TAM and TOE	**Technological**: Compatibility, Task-technology fit, Information quality, Output quality, System quality, Complexity, Accessibility, **Organisational:** Management support, User participation in implementation, User training, Organizational culture, Information culture, Change management, Organizational resources, Organizational size, Relative advantage, Job relevance. **Environmental:** Competitiveness of the environment. **Individual:** Age, Computer literacy, Education, Prior experience, Attitude, computer self-efficacy, Computer anxiety. Perceived usefulness	Semi-structured interviews with five of the BI stakeholders and Case study questionnaire with 195 employees in an EU company	• These studies have only researched the effect of the factors in the behavioural intention rather than the actual use. • These studies require empirical test and evaluation of the proposed research model.
3	(Daradkeh & Al-Dwairi 2017)	TAM and DeLone & McLean IS success model.	**Technological**: Information quality, System quality, Analysis quality and perceived ease of use.	Questionnaire with 331 non-technical business users.	• This study has covered only the technology perspective of BI. • Using a different method or conducting another survey with BI professionals will provide

					valuable information on the adoption of BI tools in this study.
4	(Hou 2013) (Hou 2016)	TAM and Decomposed TPB (DTPB)	**Technological**: Compatibility. **Social:** Peer influence, Superior influence. Subjective norms, facilitating conditions, **Behavioural beliefs and attitudes:** Perceived behavioural control, Behavioural intention to use BI and BI usage behaviour, Perceived usefulness, Perceived ease of use, Attitude toward BI use.	Questionnaire with 330 participants from Taiwanese electronics companies.	• Organisation characteristics were ignored in these studies. • Interviewing with some of the participants to add more validity to the proposed model.
5	(Kohnke, Wolf & Mueller 2011)	TAM	**Technological**: Quality of information, System performance. **Organisational:** User information, User training, Top management support. **Behavioural beliefs and attitudes:** Perceived usefulness, Perceived ease of use and subjective norm	Questionnaire with 258 active users of a BI standard software.	• Environment characteristics will add more value of this study. • This study has examined only the post-adoption stage of BI system. • Using another method, such as case study or interviewing to validate the proposed model.
6	(Foshay, Taylor & Mukherjee 2014)	TAM	**Technological**: Definitional metadata, Data Quality, Navigational metadata, Lineage metadata. **Behavioural beliefs and attitudes:** Perceived usefulness and Perceived ease of use.	Two questionnaires were conducted. The first questionnaire with 99 recruiters within each organization and the second questionnaire with 455 end-users.	• No consideration for the organizational size, in order to make the results more general.

7	(Chang, Hsu & Shiau 2013)	TAM	Tangible rewards, Intangible rewards, Desire to make good decisions, Intention to read information, Organisational rewards, Reputation and Reciprocity.	Questionnaire with 271managers in the Chinese Organisations.	• Moderator variables for the managers, such as age and IT skills could add more value for this study. • This study focuses on behavioural intentions, not actual use behaviours.
8	(P. Lautenbach, Johnston & Adeniran-Ogundipe 2017)	TOE and Diffusion of Innovation Theory DOI	**Technological**: Data-related infrastructure capabilities, Data management challenges. **Organisational:** Top management support, Talent management challenges. **Environmental:** External market and Regulatory compliance.	Questionnaire with 72 CIO's, IT and BI managers, executive decision makers, business analysts and systems architects	• Individual characteristics were ignored in this study. • Using qualitative methods could add more value by interviewing some of the participants.
9	(Chaveesuk & Horkondee 2015)	TOE	**Technological**: Relative advantage, Compatibility, Complexity. **Organisational:** Organization size, Organization readiness, Top management support. **Environmental:** Competitive pressure, and Government support.	Questionnaire is conducted with 168 logistics service companies.	• This study has examined only the post-adoption stage of the BI system, while different adoption stages will give a wide image about the adoption behaviour by users. • Using another method such as interviewing to add more validity to the proposed model.
10	(Sujitparapitaya, Shirani & Roldan 2012)	TOE	**Organisational:** Ownership structure, Organization size, Absorptive capacity. **Environmental:** Executive support, Organizational legitimacy. Competitive advantage, Stakeholder support. **Individual:**	Questionnaire with 243 participants in academic administration.	• There is no consideration of different levels of the implementation of BI.

			Perceived costs, Perceived Benefits and Perceived complexity.		
11	(Hung et al. 2016)	TOE	**Technological**: Relative advantage, Complexity, Compatibility. **Organisational:** Top management support, Organization size, Knowledge integrates, Training. **Environmental:** Competitive pressure, Consultant ability.	Questionnaire with 148 users of BIS.	• This study only examined key elements of BIS implementation effectiveness from the standpoint of TOE theory. More factors could be added, such as user innovativeness. Therefore, hypothesizing another theory is necessary.
12	(Malladi 2013)	TOE	**Technological**: Data infrastructure sophistication **Organisational:** Organization size. **Environmental:** Lack of industry standards. **Behavioural beliefs and attitudes:** Perceived benefits.	Questionnaire with 229 firms in US.	• This study only permitted the collection of data from BIA adopters, which made it more difficult to analyse data from non-adopters. • Individual characteristics were ignored in this study.
13	(Gaardboea, Nyvanga & Sandalgaardb 2017)	DeLone & McLean IS success model	**Technological**: Information quality, System quality **Individual:** User satisfaction, System use and individual impact	Questionnaire with 746 of BI user in Denmark's hospitals.	• Qualitative methods should be employed to study the situation in greater detail. • Only individual levels were measured in the study. Measuring the impact of BI applied to HIS at the organizational level would be beneficial.
14	(Mudzana & Maharaj 2015)	DeLone & McLean IS success model	**Technological**: System quality, Information quality, Service quality. **Individual:** User satisfaction, System usage.	Questionnaire with 102 conveniently selected professionals in South Africa's companies.	• Only a portion of the modified DeLone and McLean model is used in this study. It is possible to incorporate and validate the complete updated DeLone and McLean, or integrate it with a different model.

					• Using qualitative methods could add more value by interviewing some of the participants.
15	(Serumaga-Zake 2017)	DeLone & McLean IS success model	**Technological**: System quality, Service quality. **Individual:** User satisfaction and Net benefits.	Questionnaire with 211 of BI users in different companies.	• Qualitative methods should be employed to study the situation in greater detail.
16	(Alzizah, Rahayu & Hashim 2016)	DOI Theory	**Technological**: Relative advantage, Complexity, Compatibility, and Observability.	Questionnaire with 310 business analyst and decision makers in four Telcos companies in Malaysia.	• Organizational, individual, and environmental characteristics were ignored in this study. • Using qualitative methods could add more value by interviewing some of the participants.
19	(Han, Shen & Farn 2014; Han & Farn 2013)	Bhattacherjee's continued usage model and Limayem et al.'s model	**Behavioural beliefs and attitudes:** perceived usefulness, confirmation, satisfaction, pervasive BIS continuance intention, and pervasive BIS continuance usage	Questionnaire with 117 students.	• This study needs more details from respondents to find other significant factors. This can be done via conducting interviews with the participants.

Table 2. 5 BI&A in Large company studies

2.7.2 The Theory of Reasoned Action (TRA)

This is one of the earliest models, developed by Ajzen and Fishbein (1980), and aimed to explain the discrepancy between attitude and behaviour. The theory predicts deliberate behaviour on the basis behaviour is either deliberative or planned. The theory postulates that one's behaviour could be determined by one's own attitude towards the behaviour or one's own subjective norm. Intention is the best behaviour predictor and is determined by including one's attitude towards the specific behaviour, along with one's subjective norm and perceived behavioural control. The theory suggests that only specific attitudes towards the behaviour in question can be expected to predict the behaviour. In addition to measuring attitudes, people's subjective norms including their beliefs about how others view the behaviour in question should also be measured. Predicting one's intentions, knowing the beliefs, is as important as knowing one's attitudes. Behavioural control also influences intentions. This implies that an individual's or organisation's intention to perform the behaviour in question is determined by how favourable the attitude is as well as how favourable the subjective command is. This model is presented below.

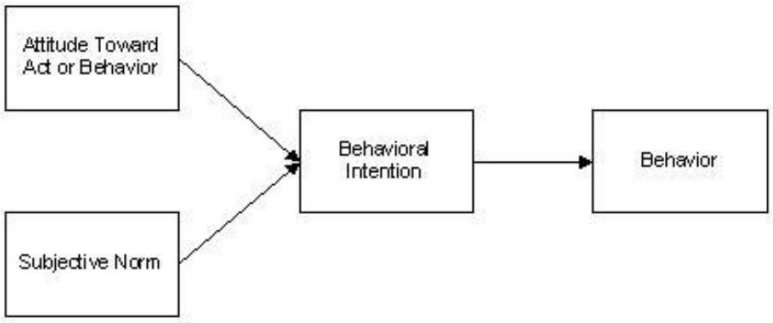

Figure 2. 6 Theory of Reasoned Action

In the words of Ajzen (1985), the theory is limited by correspondence. This implies that for this theory to predict specific behaviour, attitude and intention must agree as to action, target, context, timeframe, and specificity according to Sheppard, Hartwick and Warshaw (1988). In addition, the theory assumes that behaviour is under volitional control. This implies that irrational decisions, habitual actions, and any behaviour not consciously considered cannot be explained using the theory.

2.7.3 The Theory of Planned Behaviour TPB

This builds upon the TRA aimed at addressing the issue of incomplete volitional control identified above by (Ajzen 1985). The theory is useful in predicting and explaining human behaviour without neglecting the individual roles of members of organisations as well as social systems in what happens according to Ajzen (1991). The theory predicts partially involuntary behaviours through inclusion of measures of perceived behavioural control. The model deviates from the TRA as it adds this latter component, which deals with situations in which one has incomplete control over the action in question, which can vary between various situations and actions according to Ajzen (1991). According to Ajzen (1991), where behavioural intention on its own accounts for only a small fraction of differences in behaviour, perceived behavioural control (PBC) can separately predict behaviour. Both intention and PBC are important in predicting what people do though one may dominate in certain conditions. TPB covers the antecedents of attitude, perceived behavioural control, and subjective norms in explaining and predicting behaviour. In this regard, TPB views behaviour as arising from beliefs relevant to the behaviour which tend to determine one's intentions and actions. The model is shown in Figure 2.5 below.

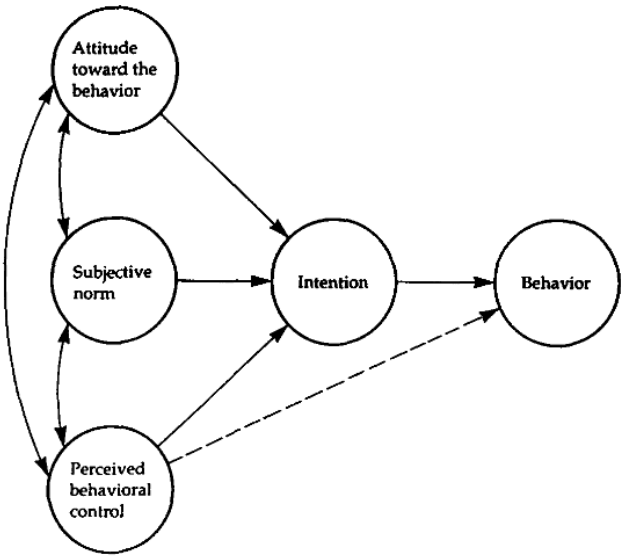

Figure 2. 7 Theory of Planned Behaviour

TBP has been criticised for not investigating the relation of behaviour and intention, where large amounts of unexplained variance are often experienced. The model fails to include demographic variables while assuming that everybody experiences the model's processes in a similar manner. In addition, Armitage and Conner (1999) criticise it for failing to account well for changes in behaviour. According to Taylor and Todd (1995b), the model uses a single variable (PBC) against all controllable elements of the conduct being considered. Furthermore,

the aggregation of beliefs behind the PBC in creating measures for it has been criticised for failing to identify specific factors able to predict behaviour and for all too often generating biases. Moreover, some researchers have doubted the effect of perceived behavioural control to the actual behaviour. For example, Yi et al. (2020) demonstrated how perceived behavioural control indirectly influences actual behaviour using the modified TPB model with five independent variables. On the other hand, Becker-Leifhold (2018) demonstrated that perceived behavioural control has an impact on actual behaviour both directly and indirectly using the modified TPB model with seven independent variables. Therefore, Ashaduzzaman et al. (2022) have challenged the TPB model's predictive power when it comes to actual behaviour by developing the universal TPB model.

2.7.4 Technology Acceptance Model (TAM)

The Technology Acceptance Model TAM of Davis (1989) is among the most widely recognised as well as influential theories on the subject of technology acceptance and use behaviour. It derives from Ajzen and Fishbein's (1980) theory of reasoned action (TRA) and seeks to elucidate why users accept and employ technology and the factors influencing how they do. The model uses two perceptions, as shown in the figure below: perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness (PU) is how much someone believes that using the particular system will improve his or her job success according to Davis (1989). On the other hand, perceived ease of use is the extent to which the person views using the new technology as being free of effort, again according to Davis (1989). The theory has been a powerful way of presenting the antecedent of new technology adoption and usage via beliefs about the above factors, according to Davis, Bagozzi and Warshaw (1989). Use of new technology depends on intention that is deemed determined by one's attitude towards using the system together with its perceived usefulness. TAM proposes that attitude and usefulness are able to influence the intention to use the system in reality. The link between intention and usefulness means that someone believes that their job performance will be enhanced irrespective of negative or positive feelings, according to Davis, Bagozzi and Warshaw (1989). The external factors in the model include things such as objective system design characteristics, computer self-efficacy, training, user involvement in design, and the nature of the implementation process, according to Venkatesh and Davis (1996). On the other hand, external variables that affect PU and PEOU as well as actual use or behaviour, according to the theory, include system quality, compatibility, computer anxiety, enjoyment, computing support, and experience, according to Lee, Kozar and Larsen (2003). The aim of this theory is to provide an

explanation of what determines technology acceptance to the extent of explaining user behaviour over various end-user technology and user groups. According to Venkatesh and Davis (1996), technology acceptance model has been successful in predicting and explaining usage across several systems.

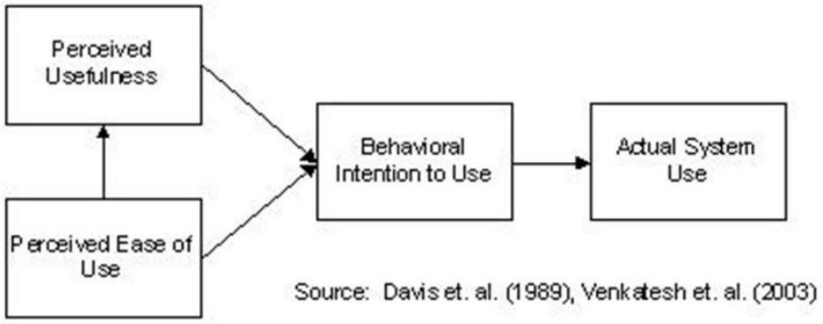

Figure 2. 8 TAM Model

The TAM model has been criticised for depending on self-reporting and going on the basis that this is an indication of actual usage, according to Legris, Ingham and Collerette (2003). The model has also been criticised for the type of respondents it employs, and the systems examined as well as sample choice. At times, student samples as well as samples from very professional users have been used, hence making generalisation of the findings difficult. Venkatesh and Davis (2000), on the other hand, criticise the model for only providing limited advice on how to influence usage via design and implementation, which fails to help in explaining or understanding acceptance in such a way as to guide development beyond pointing out that system characteristics affect ease of use. According to Sun and Zhang (2006), limitations of the TAM include its explanatory power as well as the discrepancy between past studies. Moreover, Zhao and Nakatani (2023) have surmised some limitations of TAM model including the following:

- TAM is unidimensional model explains technology acceptance by considering just two variables: perceived usefulness and perceived ease of use.
- It ignores other variables including individual variations, organizational culture, and social influence that may have an impact on technological acceptance.
- It has drawn criticism for being overly simple and unable to convey the complex reality of technology adoption in the workplace.

Nevertheless, TAM has recently criticized for being an antiquated model, Al-Emran and Granić (2021) pointed out that there are more research works on TAM and its uses, indicating that the model can still be used, modified, and expanded across a variety of applications and domains.

2.8 Theories adopted in this study.

2.8.1 Diffusion of Innovation (DOI) Theory

This model was developed by Rogers (1983) in an attempt to explain how innovations diffuse through society as well as how individuals and organisations come to accept new technology. Through the model, Rogers distinguishes adoption from diffusion in that the latter takes place in a societal context as a group process while adoption is an individual's process. As stated by Rogers (1983), diffusion implies the process through which an innovation is communicated through definite channels over the time among the members of a society. On the other hand, adoption is a decision to make full use of the innovation as the best course of action available. The diffusion of innovation theory incorporates innovation decision method, adopters' features, and innovation parameters as well as opinion leadership, as stated by Rogers (1983). The model has five stages of the process of innovation decision-making that set out the different phases an individual or an organisation undergoes in adopting or rejecting a new technology.

Stage 1: Knowledge

This occurs when an individual or an organisation learns of a new option and also gains understanding of how it functions.

Stage 2: Persuasion phase

In this phase, the apparent features of the new thing give rise to a positive or negative perception on the part of the possible user.

Stage 3: The decision phase

The person or organisation interacts in things which lead to the decision to adopt or not the innovation, which call for conflicting pro and con forces influencing the process.

Stage 4: The implementation phase

The person or the organisation makes a decision to use the new innovation. This phase contains an overt behavioural change as the individual or organisation puts the new idea into practice.

Stage 5: Confirmation phase

This is the final stage of the theory, where the decision to adopt or reject the new idea is reconsidered and may thus change where concerns or challenges around the new approach arise, according to Rogers (1983).

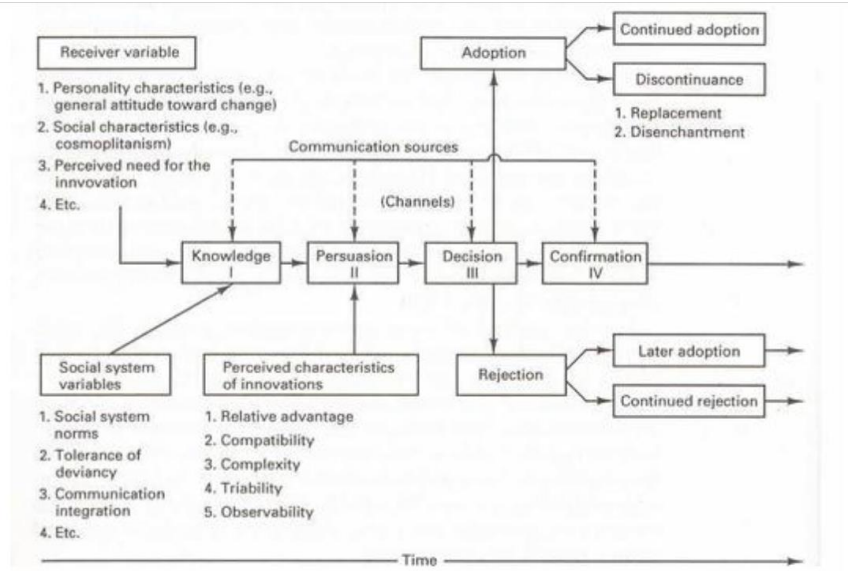

Figure 2. 9 DOI Theory

Md Hatta et al. (2015) conducted a literature review; they found the most frequently cited work about BI&A systems adoption is the DOI theory and TOE framework. DOI theory can help to explain the adoption behaviour of a collection of people, groups, or organisations, as opposed to just individuals. This means the DOI theory may analyse the adoption of technical innovation at the organisational level (Melville, Kraemer & Gurbaxani 2004). This is congruent with the objective of this study, which is to examine the adoption of BI&A systems among Saudi SMEs. According to DOI theory, the users or the prospective users evaluate the new technology based on their perceptions, and they will decide to support it if the innovation achieves one or more of five general elements comprising relative advantage, complexity, compatibility, trialability, and observability. The DOI theory has been criticised as it is biased towards the technological characteristic (Taylor, 2015), as it is insufficient on its own to explain technology adoption in an organization since it ignores organizational external influences and only considers the technological context (Alrousan & Al-Adwan, 2020). Even if company's technical characteristic is guaranteed, it does not guarantee that IT innovation will follow. Other environment, organisational, and individual factors may affect the IT adoption (Boonsiritomachai et al. 2016). Therefore, in this research model the researcher adopts the technology characteristics from DOI and other factors from TOE and IS adoption models for small business in order to deal with the criticisms of this theory. In the SLR, as shown in Table 2.7, relative advantage, complexity, compatibility and observability are the most common points considered for BI&A system adoption in both large companies and SMEs in recent years

(Almusallam & Chandran 2020a). Therefore, these four factors were adopted in this research model.

2.8.2 TOE Framework

Tornatzky and Fleischer (1990) believed that three major dimensions – technological, organisational, and environmental (TOE) – influenced the adoption of new technologies in a company. They combined technological characteristics with other factors. Consequently, they proposed the TOE framework to figure out what factors were affecting a company's decision to implement and use innovative technology. Many researchers have found that TOE provides a solid theoretical basis for studying IS adoption in SMEs. For example, Mehrtens, Cragg and Mills (2001) used the TOE model to explore the internet's adoption in seven SMEs. Also, Puklavec, Oliveira and Popovič (2018) adopted the TOE framework to investigate BI systems adoption and use in 181 SMEs. Ramdani, Kawalek and Lorenzo (2009) demonstrated the TOE framework's suitability for researching potential enterprise systems adopters in England's SMEs. Moreover, in the SLR for BI&A systems in big companies and SMEs, the researcher found that although there is a dearth of studies of BI&A systems adoption in SMEs, the TOE framework was the most considered framework for use in their implementation in SMEs (Almusallam & Chandran 2020a). Based on the empirical evidence presented above, the TOE framework is an adequate theoretical basis for investigating BI&A systems adoption in Saudi SMEs. However, numerous studies have challenged this model for failing to account for management considerations, which are seen to be extremely important decisions making process for the adoption of new technologies (Alrousan & Jones 2016; Alrousan & Al-Adwan 2020). .Also, TOE is a taxonomy for classifying variables in their respective contexts, rather than a specific framework for defining the factors affecting the adoption process (Boonsiritomachai et al. 2016). The most important contribution of this framework is that it allows researchers to consider the wider context in which adoption occurs (Ismail & Ali 2013). The constructs used in each context were typically ones chosen from previous research that were considered to be appropriate for the kind of the technology being studied. Therefore, the researchers suggested that the TOE framework has to be integrated with other models in order to provide a greater range of constructs than the original and more theoretical lenses to explain technology adoption and use (Ismail & Ali 2013; Md Hatta et al. 2015). Thus, this research model integrates TOE with the IS adoption model for small businesses and Diffusion of Innovations (DOI) theory.

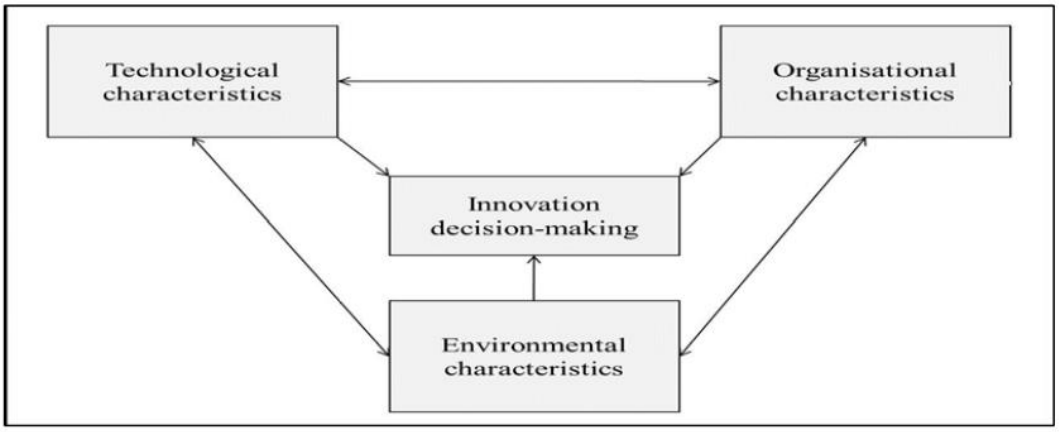

Figure 2. 10 TOE Framework

Source: Tornatzky and Fleischer (1990)

2.8.3 IS Adoption Model for Small Business

The IS adoption model for small businesses was developed by Thong (1999). Thong found that the available organisational models and theories for large organisations might not be applicable for SMEs. For this reason, he proposed the IS adoption model for small businesses. This model contains four contextual variables which are considered to be effective variables for technology adoption in small enterprises. These factors are Individual characteristics, Technological characteristics, Organisational characteristics, and Environmental characteristics. This model can be viewed as an extension of the TOE framework, as the individual characteristics can be regarded as organisational characteristics. Thong, Yap and Raman (1996) found that due to the simplicity of the organisational structure of SMEs, the individual characteristics factor is critical in determining innovation adoption and use. As the owners/managers in SMEs have great influence on making decisions to adopt and use the innovation technology, many other researchers share the same point of view and they include individual characteristics in their research models (Boonsiritomachai et al. 2016; Fogarty & Armstrong 2009; Md Hatta et al. 2015). Accordingly, the individual characteristics that include owners'/managers' IT knowledge and owners'/managers' innovation are included in the research model.

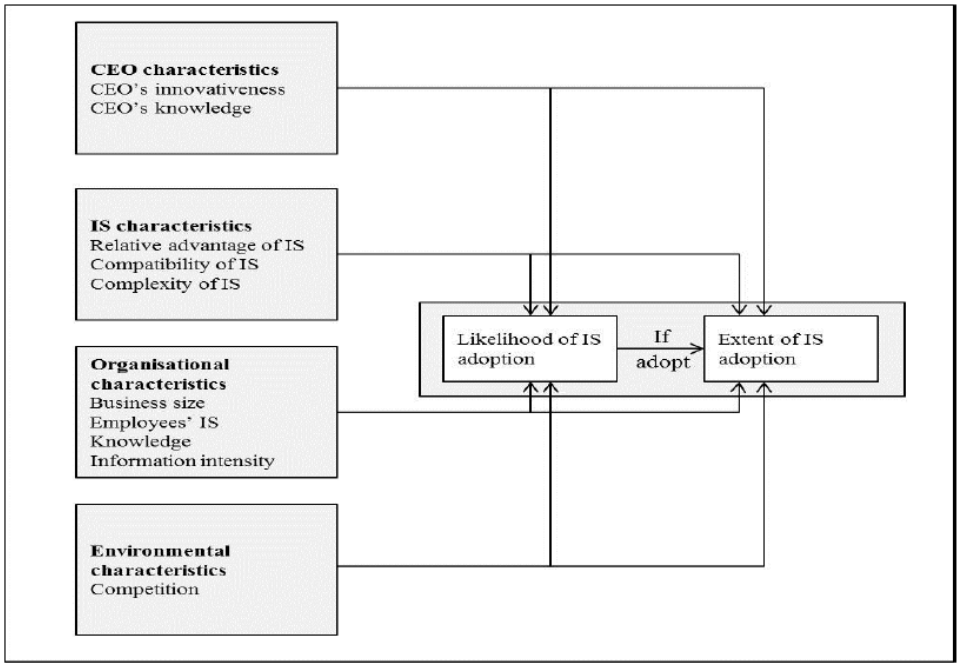

Figure 2. 11 IS Adoption Model for Small Business

Source: Adopted from Thong (1999)

2.9 Technology Adoption Factors:

Researchers have discussed several issues that define user adoption of new technology by determining specific factors. As such, there is a growing body of literature attempting to investigate what factors determine the adoption of certain technologies in the workplace (Venkatesh, Brown & Sullivan 2016). In general, looking for a single determinant of technology adoption would not yield any success. Therefore, several models of technology adoption exist in order to identify the contributing factors of technology adoption and use (Venkatesh et al. 2003). In this study several studies were analysed to identify the factors that influence BI&A system adoption. These factors were classified by characteristics using Grublješiˇ and Jakliˇ (2015) classification. These include technological, organisational, social, environmental, and individual characteristics, as shown in Table 2.5. In large companies, of these the technological and organisational characteristics factors have been studied the most and the social, environmental, and individual factors the least. While Table 2.3 in section 2.4 above shows that, for SMEs, the technological, organisational, and environmental characteristics factors have been studied the most. In these selected studies, little research has been done on individual characteristics. Pre-adoption and post-adoption of technology are affected differently by a number of factors. Most studies in large companies were on the post-adoption stage while those in SMEs were in the pre-adoption stage. Consequently, some factors such as quality of information, system performance, system quality, and staff training appear in large companies only. Also, SMEs' characteristic are different from those of large companies in terms of structure, policy, and resources (Boonsiritomachai , McGrath & Burgess 2014). As a result, factors such as cost, absorptive capacity, organisational competency and external support frequently are studied in SMEs.

2.9.1

2.9.1 Technological Characteristics

Researchers have widely studied technological characteristics in adoption and use of new technology. Compatibility is one of the technical features that have been studied extensively by experts. Compatibility is defined as the degree to which innovation is considered to be compatible with current prospective values, needs, and previous experiences for potential adopters (Moore & Benbasat 1991). Compatibility has been studied in IS and is shown to consistently influence technology adoption and use. It takes a very large amount of time and money to implement a system with a new technology if the current system is not compatible with the new system. This factor should be more prominent in SMEs given their limited resources (Boonsiritomachai , McGrath & Burgess 2014). While Alrousan and Al-Adwan, (2020) have found that because Jordanian SMEs use a wide range of technologies in their operations, decision-makers have little trouble integrating new ones into their current system. Also, Sharma and Sharma (2023) found that compatibility was an insignificant adoption construct while studying the digital marketing adoption. Interestingly, while the compatibility is a crucial component of DOI, typically it has little effect on small travel businesses' adoption of digital marketing (Sharma & Sharma 2023). The nature of the innovation or organization under study may be the cause of the inconsistencies between the earlier research. In large companies, compatibility has still proved a significant factor in technology adoption (Grublješič & Jaklič 2015; Hou 2014a; Jaklič, Grublješič & Popovič 2018). There are a limited number of studies conducted in the SME field. Moreover, the importance of relative advantage at firm & individual levels for technology adoption is controversial. It has been proven that relative advantage is the strongest and most dominant predictor of technology adoption over the past thirty years (Venkatesh & Bala 2008; Venkatesh et al. 2003; Venkatesh, Thong & Xu 2016). Alrousan and Al-Adwan, (2020) in their study of the E-marketing adoption highlight the significance of relative advantage, especially when decision-makers recognize the important benefits of technological applications over traditional methods. On the other side, empirical studies show that relative advantage is not a significant factor in some innovation adoption (Grublješič, Coelho & Jaklič 2019; Jaklič, Grublješič & Popovič 2018; Puklavec, Oliveira & Popovič 2018).

Complexity is another factor that is widely discussed (Premkumar & Potter 1995; Thompson, Higgins & Howell 1991; Venkatesh, Brown & Sullivan 2016; Venkatesh et al. 2003). Several studies have found that some innovation technology is complex and that this negatively impacts the adoption of the system (Ain et al. 2019; Hou 2014b; Md Hatta et al. 2015). Also, some

researchers asked the innovators to focus on reducing complexity of innovation to increase the usage of such advance technology (Magsamen-Conrad & Dillon 2020). However, other studies show that complexity has minor effects on innovation technology adoption and use because the users are very aware of the these technologies' complexities, and they deal with this issue and overcome any obstacles they may face (Alzizah, Rahayu & Hashim 2016; Daradkeh & Al-Dwairi 2017; Hou 2016; Sujitparapitaya, Shirani & Roldan 2012).

Another technological characteristics is observability, which is defined by Moore and Benbasat (1991) as the tangibility of the results of using the innovation. Observability is also another important technological characteristic that that has been evaluated by a number of researchers in the IS field in general (Grublješič, Coelho & Jaklič 2019; Venkatesh & Davis 2000). Eckhardt, Laumer and Weitzel (2009), consider observability as a potential additional predictor for IS adoption. Also, other studies state that results demonstrability, which is part of observability, is a significant predictor variable in BI&A adoption (Grublješič & Jaklič 2015; Jaklič, Grublješič & Popovič 2018). According to Grublješič, Coelho and Jaklič (2019), when outcomes of using innovation technology are noticeable, visible, and acknowledged in the company, the user is more ready to use these technologies. Outcomes and effects of some innovation technologies need time to be observable; thus the tangibility of the results is observed in the long-run (Moore & Benbasat 1991; Popovič et al. 2012).

Additionally, information quality is another technological characteristic that recently has been in the focus of researchers for its concurrent emergence in huge data systems. Therefore, the researchers take information quality into account while examining technology acceptance factors (Hartono, Santhanam & Holsapple 2007; Marshall & Harpe 2009; Popovič et al. 2012). Along with the technological characteristics mentioned, system quality, user interface, trainability, objective usability, output quality, and accessibility are other, more technological characteristics that have been examined by researchers (Grublješi˘ & Jakli˘ 2015).

2.9.2 Organisational Characteristics

Regarding organisational characteristics, it is highlighted in the past literature that the enterprise size factor plays an influential role in adopting innovation technology (G. Buonanno et al. 2005; Jang, Lin & Pan 2009; Ramamurthy, Sen & Sinha 2008). Enterprise size might be a critical component in system efficiency, according to Qushem et al. (2017). Also, Kinkel et al. (2022) stated that amount of technology used by a company and its size are significantly positively correlated. The reason for this can be attributed to the fact that larger businesses

possess greater financial and human resources than smaller ones, which is likely to be a significant obstacle to the adoption of technology in SMEs (Kinkel et al., 2022). Some research has considered the enterprise size as having an influential role on technology adoption and use (Boonsiritomachai , McGrath & Burgess 2014; Puklavec, Oliveira & Popovič 2018; Qushem et al. 2017; Stjepić 2017). None of these apply their study to different level of adoption stages. Lee and Xia (2006) in their research argue that the adoption of innovation technology and the enterprise size are directly correlated. However, the degree and direction of causality here rests upon many factors that include organisation type and adoption stages.

Also, organisational resource availability has been considered, by a number of studies, as an influencing factor for technology adoption (Chong et al. 2015; Maroufkhania et al. 2020; Oliveira & Martins 2010). Sahay and Ranjan (2008) state that some of the innovation technologies are expensive and require skilled personnel, which may be not affordable by companies with limited resources. Therefore, managers/owners would adopt these technology when financial and human resources are available (Boonsiritomachai et al. 2016). In contrast, several studies proved that the demand for adoption and implementation has increased their affordability (Bhatiasevi & Naglis 2018). No doubt, this enables SMEs to adopt and implement innovation technologies even with limited resources. This is consistent with the outcomes of different studies that found organisational resource availability to be unimportant for BI&A system adoption (Dibrell, Davis & Craig 2008; Duan, Deng & Corbitt 2012). Sabherwal, Jeyaraj and Chowa (2006) outline the importance of user training as a significant organisational characteristic factor in information systems use and success. In addition, the relationship between user training and behavioural intentions has been examined by Harris et al. (2018) and results in technology use. Participation and involvement of users in implementation is another organisational factor that has been approved as an effective factor in technology adoption and use (Hartono, Santhanam & Holsapple 2007; Yeoh & Koronios 2010).

2.9.3 Environmental Characteristics

Regarding environmental characteristics, **c**ompetitive pressure is one of the most common environmental characteristics in innovation technology adoption (Oliveira & Martins 2010). Information technology has undergone rapid development, which has put SEMs under pressure to be competitive against their peers (Boonsiritomachai et al. 2016). According to Tsai et al. (2013), one of the key factors influencing the adoption of IS innovations in businesses is competitive pressure. The adoption of IS innovations is generally seen to be positively impacted by industry competition. Companies should consider that they can adapt new

technology to compete in the market, it can be considered a kind of organizational strategy (Maroufkhania et al. 2020). Several studies found competitive pressure to be a predictor of innovation adoption (Boonsiritomachai et al. 2016; Gu, Cao & Duan 2012; Hwang et al. 2004; Oliveira & Martins 2010). However, other studies found competitive pressure not to be an evident predictor of innovation adoption (Ghobakhloo & Ching 2019; Oliveira, Thomas & Espadanal 2014).

Coordination between enterprises and vendors is an additional factor that influences IT adoption. Gatignon and Robertson (1989) noted that if businesses are able to collaborate effectively with their IT suppliers, they will always support advances. However, choosing who will help with this is a crucial aspect of IT adoption, since partners may expedite putting things in place through the employment of swiftly stabilising, assisting applications. This is significant because even when novel techniques are developed, they may fall short of satisfying the total information processing requirements of the majority of companies (Davenport 2000). The readiness of external support to adopt and use technology-based solutions is known as external support and is another environmental characteristic that influences IT adoption (Premkumar & Roberts 1999). The availability of outsourced or third-party support makes the companies ready to adopt a new technology by reducing its risk. Also, this factor has been shown to be a significant factor in BI&A adoption process (Puklavec, Oliveira & Popovič 2018). Lee and Larsen (2009), state that due to the limited IT human resources in SMEs, they need more external support, and they are more prompted to adopt and use innovation technology.

2.9.4 Individual Characteristics

Researchers have widely studied individual characteristics in adoption and use of new technology. Owners'/managers' IT knowledge is found to be a factor affecting innovation adoption (Deng & Chi 2014; Thong 1999). People who rate their own IT knowledge high are more likely to accept a new IT system, meaning that the likelihood of adopting new system rises with people's self-perceived IT knowledge (Sharma, 2020). Some studies (Jaklič, Grublješič & Popovič 2018; Luo 2016) found that the majority of innovation system users are educated; nevertheless, few researchers looked at the users' IT competence (Ain et al. 2019). Most IT users in SMEs are the owners of the companies, thus it is very crucial to examine owners'/managers' IT knowledge in this sector. In contrast, large companies usually have a dedicated department for IT and IT specialists who deal with the innovation system in the company.

Gopal et al. (1997), in their research, first discuss the diversity gender factor that influences the use of group support systems. The same factor has been discussed by Venkatesh and Davis (2000) on their research, by examining its influence in ease of use, perceived usefulness in their research. Although the importance of gender has been proved by many researchers, research has scarcely examined the gender effects in technology acceptance models (Venkatesh, Brown & Sullivan 2016). Also, Davis, Bagozzi and Warshaw (1989) have explored individual attitudes and how this factor affects behavioural intention.

Also, attitudes have been studied in pre-adoption and post-adoption situations (Karahanna, Straub & Chervany 1999). Moreover, Sabherwal, Jeyaraj and Chowa (2006) have explored the effect of attitudes on user satisfaction, system use, and system quality. Additionally, the age factor has been found in a number of studies to affect acceptance of new technology negatively, hence the conclusion by Venkatesh et al. (2003) that increased age decreases acceptance of technology and theorizes that age is an individual characteristic that plays a moderating role in their Unified Theory of Acceptance and Use of Technology (UTATU) model. Different genders may have a different perception of the technology, hence affecting their acceptance of the technology, while attitude towards the use of technology has been found to be a stronger predictor of technology acceptance among men than among women, Venkatesh et al. (2003) have come to the view that subjective norms, including social pressure, have an effect on acceptance of new technology among women more than they do for men.

More than two decades ago Kay (1990) discussed computer literacy and how it affects locus control. Also, personal innovativeness is another individual factor and refers to the desire to bring in innovative and creative systems for development and improvement of services and/or products (Zhu, Kraemer & Xu 2003). Pinho et al. (2021) developed six parameters, one of them is personal innovativeness that influences learners' intention and tested them on 631 participants. Their result shows the personal innovativeness is significant factor on this relationship. Also, Park and Woo (2022) looked at the impacting mechanism behind the association between people's attitudes regarding artificial intelligence and their personalities in another study using personal innovativeness. Four dimensions were used in the research to measure attitudes: sociality, functionality, negative emotions, and positive emotions. The results demonstrated how personal innovativeness continuously supports its beneficial function in foretelling all the various views regarding artificial intelligence. Usually, the users of innovation technology are decision makers such as owners, managers, or higher administration personnel who hold academic qualifications/degrees (Luo 2016) . Therefore, innovation

technology users could be potential sponsors and/or actual users. This innovative characteristic of managers and/or owners contributes to IS adoption decisions (Wang 2014). Despite the importance and significant effect of innovativeness of character, it has not been deeply studied or explored (Popovič, Puklavec & Oliveira 2019; Wang 2014).

Moreover, the education level of the individual and how it affects technology use is another factor that has been studied by different researchers (Mahmood, Hall & Swanberg 2001; Wu & Lederer 2009). They conclude that the individual's level of education will positively affect their level of technology adoption; this is because education influences perceived ease of use, meaning those who are highly educated would perceive the new technology as easier to use and hence accept it. Computer self-efficacy is another personal characteristic studied by Compeau and Higgins (1995) in their research as a factor determining computer use. Also, Venkatesh and Bala (2008) studied computer self-efficacy and its impact on perceived ease of use, the individual's self-efficacy, or their judgement of their ability to use the technology in accomplishing their particular job-related tasks, which will influence their level of acceptance of the technology according to Venkatesh and Davis (2000). In this regard, self-efficacy has been found to influence technology acceptance positively.

Computer anxiety and how it determines system use is another personal characteristic studied by researchers (Compeau & Higgins 1995; Venkatesh & Bala 2008). Agarwal and Karahanna (2000) figured out the role of computer playfulness in cognitive absorption, which in turn affects behaviour around plans to use technology. Venkatesh and Davis (2000) argue that computer playfulness is one of the anchors related to individual beliefs regarding computer use, which affects early perceptions of perceived ease of use. The same view is held by Venkatesh and Bala (2008), who outline that they found computer playfulness was a significant predictor of perceived ease of use in their suggested model. Experience level is another individual characteristic that has a role in technology acceptance by an individual, as suggested by Thompson, Higgins and Howell (1991). Taylor and Todd (1995a), in their research examined the suitability of technology adoption models for both experienced and inexperienced users. Also, Venkatesh et al. (2003), in their research, have suggested experience as a moderator variable in the (UTAUT) model. An extension of the UTAUT model was made by Venkatesh and Bala (2008), and they have found a new relationship between experience and other factors such as actual use of the system. Readiness for change (Kwahk & Lee 2008) and positive mood (Djamasbi, Strong & Dishaw 2010) are also other individual characteristics with an impact on technology adoption and use.

2.10 Conceptual Research Model

Based on the IT adoption theories and factors mentioned above, and aiming to answer the research questions, an integrated model is proposed, and the present study's hypotheses have been formulated. This model, as shown in Figure 2.10, integrates established theories that include the TOE framework (Tornatzky & Fleischer 1990), IS adoption model for small businesses (Thong 1999), and Diffusion of Innovation (DOI) Theory (Rogers 1983). This model examines the adoption and use of BI&A systems in Saudi SMEs. The results of examining the previous studies are then used as a basis for developing the research hypotheses. On the basis of this research model, ten potential influences on innovation adoption are grouped under four principal characteristics (Technological, Organisational, Environmental, and Owner/managers). Each factor has been examined in two different adoption stages: the pre-adoption and post-adoption stages. Eight hypotheses fall under technology characteristics, four of them (H1a to H4a) in the pre-adoption stage and the other four (H1b to H4b) in the post-adoption stage. Four hypotheses fall under organisational characteristics, two of them (H5a and H6a) in the pre-adoption stage and the other two (H5b and H6b) in the post-adoption stage. Four falls under environmental characteristics, two of them (H7a and H8a) in the pre-adoption stage and the other two (H7b to H8b) in the post-adoption stage. Finally, four hypotheses fall under owner/manager characteristics, two of them (H9a and H10a) in the pre-adoption stage and the other two (H9b to H10b) in the post-adoption stage. In general, a total of twenty hypotheses are proposed, ten of them (H1a to H10a) for the pre-adoption stage and ten hypotheses (H1b to H10b) for the post-adoption stage. Please prefer to Table 2.8; more details of these research hypotheses can be found in the following sections.

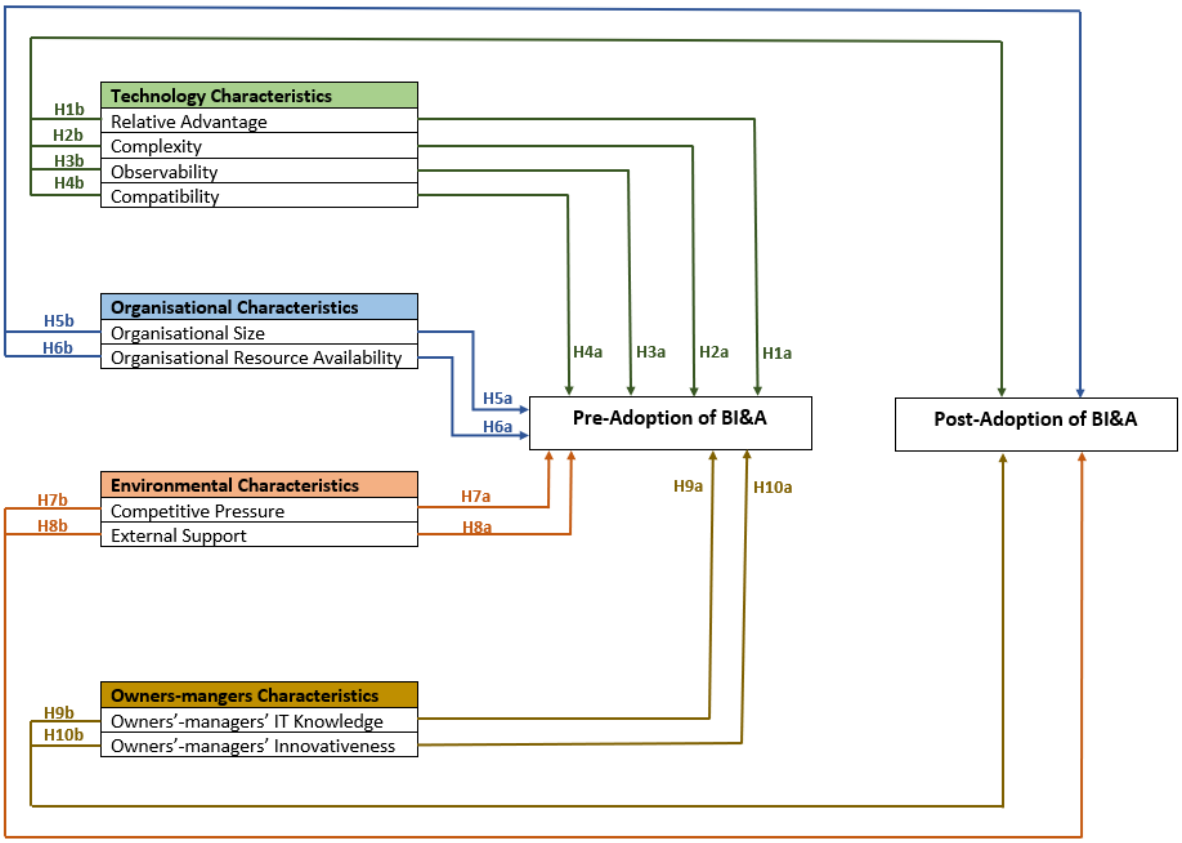

Figure 2. 12 **Conceptual Research Model**

2.11 Research Hypotheses

2.11.1 Technology Characteristics

2.11.1.1 Relative Advantage

Relative advantage is defined as "The degree to which an innovation is perceived as being better than its precursor" (Moore & Benbasat 1991). Although, some research in BI&A systems studies has highlighted the importance of relative advantage for BI&A systems adoption in SMEs (Alsibhawi et al. 2023; Simon & Suarez 2022; Salisu, Sappri & Omar 2021; Boonsiritomachai et al. 2016; Md Hatta et al. 2015; Puklavec, Oliveira & Popovič 2014; Qushem et al. 2017), empirical research in BI&A systems adoption shows that relative advantage is non-significant for BI&A systems adoption at the firm level (Stjepic et al., 2021; Puklavec, Oliveira & Popovič 2018) or at individual level (Grublješiˇ & Jakliˇ 2015; Jaklič, Grublješič & Popovič 2018). Some of their justification, related to BI&A systems characteristics, is the indirect benefits of BI&A systems, which are long-term and hard to measure compared to other ISs. Changes in performance are less observable, and consequently are non-significant for BI&A systems adoption (Grublješič, Coelho & Jaklič 2019). Others claim that it is related to user awareness as they have found both post-adopters and pre-adopters to be well aware of BI&A systems advantages (Puklavec, Oliveira & Popovič 2018). Based on

this, the BI&A systems can be thought of as an established IT innovation with large awareness of its relative advantage (Puklavec, Oliveira & Popovič 2018). Despite previous studies indicating that relative advantage has no direct effect on BI&A systems adoption, relative advantage has proved to be the strongest and most dominant predictor of technology adoption over the past three decades (Venkatesh & Bala 2008; Venkatesh et al. 2003; Venkatesh, Thong & Xu 2016). Furthermore, such a critical factor cannot be overlooked without further study and investigation, especially in the pre- and post-adoption stages. Therefore, relative advantage is considered as an independent variable in this research model.

Hence, the following hypotheses are proposed:

H1a: Relative Advantage has a positive effect on pre-adoption of BI&A systems in SMEs.

H1b: Relative Advantage has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.1.2 Complexity

Complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Venkatesh et al. 2003, p.454). In general, opinions differ about the influence of complexity on BI&A systems implementation and use. According to some researchers, BI&A systems are complex, and complexity has a major effect on BI&A systems adoption and use (Alsibhawi et al. 2023; Boonsiritomachai et al. 2016; Hou 2014a; Md Hatta et al. 2015).. Others have shown the weakness of this factor in predicting their systems adoption and use (Daradkeh & Al-Dwairi 2017; Hou 2016; Stjepic et al., 2021;Sujitparapitaya, Shirani & Roldan 2012), they find that users are well aware of the BI&A systems' complexities and that they may be willing to deal with the complications and challenges (Alzizah, Rahayu & Hashim 2016). Also, Stjepic et al. (2021) stated that a low degree of perceived complexity among businesses may be a sign of highly qualified and educated staff members. The majority of the studies listed were conducted in large companies, and a small number of studies were conducted in SMEs. As a result of this factor's negotiability and the scarcity of research in the SME area, the impact of complexity requires further investigation. Accordingly, complexity is considered as an independent variable in this research model. Therefore, it is proposed that:

H2a: Complexity has a negative effect on Pre-adoption of BI&A systems in SMEs.

H2b. Complexity has a negative effect on Post-adoption of BI&A systems in SMEs.

2.11.1.3 Observability

Observability is defined as "the degree to which the results of an innovation are observable to others" (Moore & Benbasat 1991, p.195). IS technology acceptance studies treat the observability factor as a potential additional predictor of IS adoption (Eckhardt, Laumer &

Weitzel 2009), while in BI&A systems adoption and acceptance studies the researchers recognise the result demonstrability, which is part of the observability, as a significant predictor variable for use and adoption (Grublješiˇ & Jakliˇ 2015; Grublješič, Coelho & Jaklič 2019; Hou 2014b; Salisu, Sappri & Omar 2021; Jaklič, Grublješič & Popovič 2018). If the result of using the BI&A systems is demonstrable, visible, and acknowledged in the organisation, the user will be more ready to use the BI&A systems (Grublješič, Coelho & Jaklič 2019). The impact of BI&A systems is usually indirect and can be observed in the long run (Popovič et al. 2012); this is appropriate with the nature of observability factor, as the observability relates to the tangibility of the results of using the innovation, which can be observed in the long run (Moore & Benbasat 1991).Therefore, observability is used as an independent variable in this research model. So, it is proposed that:

H3a: Observability has a positive effect on pre-adoption of BI&A systems in SMEs

H3b: Observability has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.1.4 Compatibility

Compatibility is defined as the degree to which innovation is considered to be compatible with current prospective values, needs, and previous experiences for potential adopters or users (Moore & Benbasat 1991). According to Boonsiritomachai , McGrath and Burgess (2014), the implementation of analytics and data transformation between systems accounts for 40% of BI&A systems costs. There will be a need for a considerable amount of time and money to move data across and implement it if current systems are not compatible with BI&A systems. This should be more significant in SMEs with limited resources. Although the compatibility in big companies has been shown to consistently influence BI&A systems adoption (Grublješiˇ & Jakliˇ 2015; Hou 2014b; Jaklič, Grublješič & Popovič 2018), there is a shortage of studies on this factor in SMEs. Stjepic et al. (2021) have found that Croatian SMEs acknowledge that the main technological risk that could impede a successful BIS adoption project is the compatibility of BIS with enterprise information systems. To researcher knowledge, only a few studies have examined this factor in SMEs. Some of them have found the compatibility not to be significant in a BI&A systems adoption decision (Boonsiritomachai et al. 2016), while Bhatiasevi and Naglis (2018) found it to be significant in BI&A systems adoption. Consequently, the following hypotheses are proposed:

H4a: Compatibility has a positive effect on pre-adoption of BI&A systems in SMEs.

H4b: Compatibility has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.2 Organisational Characteristics

2.11.2.1 Organisational size

It is highlighted in the literature to date that the enterprise size plays an influential role in the adoption of innovation technology (G. Buonanno et al. 2005; Jang, Lin & Pan 2009; Ramamurthy, Sen & Sinha 2008). Enterprise size might be a critical component in business intelligence efficiency, according to Qushem et al. (2017). Some researchers have considered the enterprise size as having influential role on the BI&A adoption and (Boonsiritomachai, McGrath & Burgess 2014; Puklavec, Oliveira & Popovič 2018; Qushem et al. 2017; Salisu, Sappri & Omar 2021; Stjepić 2017). None of them have applied their studies to different levels of adoption stages. Lee and Xia (2006) in their research argue that the adoption of innovation technology and the enterprise size have a positive relationship. However, the degree and direction of this relationship depend on many factors that include organisation type and adoption stages. Therefore, it is proposed that:

H5a: Organisational size has a positive effect on pre-adoption of BI&A in SMEs.

H5b: Organisational size has a positive effect on post-adoption of BI&A in SMEs.

2.11.2.2 Organisational Resource Availability

Many studies have pointed to the organisational resource availability as an influencing factor in IS adoption (Chong et al. 2015; Oliveira & Martins 2010). BI&A systems are expensive and need skilled users, which could put them out of the reach of the enterprises with limited resources (Sahay & Ranjan 2008). Owners/managers would adopt and use the system when capital and human resources were available (Boonsiritomachai et al. 2016). However, some scholars have not found this, implying instead that the demand for the implementation of BI&A systems has increased because of their affordability (Bhatiasevi & Naglis 2018). This gives SMEs the ability to implement BI&A systems even with limited resources. This is consistent with some other researchers, who found the organisational resource availability not to be important for technology adoption (Dibrell, Davis & Craig 2008; Duan, Deng & Corbitt 2012). According to Simon and Suarez (2022) study, adoption intention and organizational resource availability are not significantly related. The availability of appropriate BI&A desktop programs that enterprises can utilize for initial testing and learning could have an impact on their decision. Because of the negotiability of this factor, and due to the dearth of studies in the SME field, organisational resource availability needs further examination, and the following hypothesises are proposed:

H6a: Organisational Resource Availability has a positive effect on pre-adoption of BI&A systems in SMEs.

H6b: Organisational Resource Availability has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.3 Environmental Characteristics

2.11.3.1 Competitive Pressure

Competitive Pressure refers to the degree to which SMEs consider themselves to be challenged by their business or other sectors' counterparts (Ghobakhloo & Ching 2019). Due to the rapid development of information technology, SMEs now have to deal with more competitive challenges. Many companies are now under pressure to reduce uncertainty in their environments and gain competitive advantage by acquiring innovative technologies such as BI&A systems (Boonsiritomachai et al. 2016). SMEs aim to reduce the possibility of facing stronger competition than they are in order to maintain sustainability in an uncertain marketplace and strengthen their competitive advantage in their sector (Stjepic et al., 2021). Many empirical studies have found competitive pressure to be a predictor of innovation adoption (Boonsiritomachai et al. 2016; Gu , Cao & Duan 2012; Hwang et al. 2004; Oliveira & Martins 2010; Simon & Suarez 2022). In contrast, other empirical studies have found no evidence that competitive pressure is a predictor of technological innovation adoption (Ghobakhloo & Ching 2019; Oliveira, Thomas & Espadanal 2014). Based on these, we therefore hypothesise that:

H7a: Competitive Pressure has a positive effect on pre-adoption of BI&A systems in SMEs.

H7b: Competitive Pressure has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.3.2 External Support

External support is the readiness of external support to adopt and use technology-based solutions (Premkumar & Roberts 1999). Outsourcing and third-party support have been shown to be significant factors affecting IT adoption, as companies are better prepared for the risks of adopting new technologies if appropriate vendor or third-party support is available (Puklavec, Oliveira & Popovič 2018). Since SMEs have a restricted number of internal IT experts, the more external support is required, the more SMEs are prompted to use and adopt BI&A systems (Lee & Larsen 2009). External support, as mentioned in the definition, affects not only the adoption but also the use of IT innovations. Therefore, external support is considered as an independent variable in this research model and the following hypotheses are proposed:

H8a: External Support has a positive effect on pre-adoption of BI&A systems in SMEs.

H8b: External Support has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.4 Owners'/mangers' Characteristics

2.11.4.1 Owners'/managers' IT Knowledge

The studies on the user knowledge of IT in relation to technology adoption found this factor to be significant (Deng & Chi 2014; Thong 1999). However, previous researchers have revealed key differences between BI&A systems and other ISs (Almusallam & Chandran 2020b; Grublješič & Jaklič 2015; Popovič et al. 2012; Puklavec, Oliveira & Popovič 2018), and therefore, the nuances of BI&A systems make the need to examine the determinants of BI&A systems separately from other ISs evident. Some studies (Jaklič, Grublješič & Popovič 2018; Luo 2016) reveal that most BI&A system users are educated and their education levels have been reported (diploma, bachelor's, master's or higher); however, few researchers have looked into the knowledge of IT that the users have (Ain et al. 2019; Salisu, Sappri & Omar 2021).. The knowledge of IT of SMEs' users is a crucial factor to be examined because, in SMEs, the enterprise owner is more likely to be the BI&A systems user, while in large companies, usually they have an IT department and IT specialists who deal with the BI&A systems.

Consequently, owners'/managers' IT Knowledge is used as an independent variable in this research model, and we hypothesise that:

H9a: Owners'/managers' IT Knowledge has a positive effect on pre-adoption of BI&A systems in SMEs.

H9b: Owners'/managers' IT Knowledge has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.4.2 Owners'/managers' Innovativeness

The desire to bring in innovative and creative processes for developing or improving products, services, and processes is known as personal innovativeness (Zhu, Kraemer & Xu 2003). Normally, the BI&A system users are decision makers, general managers, or at least higher administration personnel who hold academic qualifications or degrees (Luo 2016). For this reason, BI&A system users will have a dual identity in describing technology adoption as potential sponsor and actual adopter of BI&A systems. This innovativeness is indicative of managers/owners adopting ISs (Wang 2014). Additionally, researchers have outlined that personal innovativeness is associated with BI&A systems adoption behaviour (Tzou & Lu 2009). Simon and Suarez (2022) in their research implies that the owners/ managers decision to adopt BI&A is highly influenced by their readiness to assess the new technologies. Even though personal innovativeness is a very important factor for BI&A systems adoption, it has not been explored or researched sufficiently (Popovič, Puklavec & Oliveira 2019; Wang 2014).

Thus, given the significant effect of this factor and the limited number of studies in this field, personal innovativeness is considered in this study and the following hypotheses are proposed:

H10a: Owners'/managers' Innovativeness has a positive effect on pre-adoption of BI&A systems in SMEs.

H10b: Owners'/managers' Innovativeness has a positive effect on post-adoption of BI&A systems in SMEs.

2.11.5 Summary of proposed hypotheses

Characteristics	Factor	Adoption Stage	Hypotheses
Technological	Relative Advantage	Pre-adoption	**H1a:** Relative Advantage has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H1b:** Relative Advantage has a positive effect on post-adoption of BI&A systems in SMEs.
	Complexity	Pre-adoption	**H2a:** Complexity has a negative effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H2b.** Complexity has a negative effect on post-adoption of BI&A systems in SMEs.
	Observability	Pre-adoption	**H3a:** Observability has a positive effect on pre-adoption of BI&A systems in SMEs
		Post-adoption	**H3b**: Observability has a positive effect on post-adoption of BI&A systems in SMEs.
	Compatibility	Pre-adoption	**H4a:** Compatibility has a positive effect on pre-adoption of BI&A systems in SMEs
		Post-adoption	**H4b**: Compatibility has a positive effect on post-adoption of BI&A systems in SMEs

Organisational	Organisational size	Pre-adoption	**H5a:** Organisational Size has a positive effect in pre-adoption of BI&A SMEs.
		Post-adoption	**H5b:** Organisational Size has a positive effect on post-adoption of BI&A in SMEs.
	Organisational Resource Availability	Pre-adoption	**H6a:** Organisational Resource Availability has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H6b**: Organisational Resource Availability has a positive effect on post-adoption of BI&A systems in SMEs.
Environmental	Competitive Pressure	Pre-adoption	**H7a:** Competitive Pressure has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H7b**: Competitive Pressure has a positive effect on post-adoption of BI&A systems in SMEs.
	External support	Pre-adoption	**H8a:** External Support has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H8b**: External Support has a positive effect on post-adoption of BI&A systems in SMEs.
Owners-mangers	IT Knowledge	Pre-adoption	**H9a:** Owners'/managers' IT Knowledge has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H9b**: Owners'/managers' IT Knowledge has a positive effect on post-adoption of BI&A systems in SMEs.

	Innovativeness	Pre-adoption	**H10a:** Owners'/managers' Innovativeness has a positive effect on pre-adoption of BI&A systems in SMEs.
		Post-adoption	**H10b**: Owners'/managers' Innovativeness has a positive effect on post-adoption of BI&A systems in SMEs.

Table 2. 6 Summary of Proposed Hypotheses

2.12 Chapter Summary

This chapter has laid out a comprehensive review of SMEs, BI&A system, adoption theories, and technology adoption factors in order to design the conceptual research model and propose the research hypotheses. Earlier, an overview of SMEs, SMEs' definition, SMEs in SA, and SME characteristics were provided followed by an overview of BI&A system, BI&A definition, BI&A system characteristics, and Information System (IS), the benefit and challenges of BI&A systems, and BI&A in Saudi SMEs. Then, a brief description of pre-adoption and post-adoption stages of information systems was also presented. Afterwards, a Systematic Literature Review SLR for 78 studies from 2009 to 2022 was conducted with details given of the SLR methodology, strategy, inclusion/exclusion criteria, quality assessment, data extraction and synthesis process and finally the results, which provide the main theories and factors that have been addressed in the literature review. Then, a review of the adoption theories, including a review of the notable innovation adoption and then a discussion of the three important models chosen for this research were presented. Afterwards an overview of the technology adoption factors including technological, organisational environment, and owner/manager characteristics was presented. Finally, the comprehensive review, the conceptual research model, and the proposed research hypotheses have been set out. These hypotheses need to be tested in the Saudi context. In the following chapter, the research methods employed in probing the hypotheses derived from this chapter's conceptual model will be presented in detail.

3 Chapter Three: Research Methodology

3.1 Introduction:

In Chapter 2, a comprehensive literature review of BI&A system adoption and use in SMEs was presented. Then, the conceptual model and proposed hypotheses of the present thesis were provided. Therefore, the researcher now presents the research methodology employed in an attempt to empirically probe the hypotheses arising out of the conceptual model. The first section of this chapter describes the research paradigm, research method justification, and research design. Then, in the second section, is provided a description of research model development that includes the literature review and the Systematic Literature Review (SLR). Next, in the third section, details of the quantitative phase in order to test the proposed hypotheses are presented. The quantitative phase includes details of survey questionnaire method, survey content research questionnaire development, survey translation process, population and sample, data collection procedure, assessment of normality, reliability, and validity, quantitative data analysis approach, descriptive data analysis, and multi-linear regression analysis. Then, details of the qualitative phase are presented in section four. The qualitative study aims to explain and further contextualize the quantitative results. Therefore, details of the qualitative phase are presented, which include an overview of the interview method, interview guide development, interview population and sampling, interview data collection procedure, and qualitative data analysis procedure. Finally, the ethics consideration details for this research are provided.

3.2 Research Paradigm and research method justification

A paradigm is a method of looking at the world, a broad viewpoint, and a technique of breaking down real-world complexities (Patton 1990), or a foundational set of beliefs that influences behaviour (Creswell & Creswell 2018). Its goal is to explain how the world works, how information is extracted from it, what questions may be posed, and what approaches can be employed to answer them (Dills & Romiszowski 1997).

Ontology, epistemology, and methodology are the three underlying principles of a research paradigm (Guba & Lincoln 1994). Ontology is the belief that represents a researcher's understanding of what defines a fact, whether the phenomenon is objective and external to the researcher or subjective and cognitively generated by the researcher (Long et al. 2000). Epistemology relates to the nature of knowledge and ideas, techniques, and assumptions

regarding how to acquire it (King & Kimble 2004). It relates to issues of how we know and what we know in the real world (King & Kimble 2004). Finally, a collection of methods and techniques used to investigate a particular phenomenon in a specific situation is referred to as the Methodology (Dombeu & Huisman 2011).

It is vital to specify the investigation's conceptual paradigms that drive the study's methodological consideration to attain appealing results (Easterby-Smith, Thorpe & Jackson 2012). This study is part of social research because it investigates the pre- and post-adoption factors affecting owners'/managers' decision to adopt and use BI&A systems in Saudi SMEs. In social and business research, two main paradigms are widely accepted in the literature: positivism and interpretivism (Easterby-Smith, Thorpe & Jackson 2012; LEE 1991; Venkatesh, Brown & Sullivan 2016). The positivist paradigm aims to specify causes, factors, and results and to use existing theory to develop hypotheses that answer the research questions (LEE 1991). In contrast, the interpretivist paradigm assumes real life shaped by social and human experiences, which requires the investigation and examination of a complicated social reality via instances of testing hypotheses (LEE 1991). Therefore, the positivist paradigm focuses on generalizations while in interpretivist paradigm in details (Weber 2004).

IS researchers have used several different research methods broadly categorized into three research strategies: qualitative, quantitative, and mixed. Qualitative research aims to gather non-numerical data to understand the concepts, definitions, metaphors, characteristics, and meaning people ascribe to a social phenomenon (Creswell & Creswell 2018). Thus, qualitative research is commensurate with the interpretivist paradigm. In contrast, quantitative research examines the relationship between variables to test the objective theory. These variables can be measured by different instruments and statistically analysed (Creswell & Creswell 2018). Quantitative research tends more to follow the positivist paradigm. In mixed-method research, the researcher integrates both qualitative and quantitative methods. The importance and advantages of the mixed method in IS research have been broadly discussed (Leech & Onwuegbuzie 2009; Venkatesh, Brown & Sullivan 2016), especially in the social and behaviour field (Venkatesh, Brown & Bala 2013).Venkatesh, Brown and Bala (2013) have discussed three main values of conducting a mixed-method approach in IS research; it is the ability to address confirmatory and exploratory research questions simultaneously. Also, work on mixed approaches has the potential to provide more robust inferences than a single method because the mixed method will cover the disadvantages of each method. Eventually, using

mixed approaches offers an opportunity for a greater range of divergent or complementary views, which help the researcher to re-examine the concept or open new questions for future research (Venkatesh, Brown & Bala 2013).

Although many mixed-method designs exist, there are three primary designs in social research: the Convergent, Explanatory sequential, and Exploratory sequential mixed-method approaches (Creswell & Creswell 2018). In convergent mixed-method research, the researcher conducts the qualitative and quantitative research simultaneously. This design aims to explain future probes' contradictions or incongruent results (Creswell & Creswell 2018).

In the explanatory sequential mixed method, the researcher starts with quantitative research, analyses the results then conducts qualitative research. This design aims to explain the initial quantitative results using the subsequent qualitative results (Venkatesh, Brown & Bala 2013). Finally, in the exploratory sequential mixed method, the researcher conducts qualitative research, then analyses the results used for the quantitative research. This design usually uses a qualitative approach to propose the hypotheses or determine the factors that will be examined in the quantitative approach (Venkatesh, Brown & Bala 2013).

The positivist methodological approach was the one mainly applied in this study. This is because most crucial research to date has been conducted within the positivist paradigm. Also, this research model can be measured by quantitative research processes. However, the positivist research is backed up by a qualitative interview (interpretivism), which adds to the positivist study's depth and richness. Hence, this research applied a mixed method (Creswell & Creswell 2018). This is because the mixed method can address confirmatory and exploratory research questions at the same time. Also, work on mixed approaches has the potential to provide more robust inferences than a single method because the mixed method will cover a multitude of sins. Eventually, using mixed approaches offers an opportunity for a greater range of divergent or complementary views, which make it easier to re-examine the conceptual or open new questions for future research (Venkatesh, Brown & Bala 2013). Specifically, this study has applied an explanatory sequential mixed method (Creswell & Creswell 2018). This study concentrates on adopting and using BI&A systems in Saudi SMEs. When research centres on such a particular context, findings that were generalizable to this specific context would be essential, highly valuable, and meaningful. Therefore, it is clear that a quantitative deductive questionnaire was required to produce generalizable statements (Peng, Nunes &

Annansingh 2011). Interviews were then conducted to explain any unexpected findings from the quantitative stage.

3.3 Research Design

In every research project, the design is critical. This is due to the fact that it supports researchers in obtaining solutions to study questions while controlling logic via providing connections to the data utilised to answer the study questions (Cavana, Sekaran & Delahaye 2001).

The study design entails the researcher making a sequence of reasoned decisions. These pertain to the study's goal setting, tools of analysis, kind of sample, and data collection techniques to be employed, as well as how the variables will be measured and analysed (Cavana, Sekaran & Delahaye 2001).

Figure 3.1 Summary of the research design phases designed for this study:

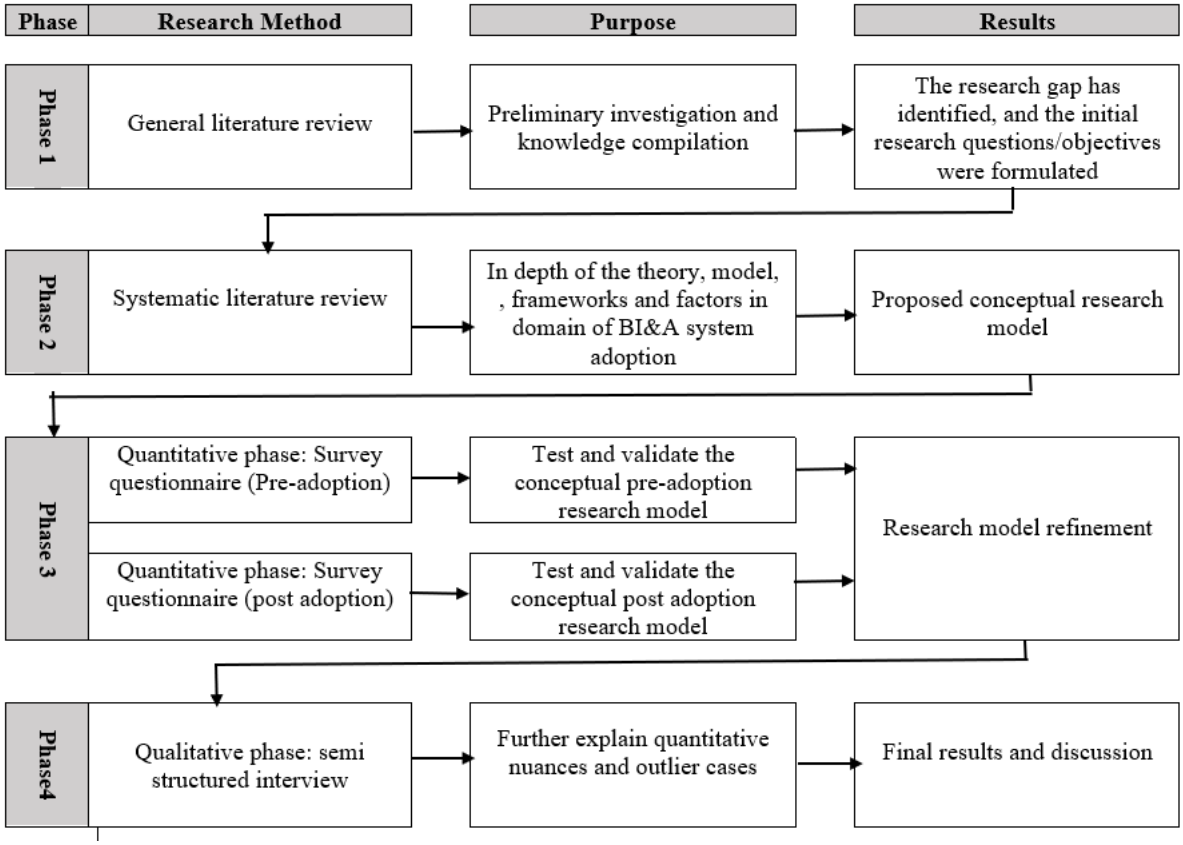

Figure 3. 1 Research Design

Phase one: General literature review

In this phase, the existing literature was collected to pull together foundational knowledge regarding BI&A adoption in organisations. As a result of this phase, the research gap was identified, and the initial research questions and objectives were formulated. A literature review

is a continuous process throughout a study, which means that literature was updated throughout the duration this study.

Phase two: Systematic literature review

In this phase, the research gap was further investigated through a systematic literature review, and the existing knowledge was captured of the present state of the domain of BI&A adoption. Existing theories, models, frameworks, and influences were discussed and categorized while adopting BI&A in organisations. As a result, the conceptual research model and hypothesis were proposed.

Phase three: Quantitative

In order to test and validate the proposed research model and hypotheses, a set of questionnaires was designed based on previous relevant studies and distributed to relevant SMEs in Saudi Arabia via email. As a result of this phase, the proposed conceptual model was refined.

Phase Four: Qualitative

In order to explain and further validate the refined conceptual model based on quantitative results, interviews were conducted with some of the survey participants. The interview transcripts were analysed to ensure the results from quantitative study. As a result, the qualitative results further explained the quantitative results' nuances and outlier cases.

3.4 Research Model Development

3.4.1 Literature reviews

The initial data and fundamental knowledge for this study came from secondary sources through a literature review of various studies on BI&A system adoption. This enabled the researchers to formulate the research problems, gaps, and understand current level of BI&A systems use and implementation. It indicated a scarcity of research on BI&A system adoption for SMEs and BI&A system adoption in Saudi SMEs specifically. As a result, the initial research questions and objectives were formulated. More details about this stage have been provided in Chapter 2

3.4.2 Systematic literature review

A total of 81 studies were selected and systematically reviewed. Due to the shortage of studies on BI&A adoption and use in SMEs, a comparison was made between large companies and SMEs to give a clear image of the current situation in both fields. Theory, models, frameworks, and factors have been discussed and categorized. This stage aims to comprehensively understand the theories, models, and frameworks that have been used in the context of the BI&A system. Also, this stage aims to identify potentially vital factors that affect the adoption

and utilisation of BI&A systems in Saudi SMEs. As a result of this stage, a proposed conceptual research model and hypotheses were generated.

The following research questions have been formulated in order to achieve the aims of the SLR:

- What are the theories of BI&A system adoption in large companies and SMEs that have been addressed in the literature?
- What are the factors of BI&A system adoption in large companies and SMEs that have been addressed in the literature?

The results of this SLR were integrated with the literature review in chapter 2.

3.4.2.1 SLR Research Methodology

This research involves SLR based on Kitchenham's proposed guidelines (Kitchenham 2004). These provide a structured way to examine the literature status. The steps followed during the review are described in the following sub-sections.

3.4.2.2 SLR Search Strategy

The search strategy in an SLR is important for keeping track of the search area by removing unrelated studies. Also, to ensure success, the search domain, search strings, and electronic and manual data sources used are determined. The search approach includes both manual and automatic research (Kitchenham 2004). Online databases were queried in the automatic search as follows: Scopus, IEEE Xplore, Taylor & Francis Online, ProQuest, Web of Science, ScienceDirect, and ACM Digital Library. Suggestions from Dieste empirically guided the effectiveness of the online database search rather than the given collection of journals and conferences (Dieste, Grimán & Juristo 2009). The databases chosen were considered very relevant, including the highest impact journals and conference papers in the BI&A system field. A manual search was conducted in addition to automatic research to ensure that no studies were missing. Therefore, all the references of the primary studies were reviewed while the criteria for exclusion were applied. To assess the relevant literature, the relevant search terms were applied to the chosen databases. The search terms include business intelligence SMEs, business intelligence and analytics, business intelligence systems, BI, BIS, SME, BI&A system, BI&A system acceptance in SMEs, BI&A system adoption, BI&A system use, BI&A user adoption, and combinations of these keywords by using AND/OR with dates ranging from 2009 to 2019 at the first stage; then, more studies were added to include the years 2020, 2021 and 2022. Once the search process was completed, the study identified 379 articles potentially relevant to the BI&A system adoption domain.

3.4.2.3 SLR inclusion/exclusion criteria

Inclusion and exclusion criteria were applied to make sure that only pertinent papers were used in this SLR. The inclusion criteria applied to articles and conference papers published between 2009 and 2022, as well as studies directly related to BI&A system adoption and use. Moreover, the inclusion criteria applied to those papers that were available on the selected databases in the English language only.

The exclusion criteria applied to duplicated papers, papers published in non-English languages, and papers published before 2009. Prior to 2009, BI&A system adoption studies were in big companies only, while SMEs studies started afterwards. The exclusion criteria also applied to papers with highly technical perspectives or unrelated to the research question. Based on these criteria, a total of 87 studies were selected. Table 3.1 represents the number of papers before and after the exclusion criteria for each database.

3.4.2.4 Quality assessment (QA)

The 87 selected studies were assessed according to quality assessment (QA) criteria (Kitchenham 2004). The aim of QA is to judge the overall quality of the papers chosen. To ensure the strength of the inferences from them, the following evaluation questions were developed:

- Do the research topics covered relate directly to BI&A system adoption and use?
- Is the context of the research clear?

Based on the QA criteria, six studies were excluded due to their low quality. Of the 81 studies selected for this study, 29 focused on SMEs and 52 on large companies. Table 3.1 presents the number of papers before and after QA criteria on each database.

Database	Before Exclusion	After Exclusion	After QA
Scopus	169	53	51
proQuest	33	7	6
IEEE	78	4	4
ACM digital library	34	5	4
ScienceDirect	33	8	7
Web of Science	23	3	2
Taylor & Francis Online	9	7	7
Total	379	87	81

Table 3. 1 Number of Articles after Exclusion and QA

3.4.2.5 Data extraction and synthesis process

The next step after selection of the 81 studies was to extract and synthesise data from each paper. This preview process was conducted in different ways depending on study aims and needs (Ain et al. 2019; Llave 2019). For this study, the process was carried out with a careful reading of each of the 81 articles. The articles were managed and carefully reviewed using Microsoft Excel and Endnote, according to a number of elements for the purposes of this study. These elements include study type (large company/SME), year of study publication, study research method, study theory or framework used, study key determinants factors, and study country.

3.5 Quantitative Study

3.5.1 Survey Questionnaire Method

The survey questionnaire method was adopted in this study so as to test hypotheses and attempt to validate the research model. When studying a sample of a broader population, the survey questionnaire technique is most useful, which makes this technique compatible with this study's characteristics, as this study assesses the critical factors that influence the pre-adopters and post-adopters' decision to adopt and use BI&A systems in Saudi's SMEs. As the research focused on such a particular context, findings that were generalizable to this specific context would be essential and highly valuable, and hence meaningful. Babbie (2016) states that "surveys are particularly useful in describing the characteristics of a large population because they make large samples feasible"(p. 234). Researchers can gather quantitative data using the survey method, that is used to assess the hypotheses and explain the connection between independent and dependent components statistically (Cavana, Sekaran & Delahaye 2001).

There are two types of survey research, cross-sectional surveys, and longitudinal surveys. In the cross-sectional survey, researchers investigate the phenomenon at a specific time of data collection (Saunders, Lewis & Thornhill 2019), while the researchers in longitudinal surveys examine particular phenomena over time (Saunders, Lewis & Thornhill 2019). In this study, cross-sectional surveys are considered appropriate. This is because the longitudinal required time exceeds the Ph.D. timeframe, making the cross-sectional surveys more suitable so as to take up the least time in the research project.

3.5.2 Survey Content

The questionnaire was designed for pre-adopter and post-adopter groups. Both groups have the same questions until question nine. When participants answer question nine, they will be categorised as pre-adopters or post-adopters depending on their answers (See Appendices A and B). Then, each group will have their own specific questions. To be sure that each group received their own questions, the researcher used the display logic and skip logic techniques available in Qualtrics software. The questionnaire was designed in two major parts:

- Part one is designed to gather the participants' demographic information and BI&A system adoption status.
- Part two explores the participants' opinions and factors affecting their adoption level and use of BI&A systems in Saudi SMEs.

3.5.3 Research Questionnaire Development

A questionnaire is a set of pre-written questions meant to extract knowledge and information related to the study topic and to which participants record their replies by following the prescribed processes (Sekaran & Bougie 2013). According to Boudreau and Gefen (2004), researchers should employ verified survey tools whenever. The goal of using a pre-validated parameter from prior research is to guarantee that the measuring items are content-valid (Boudreau, Gefen & Straub 2001). The initial draft of questionnaire was developed depending on the proposed conceptual research model developed from the existing literature review. According to scholars, researchers should employ verified survey tools whenever appropriate (Boudreau, Gefen & Straub 2001; Straub, Boudreau & Gefen 2004). The goal of using a pre-validated parameter from prior research is to guarantee that the measuring items are content-valid (Boudreau, Gefen & Straub 2001). Moreover, using the research measurements will make it easier to connect with these measurements and cover the study gap mentioned in the theoretical framework. As a result, hitherto verified survey items were modified and employed

in the present research. A preliminary study with 319 Saudi SMEs from different sectors was conducted to gather a general idea about the BI&A adoption situation in Saudi SMEs (Almusallam, Pradhan & Mastio 2021). In addition, a pilot study was conducted with the three SME owners/managers, two BI&A system experts, and one doctoral candidate to provide feedback on several aspects of the survey instruments and their applicability. Each respondent carefully read the questionnaire questions and added comments where they believed it was appropriate. Some questions were changed based on the data gathered and input received during this phase. They also suggested replacing some highly technical terms that could be hard to understand for SMEs' owners/managers with more common terms. For example, the term BI&A system was replaced with data analysis to make a business decision. Also, a comprehensive literature review was re-employed to redesign the ultimate questionnaires for the present work. For each question in the survey, a Likert scale with values ranging from 1 to 5 (1 = Strongly Disagree to 5 = Strongly Agree) was used to measure all factors. The Likert scale is one of the most often utilised survey response scaling approaches. At the end of the questionnaire, there were open-ended questions to ask participants to express their opinions about the barriers to adopting and using BI&A systems in SA, allowing participants to voice any essential factors not covered by the closed questions. Also, the participants were asked to provide their email addresses if they would like to contribute to a future interview: please refer to Appendices A and B.

3.5.4 Survey Translation

Firstly, the questionnaire was written in English. However, because Arabic was the first language of the potential responders, it was crucial to translate it into Arabic. This was done to raise response rates and avoid poor responses due to linguistic barriers. Cross-cultural translation was adopted in this study (Sperber, Devellis & Boehlecke 1994) in order to maintain excellent translation quality and ensure functional equivalence between English and Arabic. The goal of the translation step is for developing Arabic questionnaires that are lingually equivalent to their English counterparts. As a result, functional equivalency was applied rather than giving a literal word-for-word rendering of the English elements. The goal of the equivalency was to develop Arabic questionnaires that had the exact meaning in the English version questionnaire. Functional equivalence ensured that the translated measurements had the same basic meaning as the English ones and that no misleading or unclear phrases were used. Therefore, the main English questionnaire was sent to an English-Arabic certified professional translator. The need to keep the meaning of the translated questionnaire had been

advised to the professional translator. Then, to refine the English/Arabic version, a copy of the English/Arabic questionnaires was sent to three Arabic specialists who use English in their communication and daily work. Based on their comments, the final questionnaires were evaluated and revised for clarity by the researcher.

3.5.5 Population and Sample

In survey-based research, selecting the survey population and sample is crucial (Lavrakas 2008). The population under study should be represented in the survey sample (Saunders, Lewis & Thornhill 2019). The two most common sampling methods are non-probability sampling and probability sampling (Lohr 2010).

Non-probability sampling assumes that the study sample is selected on the basis of the researcher's subjective judgment (Fowler 2014). The likelihood of selecting each respondent from the target population is uncertain (Sekaran & Bougie 2016). When there are cost and time restrictions, this method is more likely to be used, and it is also commonly used in studies with a limited number of respondents (Sekaran & Bougie 2016). The non-probability sampling method is inappropriate for this study since it produces research findings that cannot confidently be generalised to the entire population (Lohr 2010).

On the other hand, probability sampling is based on the assumption that the probability of selecting each response from the population of interest is known (Lohr 2010; Sekaran & Bougie 2016). Every person in the target population is equally likely to be randomly chosen for the research (Fowler 2014). The researcher can collect data from a sample representing the total population under examination using probability sampling (Fowler 2014; Lavrakas 2008). As a consequence, the findings of the study may be confidently applied to the whole population (Lohr 2010). Because of this benefit, the probability sampling approach has been frequently used in BI&A system adoption studies (Boonsiritomachai et al. 2016; Daradkeh & Al-Dwairi 2017; Hou 2016; Jayakrishnana et al. 2018). As a result, the probability sampling method was chosen for this study.

Most BI&A systems users are owners or managers in high-level positions in SMEs (Boonsiritomachai , McGrath & Burgess 2014; Luo 2016). Hence, the owners/managers in SMEs are more likely to have a dual identity in describing technology adoption: the potential sponsor and the actual adopter of BI&A systems (Luo 2016). Hence, the owners/managers of

SMEs have been considered target participants for this study. Also, this study was limited to SA SMEs registered in the Chambers of Commerce database. Moreover, the current study examines the pre- and post-adoption factors that influence the owners'/managers' decision to adopt and extensively use BI&A systems in SMEs. Therefore, the adopters and pre-adopters of BI&A systems were the target participants for this study.

Choosing an appropriate sample size is crucial for generalising findings to the entire population with the requisite precision and confidence (Fowler 2014; Teddlie & Yu 2007). Some studies have found that a sample of 100 is regarded as small, one of 100 to 200 is considered medium, and a sample size of more than 200 is viewed as large (Hair et al. 2013; Kline 1998). When calculating sample size, Roscoe (1975) suggested some general guidelines. One of the requirements is that most studies should have a sample size of greater than 30 but fewer than 500 individuals. According to Roscoe (1975), the sample size in multivariate research, such as multiple regression analysis, should be at least ten times or more that of the number of variables in the study. In the present research model, there are 11 independent and dependent variables for multiple regression analyses, making the smallest acceptable sample size for this study 110 participants. Moreover, According to Hair et al. (2018), ratios of 15:1 or 20:1 are preferred, however a minimum response-to-variable ratio of 5:1 is acceptable. Thus, while each independent variable in the model needs to be taken into account for a minimum of five respondents, 15 to 20 observations highly advised for each independent variable. In this study, there were 375 participants in the pre-adoption group and 194 participants in the post-adoption group, which is much greater than the minimum sample size that is recommended by researchers. As a result, the sample size in this study is suitable for multiple regression analysis in both groups.

3.5.6 Data Collection Procedure

The data collection was conducted between June 2021 and August 2021. The survey was electronically developed using the UTS Qualtrics system and distributed to relevant SMEs via emails. The list of SMEs was obtained from Chambers of Commerce of SA. To increase the response rate, each participant required no more than 10 minutes to complete the survey. Also, emails were sent, and the researcher randomly contacted some enterprises via phone around four weeks after the first contact. An invitation letter was also sent to introduce the researcher and the point and importance of the study, as well as to explain the study's ethical requirements under the UTS Ethics Committee guidelines.

The raw number of respondents reached a total of 521 participants for the pre-adoption group and 240 participants for the post-adoption group, thus bringing the total sample size to 761. To ensure the quality of the responses, the researcher looked into incomplete responses, the duration of the time spent on the survey, and the annual revenue of the enterprises. If the annual revenue exceeds 200 million SAR, this enterprise was excluded from the list, as mentioned in Chapter 2 section 2.2.1 (SME definition). After this cleaning process, the responses decreased to 569 participants: 375 for the pre-adoption group and 194 for the post-adoption group.

3.5.7 Procedures of Quantitative Data Analysis

Data acquired from survey questioner were processed statistically to analyse them. Sekaran & Bougie (2010) state that data analysis enables researchers to meet numerous major purposes, including assessing the data's quality by measuring reliability, validity and validating the hypotheses created for specific research (Sekaran & Bougie 2010). The quantitative analysis of this current study was carried out using Statistical Package for the Social Sciences SPSS and the analysis went through different steps:

3.5.7.1 Data Screening

During the first review, it was found that some survey replies were incomplete as they left most of the questions without answers. So, they are removed. After this stage, the number of responses decreased from 761 to 602. Then, the researcher looked at the duration of the time spent on the survey to exclude any quick responses with random selection. Also, the researcher excluded companies with more than 250 employees or/and yearly revenue over 200 million SR. As a result, 569 responses for both pre- and post-adoption groups were considered valid responses for analysis in this study. These processes were done using Excel before uploading the data to the SPSS software.

3.5.7.2 Assessment of Normality, Reliability, and Validity:

A systematic test is conducted to test the questionnaire's normality, reliability, and validity.
The normality test was performed on the data to guarantee that the data were usable and represented the target population (Hair 2006). In this study, the Kurtosis and Skewness measurement have been used to test the normality of the data. Outlying data may throw off the overall results (Hair 2006).

Reliability serves to make sure that collected data is accurate which means that recorded parameters represent an accurate measurement of the elements under study (Hinkin 1998).

Cronbach's alpha was used, which is commonly used to determine the internal consistency of variables (Hinkin 1998). It shows the level of consistency of responses are across items on the Likert scale (Sekaran & Bougie 2016).

Content validity and construct validity tests were conducted for this study. Content validity has been used to determine whether the chosen instrument and constructs are adequately determined or whether variables accurately measure the content they were designed to assess (Creswell & Creswell 2018). Construct validity was tested by Confirmatory Factor Analysis (CFA). This factor analysis was chosen for its widespread well-known method for examining the extent to which a hypothesized factor structure corresponds to the actual data (Hair 2006). CFA is used to analyse construct validity, consisting of both convergent and discriminant validity, it makes sure the measure resembles the other measures while also being unique. Further detail and results on the data's normality, reliability, and validity are to be found in Chapter 4.

3.5.7.3 Descriptive Data Analysis:

A descriptive data analysis was applied using SPSS software to find out frequency distribution features of demographics like age, gender, education level, work experience, enterprise size, positions, and adoption status (pre- or post-adoption). The descriptive data analysis gives graphical representations of the data through charts and graphs. More details and outcomes of the descriptive data analysis are in Chapter 4.

3.5.7.4 Multi Linear Regression Analysis:

To answer the research questions and explore the proposed hypotheses, multi-linear regression (MLR) analysis was used. MLR is a statistical technique used to examine the relationship between two or more independent variables and one dependent variable (Gelman & Hill 2006). It attempts to represent the linear connection between explanatory (independent) and response (dependent) variables. In this study the MLR used to validate research hypotheses because it provides a systematic and rigorous approach to examining relationships between variables, controlling for confounding factors, and assessing the strength and significance of these relationships by providing empirical evidence to support or refute hypotheses. It helped the researcher draw reliable conclusions from empirical data and contributed to the accumulation of knowledge in this study. In particular, MLR analysis in this study examined whether relative advantage, observability, compatibility, complexity, enterprise size, resource availability, competitive pressure, external support, IT knowledge, and innovativeness were significant predictors of the dependent variable. Two separate regression analyses were conducted to

examine the research hypotheses, – one for the pre-adoption group and another for the post-adoption group.

3.6 Qualitative Study

3.6.1 Interviews

A particularly crucial method for gathering data in qualitative research is the case study technique (Yin 2014). This study approach uses different data gathering methods, including interviews, questionnaires, documentation, and observations (Yin 2014). The case study, which usually uses the interview as the primary technique for gathering the data, allows the researcher to capture the diversity of the data about SME owner/manager opinions and cases regarding BI&A system adoption and use in Saudi SMEs. Furthermore, in this study, semi-structured interviews were used to increase interview flexibility and give the chance to personalize the interview to the individual participant (Ashakkori & Teddlie 1998). In explanatory studies, semi-structured interviews are most commonly utilised since they are adequate for understanding the correlations between variables (Yin 2014). In general, there are three interview approaches: exploratory, explanatory, and descriptive (Yin 2014):

- Exploratory interviews are often used to answer "what" questions with the goal of generating relevant hypotheses and proposals for future investigation. This helps to formulate questions and hypotheses for the study.
- Explanatory interviews are often employed to figure out "how" and "why" something happened. The goal is to see if any causal relationships can be discerned between sources and factors.
- Descriptive interviews comprehensively depict the events surrounding the phenomena under investigation. They are utilised to answer "how many" or "how much" queries.

The qualitative study aims to explain and further contextualize the quantitative results in this study. Therefore, the explanatory semi-structured interviews were used in the current study to meet the qualitative study's aim.

3.6.2 Interview Guide Development

The interview aims to explain and further contextualize the quantitative results. Therefore, the quantitative results were based on developing the interview guide. Also, a comprehensive literature review helped in the development of this guide (please refer to Appendices C and D).The questions in the guide were follow with why? And how? questions, especially for the factors that were statistically significant or not significant. Three academic specialists reviewed the interview guide. Before the actual interview, some edits were made based on the specialists'

recommendations to improve clarity. The interview guide was written in English and then translated to Arabic. The researcher followed the same translation process used in the survey (please refer to section 3.5.4).

Moreover, to maintain the conversation's flow and consistency during an interview, Yin's (2014) recommendation on writing the interview questions was followed in this research. In addition to the interview guide, more questions were added when appropriate, based on participants' responses.

3.6.3 Interview Population and Sampling

Nineteen interviews were conducted with owners/managers of SMEs located in SA. Seven were from the pre-adoption group and twelve participants were from the post-adoption group. The sample was collected from the survey questionnaires. At the end of the survey questionnaires, a question asked if the participant would like to participate in a future interview. If yes, the participant provided his/her email. There exists no ideal number of participants for qualitative research, according to researchers, as long as each person contributes to the study (Yin 2014). Therefore, nineteen participants were considered adequate for this study. The participants were from both pre- and post-adoption groups. However, this study focused on the post-adoption group interviewees as they have experiences in using BI&A systems and have a broad image of which factors have affected their adoption and use of the BI&A system, as they went through both stages – pre- and post-adoption. In the pre-adoption group, the participants were chosen depending on their adoption intention. Some are planning to adopt the BI&A system soon, and others have no intention to adopt the BI&A system in their enterprise. In the post-adoption group, the participants were chosen depending on their experience and usage of the BI&A system at their enterprises (more details the system usage are in Chapter 4, section 4.3.10). Two levels were identified:

- The initial adopters are the owners/managers with less than five years of relevant experience with using their BI&A system, and they use the system in very simple way.
- The advanced adopters are the owners/managers with more than five years such experience with their BI&A system, and they use the BI&A system in an advanced way. (Please refer to question 11 in Appendix B.)

In general, this study concentrates on the initial adoption stage because most of the survey participants were initial adopters, 92.2%. However, the advanced adopter interviewees have given value to this research because they shared their long and valuable experiences.

3.6.4 Interview Data Collection Procedure

All interviews were conducted online between November 2021 and December 2021 using Zoom meeting software. The interviewees were SMEs owners/managers who opted-in via an online survey. Although the interviewees provided their consent for the interview participation through the survey, another consent form was sent to them along with the participant information sheet to ensure a deeper understanding of this research. The researcher conducted all the interviews so as to clarify any unclear questions for the interviewees. The interviews were recorded after the participants' agreement and permission had been obtained. In addition, each participant received a copy of the questionnaire to use in the interview. The interviews, in general, were not longer than 60 minutes. Each participant was given a chance to evaluate the data gathered. Also, each participant will have access to the results if they ask. The researcher documented the interview notes to avoid losing summary points immediately. The researcher transcribed the recorded interviews and thoroughly checked them for errors.

Before conducting interviews, research ethics were considered, especially the participant's confidentiality, and clearly described to the participants. Also, the ethics form was submitted to the University of Technology Sydney's Human Research Ethics Committee and accepted by this committee.

3.6.5 Qualitative Data Analysis

In qualitative research, there are several ways and strategies for data analysis. Discourse analysis, grounded theory, theme analysis, content analysis, and narrative analysis are among the most popular data analysis methodologies for qualitative data (Creswell 2003). However, the study objectives must guide the selection of an appropriate analytical tool. For the analysis of qualitative data acquired via semi-structured interviews, thematic analysis was chosen. Theme analysis can reflect on participants' perspectives, experiences, and understanding of issues while evaluating how events, realities, experiences, and meaning have developed (Braun & Clarke 2006).

For qualitative thematic analysis, the following (Creswell 2003) generic procedures were used:

- Transcribing the interviews.
- Familiarizing yourself with your data by reading and re-reading the data.
- Getting a general sense of the information and identifying the main points.
- Coding data into categories.
- Clustering similar topics.

- Identifying themes.

Since the interview in this research aims to explain and further validate the quantitative results, the themes were already defined during the quantitative phase. Therefore, the following steps were used:

- The interviews were transcribed.
- The audio files were re-played for confirmation, with the interviews transcribed.
- The researcher read and re-read the data to be familiar with the data and note down the main ideas.
- The data were coded.
- The quantitatively identified themes were entered into NVivo software.
- The codes were then clustered into the identified themes.

Also, some new themes and subthemes were identified by following Creswell's (2003) procedures mentioned above.

3.7 Ethics Considerations

The participants in this study are humans. As a result, following proper research ethics was critical. The UTS Human Research Ethics Committee guidelines were compiled to assure the participants' confidentiality, ethical protection, and the integrity of the research technique. The Human Research Ethics Committee granted ethical approval before the data collection process began. The ethics approval number for this research is ETH20-4996.

3.8 Research method limitations

In terms of the limitations, this research used cross-sectional data, so it may not reflect long term BI&A usage behaviour of SMEs. Moreover, although the multiple linear regression analysis is suitable data analysis technique for this study, as in this research model all independent variables have one direct relationship to the dependent variable, more advanced analysis technique could be used such as Structural Equation Modelling (SEM). The SEM offers the capability to explore latent variables, measurement error. Also, the sample size for this study is 375 participants in the pre-adoption group, and 194 participants in the post-adoption group. Future study could consider increasing the sample size of post-adoption group, because each sampling distribution's variability diminishes with increasing sample sizes, making them more leptokurtic.

3.9 Chapter Summary

The foregoing chapter has presented the study's research methodology. It has included the introduction and described the research paradigm, research method justification, and research design. Using both qualitative and quantitative data, a mixed-method research methodology was utilised for this study, which was explored in depth. In the first phase, the quantitative data was used to test the proposed hypotheses, which had been constructed based on study of the literature. This was then followed by the second step, which utilised a qualitative technique to explain and further contextualize the quantitative results. The results of the quantitative phase will be presented in the next chapter, while the results of the qualitative phase will be presented in Chapter 5.

4 Chapter four: Quantitative Data Results

4.1 Introduction:

The objective of the present chapter is to lay out the quantitative data results including the participants' descriptive statistic details followed by verifying the data from the questionnaire and then the outcomes of the research hypotheses, which were tested by using multiple linear regression analysis. The first section presents the participants' descriptive statistic details including the adoption status, participant's gender, age, education level, and position, as well as enterprise size, post-adopters' BI&A system experience, and post-adopters' BI&A system tools. In the second section, details of the verification of the data of the questionnaire are presented which include normality test, reliability test, content validity test, and construct validity. Finally, the chapter covers the multiple linear regression analysis that was conducted, including the test of the technology characteristics hypotheses, organisational characteristics hypotheses, environmental characteristics hypotheses, owner/manager characteristics hypotheses, and finally the model hypotheses test result summary.

4.2 Questionnaire

The data collection was conducted between June 2021 and August 2021. The questionnaire was sent to the owners/managers of Saudi SMEs. More details about questionnaire development, data collection procedure, and population and samples were mentioned under methodology in Chapter 3. The participants in this research varied in gender, age, education level, enterprise size, and adoption status (pre-adopters and post-adopters).

To ensure the survey questions' reliability and validity, this study employed previously verified measurements as described in Chapter 3. The questionnaire was published via Qualtrics

Surveys online, a Likert scale with scores ranging from 1 to 5 (1 = Strongly Disagree to 5 = Strongly Agree) was employed. The SME list was obtained from the Chambers of Commerce of SA. Due to the inadequate response to the questionnaires, reminder emails were sent, and the researcher randomly contacted some enterprises via phone.

The raw number of respondents reached a total of 521 participants for the pre-adoption group and 240 participants for the post-adoption group, thus bringing the total sample size to 761. To ensure the quality of the responses, the researchers looked into incomplete responses and the duration of the time spent on the survey. After this cleaning process, the number of responses decreased to 569 participants, 375 for the pre-adoption group and 194 for the post-adoption group.

The participants' descriptive statistical details are presented in the following sections.

4.3 Descriptive Statistical Details

4.3.1 Adoption Status

The questions 7, 8 and 9 (please refer to an Appendix A and B) were used to determine the participants' adoption statutes. If the participant has an IT system and uses it to capture and analyse the data to make a business decision, then the participant is considered a post-adopter; if they do not analyse the data to make the business decision, they are pre-adopters. Of 569 participants, 375 were categorized as pre-adopters and 194 as post-adopters.

4.3.2 Participant's Gender

As shown in Table 4.1 and Figure 4.1, the highest number of participants for the pre-adopters' group were males with 302 (80.5%), while the females numbered 73 (19.5%). A similar result was found for the post-adopters' group in Table 4.2 and Figure 4.2; the males were the most numerous participants with 146 (75.3%) while females counted 48 (24.7%).

Gender	Frequency	Percentage
Male	302	%80.5
Female	73	%19.5
Total	375	%100

Table 4. 1 Pre-adopter Participants' Gender

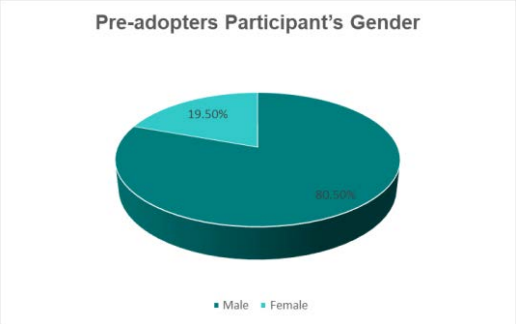

Figure 4. 1 Pre-adopter Participants' Gender

Gender	Frequency	Percentage
Male	146	%75.3
Female	48	%24.7
Total	194	%100

Table 4. 2 Post-adopter Participants' Gender

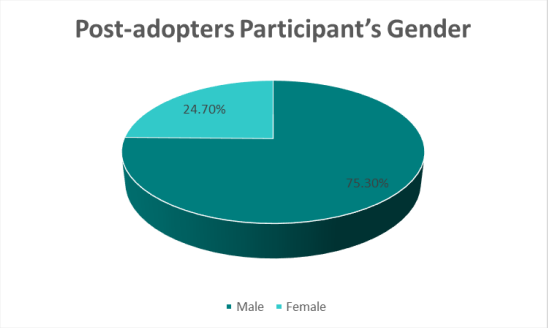

Figure 4. 2 Post-adopter Participants' Gender

4.3.3 Participants' Age

Table 4.3 and Figure 4.3 show that in the pre-adopters' group, the highest number of participants were aged 36-45 with 34.7 %, followed by the participants aged 26-35 with 26.9% and the participants in aged 46-60 with 23.7%. 12% of participants were aged 18-25, and only 10% of the participants were more than 60 years old.

In the post-adopters' group, as shown in Table 4.4 and Figure 4.4, the highest number of participants were aged 36-45 with 39.2 %, followed by the participants aged 26-35 with 28.4%, and the participants aged 46-60 with 22.2%. The participants aged 18-25 and the participants older than 60 years old showed in the same percentage at 10%.

Age Group	Frequency	Percentage
18 – 25	45	12%
26 – 35	101	26.90%
36 – 45	130	34.70%
46 – 60	89	23.70%
> 60	10	2.70%
Total	375	100%

Table 4. 3 Pre-adopter Participants' Age Group

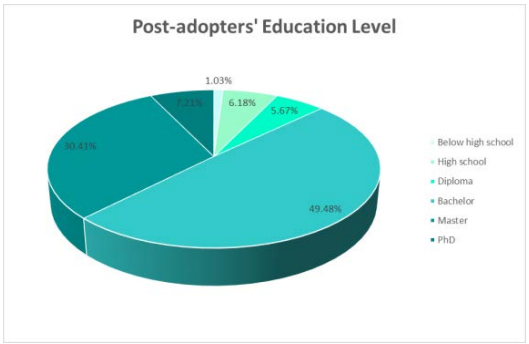

Figure 4. 3 Pre-adopter Participants' Age Group

Age Group	Frequency	Percentage
18 – 25	10	5.20%
26 – 35	55	28.40%
36 – 45	76	39.20%
46 – 60	43	22.20%
> 60	10	5.20%
Total	194	100%

Table 4. 4 Post-Adopter Participants' Age

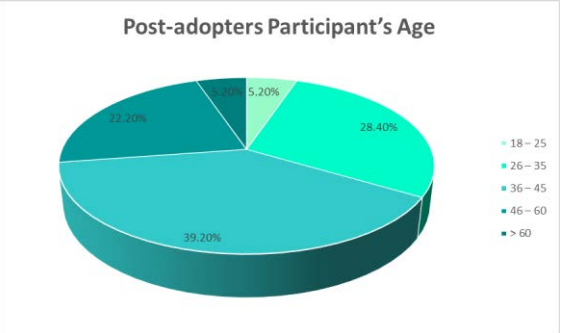

Figure 4. 4 Post-Adopter Participants' Age

4.3.4 Participants' Education Level

Table 4.5 and Figure 4.5 illustrate that in the pre-adoption group, most participants were bachelor's degree holders at 57.06%, followed by high school with 18.67%; 15.73% of participants have a master's degree, while 1.3% of participants did not finish their high school and only 1.06% of participants are Ph.D. holders.

In the post-adoption group, as shown in Table 4.6 and Figure 4.6, the majority of participants were bachelor's holders at 49.48%, followed by the participants with master's degrees accounting for 30.41%; 7.21% of participants were Ph.D. holders, and a low number of participants who were diploma holders and below high school certificate level with 5.67% and 1.03% respectively.

On the basis of a comparison between the pre-adopter and post-adopter participants in this study, the post-adopters turned out to be more educated as they have a higher percentage of master's and Ph.D. holders among them, see Figure 4.7.

Educational Level	Frequency	Percentage
Below high school	5	1.3%
High school	70	18.67%
Diploma	23	6.13%
Bachelor	214	57.06%
Master	59	15.73%
PhD	4	1.06%
Total	375	100%

Table 4. 5 Pre-adopters' Education Level

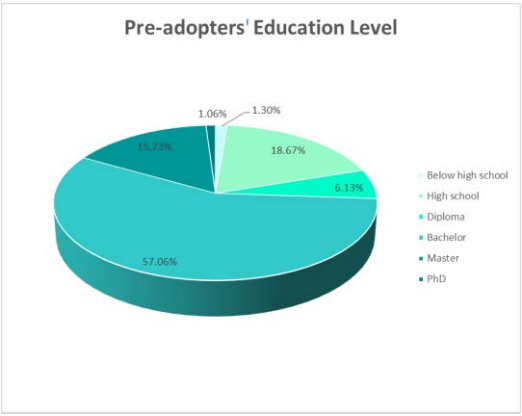

Figure 4. 5 Pre-adopters' Education Level

Educational Level	Frequency	Percentage
Below high school	2	1.03%
High school	12	6.18%
Diploma	11	5.67%
Bachelor	96	49.48%
Master	59	30.41%
PhD	14	7.21%
Total	194	100%

Table 4. 6 Post-adopters' Education Level

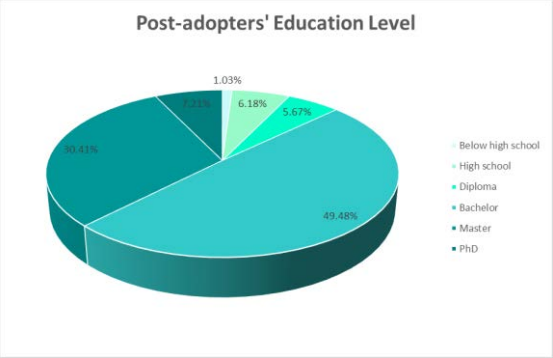

Figure 4. 6 Post-adopters' Education Level

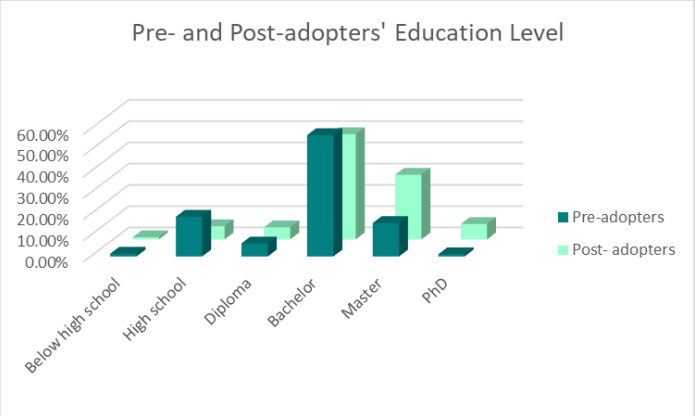

Figure 4. 7 Pre- and Post-adopters' Education Level

4.3.5 Participants' Position

Each enterprise had only one person complete the survey. For most businesses, the survey was completed by the owner or manager; however, in some cases, the survey was completed by a representative from another department.

Table 4.7 and Figure 4.8 show that in the pre-adoption group, most of the participants, 77.86%, were owners and managers at the same time; 17.86% were owners, and only 3.4% were managers. In the post-adoption group, as shown in Figure 4.9 and Table 4.8, most of the participants were owners/managers, 43.8%, followed by the owners only with 36.1%. 16.5% were managers, and 3.6% were in other positions.

Position	Frequency	Percentage
Owner/Manager	292	77.86%
Owner	67	17.86%
Manager	13	3.4%
Other	3	0.8%

Table 4. 7 Pre-Adopters' Position

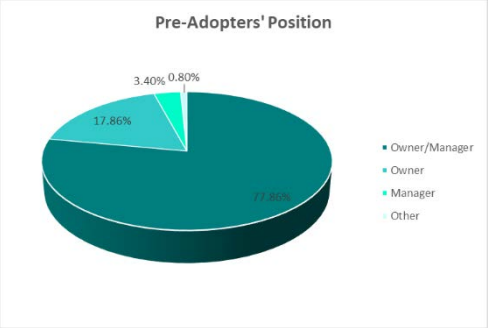

Figure 4. 8 Pre-Adopters' Position

Position	Frequency	Percentage
Owner/Manager	85	43.8%
Owner	70	36.1%
Manager	32	16.5%
Other	7	3.6%

Table 4. 8 Post-Adopters' Position

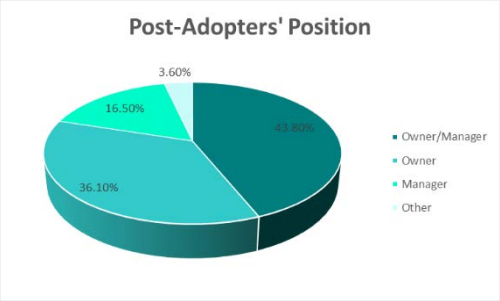

Figure 4. 9 Post-Adopters' Position

4.3.6 Enterprise Size

The sample is quite diverse as related to the enterprise size. As illustrated in Table 4.9 and Figure 4.10, in the pre-adoption group, the most numerous enterprise size is the enterprises that have 1 to 5 employees 37.3%, followed by the enterprises that have 6 to 49 employees at 25.6%; 14.9% of participants' enterprises were in in the range 101-200 employees; 14.1% of participants' enterprises were 51-100 employees. Finally, only 8.0% of enterprises were between 200 and 250 employees.

Enterprise Size	Frequency	Percentage
1_5	140	37.3%
6 – 49	96	25.6%
51 -100	53	14.1%
101-200	56	14.9%
200 -250	30	8.0%
Total	375	100%

Table 4. 9 Pre-Adopters' Enterprise Size

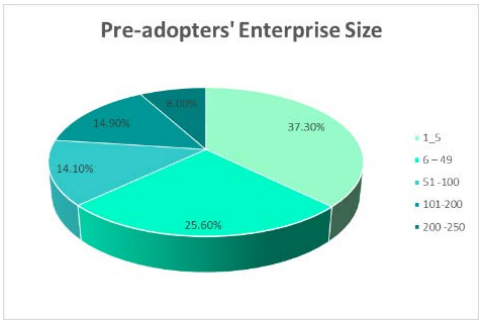

Figure 4. 10 Pre-Adopters' Enterprise Size

In the post-adoption group, as shown in Table 4.10 and Figure 4.11, the highest enterprise size is the enterprises with 51-100 employees, at 35.1%, followed by the enterprises with 6–49

employees, 20.6%. 19.6% and 18.6% of participants' enterprises were in the ranges 200-250 and 101-200 employees, respectively. Finally, only 6.2% of enterprises were 1-5 employees. When comparing between pre' and post-adopter enterprise sizes, as shown in Figure 4.12, the post-adopter participants' enterprises sizes were much higher than those in the pre-adoption group.

Table 4. 10 Post-Adopters' Enterprise Size

Enterprise Size	Frequency	Percentage
1_5	12	6.2%
6 – 49	40	20.6%
51 -100	68	35.1%
101-200	36	18.6%
200 -250	38	19.6%
Total	194	100 %

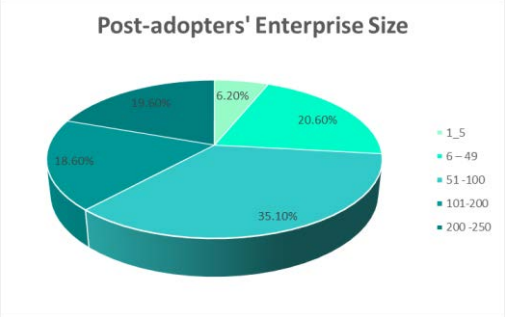

Figure 4. 11 Post-Adopters' Enterprise Size

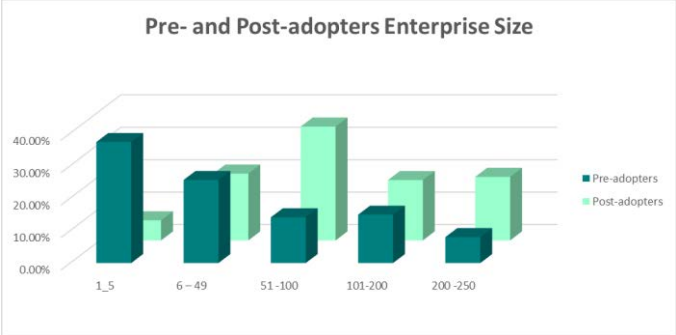

Figure 4. 12 Pre- and Post-Adopters' Enterprise Size

4.3.7 Pre-adopters' intention to use BI&A system.

A great many pre-adopters, 43.70%, have no intention to use any analysis tool. 19.20% of pre-adopters are planning to use a BI&A system within two to three years. There were close percentages for the pre-adopters who planning to use the system within one to two years, three to four years, and four to five years with 14.60%, 10.40%, and 12% respectively.

Pre-adopters' intention to use BI&A system	Frequency	Percentage
Within 1 to 2 year	55	14.60%
Within 2 to 3 years	72	19.20%
Within 3 to 4 years	39	10.40%

More than 5 years	45	12%
No intention to use any analyse tool	164	43.70%

Table 4. 11 Pre-adopters' Intention to Use BI&A System

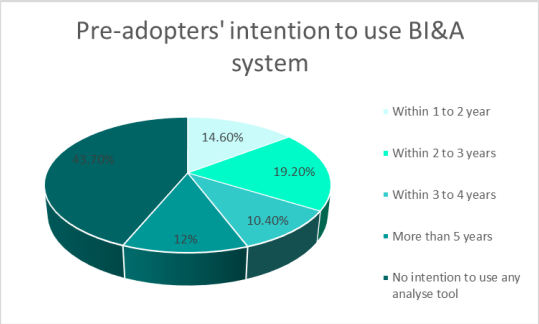

Figure 4. 13 Pre-adopters' Intention to Use BI&A System

4.3.8 Post-adopters' BI&A system Experience

Most post-adopters of BI&A systems in SMEs are in the initial stage of using the BI&A system. As shown in Table 4.12 and Figure 4.14, the biggest fraction of BI&A system users, 45.87%, have less than one year of experience in using the system; 33.5% of participants have 1 to 3 years of BI&A system experience; while only 3.6% of participants have 4 to 5 years' experience with their BI&A system, and 5.67% of the participants have more than five years' experience in using the system.

Years of Experience	Frequency	Percentage
less than one year	89	45.87%
1 to 2 years	65	33.5%
2 to3 years	22	11.34%
4 to5 years	7	3.6%
5 years and more	11	5.67%

Table 4. 12 Post-Adopters' BI&A System Experience

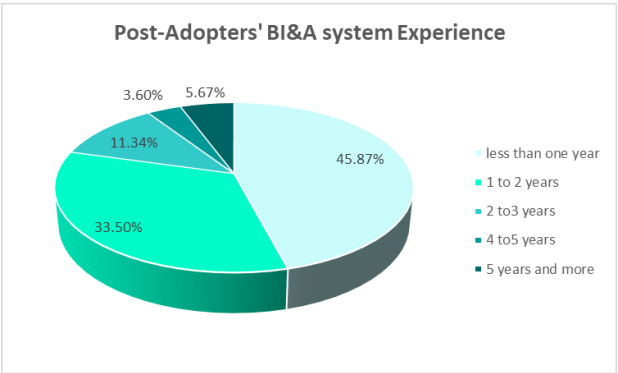

Figure 4. 14 Post-Adopters' BI&A System Experience

4.3.9 Post-adopters' BI&A system tools

BI&A system tool	Frequency	Percentage
Excel	143	73.70%
SAP business objective	12	6.20%
Microsoft Power BI	23	11.80%
Tableau	9	4.60%
Other	7	3.60%

Table 4. 13 Post-Adopters' BI&A System Tools

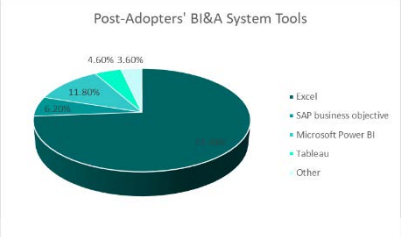

Figure 4. 15 Post-Adopters' BI&A System Tools

As shown in Table 4.13 and Figure 4.15, most BI&A system users, 73.70%, are using Excel software to analyse their data; 11.80% of participants are using Microsoft Power BI; while only 6.20% of participants use SAP business objective software and 4.60% are using Tableau software to analyse their data and make business decisions.

4.3.10 Post-adopters' BI&A system usage

Most post-adopters in Saudi SMEs are using the BI&A system in very simple way; as shown in Table 4.14 below, 63.4% of participants are using the BI&A system only to generate reports. 21.1% of participants are using a BI&A system which offers restricted user access to inquiries and only 7.7% are using a BI&A system able to give a multi-dimensional view of data. These three levels of BI&A system usage in this research are categorised as initial post-adoption stage as they do not use advanced analysis techniques. Only 7.8% of participants are categorised as advanced adopters of BI&A systems in Saudi SMEs.

BI&A system usage description	Frequency	Percentage	Post-adoption
(a) we use basic data analysis software to generate reports or spreadsheets.	123	63.4%	Initial Adoption 92.2%
(b) we use data analysis software that keeps data in a standardised format and provides restricted user access to inquiries (For example, the marketing function would deal with sales.)	41	21.1%	
(c) we use data analysis software that keeps data in a standardised format that allows us a multi-dimensional view of data (For example, sales data	15	7.7%	

can be analysed in terms of geographical area or time.)			
(d) we use data analysis software that can do multi-dimensional analysis, find relevant information, and provide predictive outcomes.	9	4.6%	Advanced Adoption 7.8%
(e) we use data analysis software that allows users to keep track of what is going on and generates automatic exception reports when something strange happens.	6	3.2%	

Table 4. 14 Post-Adopters' BI&A system Usage

4.4 Verifying the Data of the Questionnaire

As stated by Sekaran and Bougie (2010), before beginning data analysis to test hypotheses, some crucial preparatory processes must be completed. These steps guarantee that the data is correct, comprehensive, and ready for further analysis. Therefore, many tests have been conducted to ensure the data's normality, reliability, and validity.

4.4.1 Normality test

Prior to the data analysis process, a normality test is necessary. It is the most significant multivariate analysis foundational premise (Hair 2006). The shape of a variable's data distribution and its symmetry around the normal distribution is determined through normality testing (Hair 2006). In this study, the Kurtosis and Skewness measurement were used to test the normality of the data. The data with extraordinarily high or low-value items may have an impact on the overall results. Skewness is a measure of distribution symmetry; positive skewness indicates that the mean of a distribution is to the right, whereas negative skewness means that the mean falls on the left. (Hair 2006).

On the other hand, kurtosis serves to quantify 'peakedness.' A positive kurtosis indicates that an extreme peak can be found in the centre of the distribution. In contrast, a negative kurtosis indicates that the distribution is exceedingly flat. As a result, skewness and kurtosis are generated using normally distributed structures, with allowable values ranging from -2.00 to +2.00 (Hair 2006). Also, Hair (2006) argues that a normal border of -3 to +3 can also be considered normal.

Table 4.15 and Table 4.16 demonstrate the kurtosis and skewness for each question asked in the survey, both for before and after adoption.

In each table, only one value falls outside the -2 to +2 border. However, it does fall within the range of -3 to +3, which is considered normal according to Hair (2006).

Variables	Skewness	Kurtosis
IT_Knowledge1	-.056	-1.610
IT_Knowledge2	-.285	-1.284
IT_Knowledge3	-.416	-.824
Innovativeness1	.235	-1.263
Innovativeness2	.819	-.248
Innovativeness3	.359	-.319
Observability1	.291	-.978
Observability2	.341	-1.475
Observability3	.653	.117
Compatibility1	.739	.176
Compatibility2	-1.173	1.742
Compatibility3	-1.219	1.769
Compatibility4	-1.252	2.200
Complexity1	-.768	-.268
Complexity2	-.252	-1.146
Complexity3	-.382	-.978
Complexity4	-.533	-.992
Relative advantage1	-.496	-.686
Relative advantage2	-.166	-1.013
Relative advantage3	-.339	-.840
Relative advantage4	-.007	-.934
Resource availability1	-.129	-.884
Resource availability2	-.515	-.335
Resource availability3	-.301	-1.320
Resource availability4	-.747	-.384
competitive pressure1	-.300	-1.118
competitive pressure2	-.100	-1.360
competitive pressure3	-.778	-.401

External support1	-.047	-1.607
External support2	-.275	-1.286
External support3	-.291	-.978

Table 4. 15 Pre-Adoption Normality Test

Variables	Skewness	Kurtosis
IT_Knowledge1	-.303	-1.128
IT_Knowledge2	-.093	-1.368
IT_Knowledge3	-.783	-.388
Innovativeness1	.922	-.897
Innovativeness2	.232	-1.263
Innovativeness3	.664	-.792
Observability1	1.119	-.306
Observability2	.181	-.954
Observability3	.893	-.327
Compatibility1	-.501	-.703
Compatibility2	.685	-.597
Compatibility3	-1.246	.736
Compatibility4	-.167	-.492
Complexity1	-.311	-1.113
Complexity2	-.093	-1.368
Complexity3	-.783	-.388
Complexity4	-.093	-1.368
Relative advantage1	-.504	.276
Relative advantage2	1.039	2.607
Relative advantage3	.964	1.922
Relative advantage4	1.280	.124
Resource availability1	-1.119	-.306
Resource availability2	-.181	-.954
Resource availability3	-.893	-.327
Resource availability4	-.517	-1.036
competitive pressure1	-.430	-1.032
competitive pressure2	-.235	-1.379

competitive pressure3	-.143	-.468
External support1	-1.246	.736
External support2	-.167	-.492
External support3	-.501	-.703

Table 4. 16 Post-Adoption Normality Test

4.4.2 Reliability Test

The assessment process covers the testing of reliability (internal consistency) of the survey tool to guarantee that the survey tool is successful in collecting reliable data. That internal consistency was checked by using Cronbach's Alpha coefficient. This will provide us with an indication of the reliability of the survey tool and how much we can depend on it to gather the data needed to achieve the research objectives and test the research hypotheses. A low Cronbach's alpha value shows that they are likely too diverse to reflect the measure accurately. According to Joe F. Hair, Christian M. Ringle and Sarstedt (2011), the acceptable value of Cronbach's Alpha is 0.7 or more. The Cronbach alpha of the various components in the pre- and post-adoption model is shown in the Table 4.17.

Factors	Pre-Adoption		Post- Adoption	
	No. of items	Cronbach's Alpha	No. of items	Cronbach's Alpha
Relative Advantage	4	0.753	4	0.731
Complexity	4	0.842	4	0.902
Observability	3	0. 827	3	0.873
Compatibility	3	0.795	3	0.727
Resource Availability	4	0.891	4	0.901
Competitive Pressure	3	0.832	3	0.891
External Support	3	0.833	3	0.883
IT Knowledge	3	0.770	3	0.834
Innovativeness	3	0. 842	3	0. 883

Table 4. 17 Reliability test

As is evident from Table 4.17, the overall survey instrument reliability for each factor in the pre-adoption model is a range between 0.753 to 0.891, and for the post-adoption model it is a range between 0.727 to 0.902, which indicates that the survey instrument is highly reliable and confirms the consistency of the survey instrument as suitable to achieve the research objectives.

4.4.3 Content Validity Test

The content validity test assesses if the survey instrument and constructs are properly determined or whether variables accurately measure the topic they were supposed to assess (Creswell & Creswell 2018). Several tasks were used to guarantee the research's content validity. The likely factors were first identified through the literature systematic review. Prior BI&A system models were used to derive and adapt the likely factors, which were also verified by the earlier investigations that have been discussed in Chapter 2. Then, the survey questions were validated by pilot testing (more detail in Chapter 3). Some questions were modified according to the information obtained and feedback received during this phase, which improved the questions' validity.

4.4.4 Construct validity

Construct validity is "the extent to which the constructs or a set of measured items reflects the latent theoretical construct those items are designed to measure" (Hair et al. 2013, p.211). The construct validity was conducted by employing confirmatory factor analysis (CFA). CFA was chosen because it is the most well-known method for determining how well a hypothesised factor structure matches the actual data (Hair 2006). CFA is used to examine construct validity, including convergent and discriminant validity, to ensure that the measure resembles but is distinct from other measures (Hair et al. 2013).

Convergent validity is measured by taking the composite reliability (CR) and average variance extracted (AVE), and then the CR value must be above the AVE. Also, all AVE values have to be more than 0.50 (Hair et al. 2013), while the discriminant validity shows if the construct is different from all other constructs by determining if the square root of each construct's AVE value is substantially bigger than the correlation between any latent constructs.
Table 4.18 and Table 4.19 show that, in both pre- and post-adoption models, the CR values were more than the AVE and all AVE value were more than 0.50. This demonstrates the convergent validity of both models.

Table 4.20 and Table 4.21 show the discriminant validity of the constructs in both models. The square root of each construct's AVE (Bold font in both tables) was more significant than the correlation between latent constructs, establishing the discriminant validity.

Factors	Composite Reliability (CR)	Average Variance Extracted (AVE)
IT knowledge	0.869863	0.690809
Innovativeness	0.904857	0.760327
Observability	0.902169	0.754708
Compatibility	0.866345	0.61973
Complexity	0.893511	0.678476
Relative Advantage	0.919338	0.741187
Resource Availability	0.925733	0.757391
Competitive Pressure	0.902449	0.755486
External Support	0.90517	0.761563

Table 4. 18 Pre-Adoption Convergent Validity

Factors	Composite Reliability (CR)	Average Variance Extracted (AVE)
IT knowledge	0.903548	0.757794
Innovativeness	0.930892	0.817992
Observability	0.922	0.798214
Compatibility	0.90019	0.695938
Complexity	0.866345	0.61973
Relative Advantage	0.840647	0.570642
Resource Availability	0.931403	0.772902
Competitive Pressure	0.938592	0.83615
External Support	0.930938	0.81799

Table 4. 19 Post-Adoption Convergent Validity

Factors	IT knowledge	Innovativeness	Observability	Compatibility	Complexity	Relative Advantage	Resource Availability	Competitive Pressure	External Support
IT knowledge	**0.83**								
Innovativeness	0.45	**0.87**							
Observability	0.75	0.55	**0.86**						
Compatibility	0.67	0.12	0.54	**0.78**					
Complexity	0.52	0.68	0.31	0.28	**0.82**				
Relative Advantage	0.68	0.51	0.54	0.47	0.12	**0.86**			
Resource Availability	0.80	0.36	0.27	0.44	0.46	0.60	**0.87**		
Competitive Pressure	0.23	0.44	0.53	0.10	0.58	0.63	0.44	**0.86**	
External Support	0.45	0.41	0.52	0.23	0.53	0.55	0.77	0.23	**0.87**

Table 4. 20 Pre-Adoption Discriminant Validity

Factors	IT knowledge	Innovativeness	Observability	Compatibility	Complexity	Relative Advantage	Resource Availability	Competitive Pressure	External Support
IT knowledge	**0.87**								
Innovativeness	0.15	**0.90**							
Observability	0.30	0.62	**0.89**						
Compatibility	0.55	0.51	0.24	**0.83**					
Complexity	0.64	0.44	0.61	0.42	**0.78**				
Relative Advantage	0.72	0.49	0.40	0.30	0.65	**0.75**			
Resource Availability	0.42	0.31	0.51	0.34	0.28	0.29	**0.87**		
Competitive Pressure	0.54	0.68	0.71	0.42	0.57	0.55	0.57	**0.91**	
External Support	0.61	0.33	0.56	0.62	0.32	0.50	0.63	0.67	**0.90**

Table 4. 21 Post-Adoption Discriminant Validit

4.5 Multiple Linear Regression Analysis

The questionnaire's reliability and validity were evaluated following the normality test. The models that were proposed were tested and analysed. SPSS was used to conduct multiple linear regression analysis in the hope of answering the research questions and investigating the provided hypotheses. In particular, multiple linear regression analysis examined relative advantage, complexity, observability, compatibility, enterprise size, resource availability, competitive pressure, external support, IT knowledge and innovativeness were significant predictors of the dependent variable. Two separate regression analyses were conducted – one for the pre-adoption group and another for the post-adoption group. The support for the hypotheses depended on the path correlation coefficients (R) and the significance levels (p). When the *p*-value is less than 0.01 *p* 0.01), the correlation is considered significant.

In this research, the principal question is: ***'What are the critical factors that influence BI&A pre and- post-adoption by Saudi SMEs?'*** In order to answer the main research question, three sub-questions were formulated. In the following sections, the answer offered to each sub-question comprises related hypotheses.

4.5.1 Technology Characteristics

The first research sub-question is: *How do the technology characteristics (Relative Advantage, Complexity, Compatibility, and Observability) affect BI&A system pre- and post-adoption in Saudi SMEs?*

The fifth research sub-question is: *How do these critical factors influence SMEs differentially in pre- and post-adoption stages?*

The following hypotheses address these questions:

H1a: Relative Advantage has a positive effect on pre-adoption of BI&A systems in SMEs

H2a: Complexity has a negative effect on pre-adoption of BI&A systems in SMEs.
H3a: Observability has a positive effect on pre-adoption of BI&A systems in SMEs.
H4a: Compatibility has a positive effect on pre-adoption of BI&A systems in SMEs.

H1b. Relative advantage has a positive effect on post-adoption of BI & A in SMEs
H2b. Complexity has a negative effect on post-adoption of BI&A systems in SMEs.
H3b: Observability has a positive effect on post-adoption of BI&A systems in SMEs.
H4b: Compatibility has a positive effect on post-adoption of BI&A systems in SMEs.

Regarding the pre-adoption hypotheses, **H1a** to **H4a**, Table 4.22 and Figure 4.16 show the results. However, not all predictors included in the model were statistically significant. For instance, looking at Table 4.22, compatibility was not a significant predictor of the dependent variable. This means **H4a** was not supported. It was found that the predictors with the highest magnitude were relative advantage ($\beta = .427$, $p < .01$), observability ($\beta = .320$, $p < .01$), and complexity ($\beta = -.269$, $p < .01$). If relative advantage increases by one standard deviation, the dependent variable will increase by .427 sigma. Similarly, if observability increases by one standard deviation, the dependent variable will increase by .572 standard deviations. For the complexity, the Standardized Coefficients Beta (β) is negative, which means that if complexity increases by one standard deviation, the dependent variable will decrease by .269 sigma, which supports **H2a.**

Meanwhile, in the post-adoption hypotheses, **H1b** to **H4b**, Table 4.23 and Figure 4.17 show the results. Most of the predictors included in the model were not statistically significant. For instance, looking at the Table 4.23, Relative Advantage ($\beta = .017$, $p > .01$), Complexity ($\beta = .054$, $p > .01$) and Compatibility ($\beta = -.116$, $p > .01$) were not significant predictors of the dependent variable: the p values of all of these were more than 0.01. This means **H1b. H2b** and **H4b** were not supported. Only the Observability ($\beta = .837$, $p < .01$) was a significant predictor in the post-adoption hypotheses within technology characteristics. If Observability increases by one standard deviation, the dependent variable will increase by .837 sigma, which is in line with **H3b**.
Figure 4.18 summaries the results for all technology characteristics pre- and post-adoption hypotheses.

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Relative Advantage	.884	.224	.427	3.949	.000	Supported
Complexity	-.518	.190	-.269	-2.723	.007	Supported
Observability	.646	.156	.320	4.155	.000	Supported
Compatibility	.054	.122	.014	.444	.658	Not Supported

Table 4. 22 Technology Characteristics Pre-Adoption Hypotheses Results

Model 2	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p value)	Result
Relative Advantage	.039	.078	.017	.498	.619	Not Supported
Complexity	.047	.278	.054	.169	.866	Not Supported
Observability	.844	.247	.837	3.415	.001	Supported
Compatibility	-.184	.280	-.116	-.656	.513	Not Supported

Table 4. 23 Technology Characteristics Post-Adoption Hypotheses Results

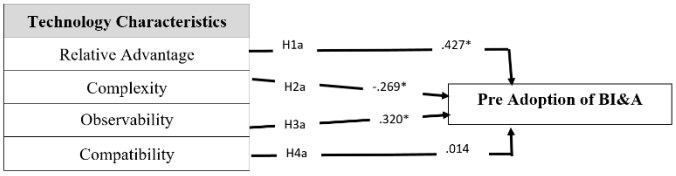

Figure 4. 16 Technology Characteristics Pre-Adoption Hypotheses Results

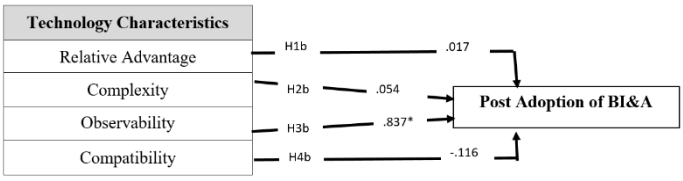

Figure 4. 17 Technology Characteristics Post-Adoption Hypotheses Results

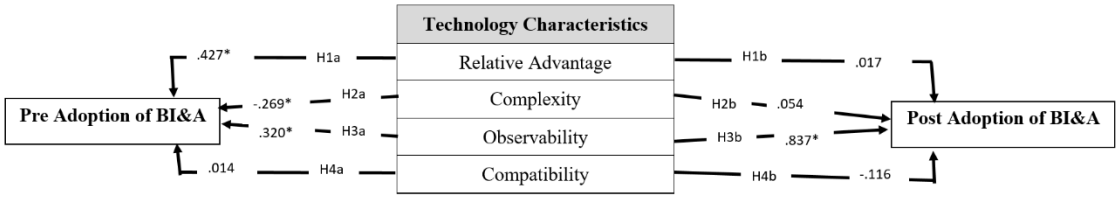

Figure 4. 18 Technology Characteristics Pre- and Post-Adoption Hypotheses Results

4.5.2 Organisational Characteristics

The second research sub-question is: *What role do the organisational characteristics (Resource Availability and Enterprise Size) play regarding BI&A system pre- and post-adoption in Saudi SMEs?*

The fifth research sub-question is: *How do these critical factors influence SMEs differentially in pre- and post-adoption stages?*

The following hypotheses address these questions:

H5a: Organisational Size has a positive effect on pre-adoption of BI&A systems in SMEs.

H6a: Organisational Resource Availability has a positive effect on pre-adoption of BI&A systems in SMEs.

H5b: Organisational Size has a positive effect on post-adoption of BI&A in SMEs

H6b: Organisational Resource Availability has a positive effect on post-adoption of BI&A systems in SMEs.

Regarding the pre-adoption hypotheses, **H5a** and **H6a**, as shown in Table 4.24 and Figure 4.19, factors included in the model were statistically significant. It was found that the predictor with the highest magnitude was Resource Availability ($\beta = .527$, $p < .01$), followed by Enterprise Size ($\beta = .103$, $p < .01$). If Resource Availability increases by one standard deviation, the dependent variable will increase by .527 sigma. Similarly, if Enterprise Size increases by one standard deviation, the dependent variable will increase by .103 standard deviations. This leads to the conclusion that both organisational characteristics predictor hypotheses, **H5a** and **H6a**, were supported in the pre-adoption stage.

In the post-adoption stage, as shown in Table 4.25 and Figure 4.20, the Enterprise Size ($\beta = .047$, $p > .01$) was not statistically significant, which means that **H5b** was not supported. The

Resource Availability, on the other hand (β = 1.337, p < .01), was strongly significant. If Resource Availability increases by one standard deviation, the dependent variable will increase by 1.337 sigma, which is in line with **H6b**.

Figure 4.21 summaries the results for the organisational characteristics pre- and post-adoption hypotheses.

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Enterprise Size	.145	.046	.103	3.185	.002	Supported
Resource Availability	.982	.147	.527	6.663	.000	Supported

Table 4. 24 Organisational Characteristics Pre-Adoption Hypotheses Results

Model 2	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig. (p-value)	Result
Enterprise Size	.037	.028	.047	1.313	.191	Not Supported
Resource Availability	1.334	.327	1.337	4.084	.000	Supported

Table 4. 25 Organisational Characteristics Post-Adoption Hypotheses Results

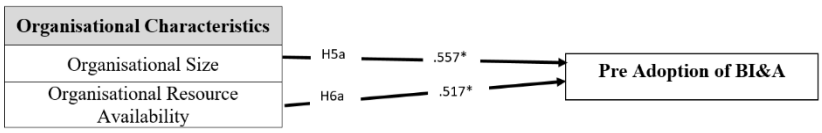

Figure 4. 19 Organisational Characteristics Pre-Adoption Hypotheses Results

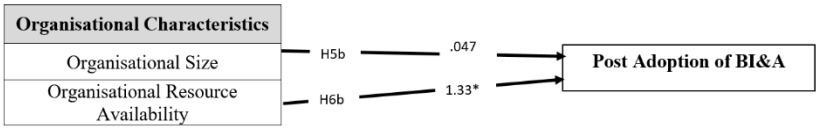

Figure 4. 20 Organisational Characteristics Post-Adoption Hypotheses Results

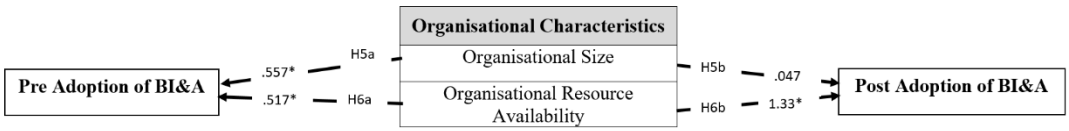

Figure 4. 21 Organisational Characteristics Pre- and Post-Adoption Hypotheses Results

4.5.3 Environmental Characteristics

The third research sub-question is: *How do environmental characteristics (Competitive Pressure and External Support) impact BI&A system pre- and post-adoption in Saudi SMEs?*
The fifth research sub-question is: *How do these critical factors influence SMEs differentially in pre- and post-adoption stages?*
The following hypotheses address these questions:
H7a: Competitive Pressure positively affects pre-adoption of BI&A systems in SMEs.
H8a: External Support positively affects pre-adoption of BI&A systems in SMEs.

H7b: Competitive Pressure positively affects post-adoption of BI&A in SMEs.
H8b: External Support positively affects post-adoption of BI&A in SMEs.

Regarding the pre-adoption hypotheses, **H7a** and **H8a**, Table 4.26 and Figure 4.22 show the results. However, not all predictors included in the model were statistically significant. For instance, looking at Table 4.26, Competitive Pressure was not a significant predictor of the dependent variable. This means that **H7a** was not supported. In contrast, External Support ($\beta = .577$, $p < .01$) was strongly significant. If External Support increases by one standard deviation, the dependent variable will increase by .577 sigma, which means that **H6b** is supported.

For the post-adoption hypotheses, **H7b** and **H8b**, Table 4.27 and Figure 4.23 show the results. All predictors that were included in the model were statistically significant. It was found that the predictors with the highest magnitude were External Support ($\beta = .791$, $p < .01$) and then Competitive Pressure ($\beta = .465$, $p < .01$). If External Support increases by one standard deviation, the dependent variable will increase by .791 sigma. Similarly, if Competitive Pressure increases by one standard deviation, the dependent variable will increase by .465 standard deviations. This leads to the conclusion that both environmental characteristics predictors hypotheses, **H7b** and **H8b**, were supported in the pre-adoption stage.

Figure 4.24 summaries the results for the environmental characteristics pre- and post-adoption hypotheses.

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Competitive Pressure	.011	.115	.007	.096	.924	Not Supported
External Support	.825	.161	.557	5.130	.000	Supported

Table 4. 26 Environmental Characteristics Pre-Adoption Hypotheses Results

Model 2	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Competitive Pressure	.433	.071	.465	6.116	.000	Supported
External Support	.828	.232	.791	3.577	.000	Supported

Table 4. 27 Environmental Characteristics Post-Adoption Hypotheses Results

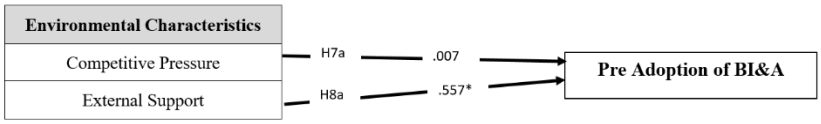

Figure 4. 22 Environmental Characteristics Pre-Adoption Hypotheses Results

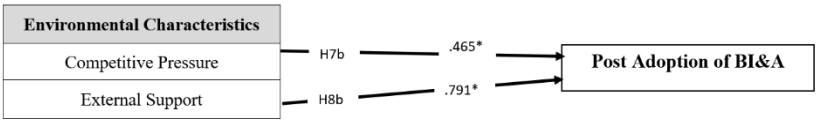

Figure 4. 23 Environmental Characteristics Post-Adoption Hypotheses Results

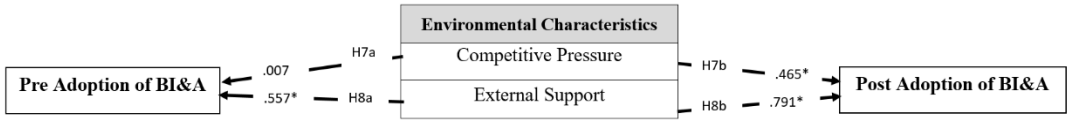

Figure 4. 24 Environmental Characteristics Pre- and Post-Adoption Hypotheses Results

4.5.4 Owners'/mangers' characteristics

The fourth research sub-question is: *How do owners'/managers' characteristics (IT knowledge and innovativeness) at SMEs affect BI&A pre- and post-adoption in SA?*

The fifth research sub-question is: *How do these critical factors influence SMEs differentially in pre- and post-adoption stages?*

The following hypotheses address these questions:

H9a: Owners'/Managers' IT Knowledge has a positive effect on pre-adoption of BI&A systems in SMEs.

H10a: Owners'/Managers' Innovativeness positively affects preadoption of BI&A systems in SMEs.

H9b: Owners'/Managers' IT Knowledge positively affects post-adoption of BI&A in SMEs.

H10b: Owners'/Managers' Innovativeness has a positive effect on post-adoption of BI&A in SMEs.

Regarding the owner/manager characteristic pre-adoption hypotheses, **H9a** and **H10a**, as shown in Table 4.28 and Figure 4.25, all predictors included in the model were statistically significant. It was found that the predictor with the highest magnitude was Innovativeness ($\beta =$ . .864, $p < .01$) followed by IT Knowledge ($\beta = .517$, $p < .01$). If Innovativeness increases by one standard deviation, the dependent variable will increase by .864 sigma. Similarly, if IT knowledge increases by one standard deviation, the dependent variable will increase by .517 standard deviations. This leads to the conclusion that both organisational characteristics predictors hypotheses, **H9a** and **H10a**, were supported in the pre-adoption stage.

In the post-adoption stage, as shown in Table 4.29 and Figure 4.26, IT Knowledge ($\beta = -.022$, $p > .01$) was not statistically significant, which means that **H9b** was not supported. Innovativeness, on the other hand ($\beta = .877$, $p < .01$), was strongly significant. If Innovativeness increases by one standard deviation, the dependent variable will increase by .877 sigma, which is in line with the **H10b**.

Figure 4.27 summaries the results for the owner/manager characteristics pre and post-adoption hypotheses.

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
IT knowledge	.778	.187	.517	4.165	.000	Supported
Innovativeness	1.489	.196	.864	7.595	.000	Supported

Table 4. 28 Owners'/Managers' Characteristics Pre-Adoption Hypotheses Results

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
IT knowledge	-.019	.278	-.022	-.068	.946	Not Supported
Innovativeness	.704	.096	.877	7.328	.000	Supported

Table 4. 29 Owners'/Managers' Characteristics Post-Adoption Hypotheses Results

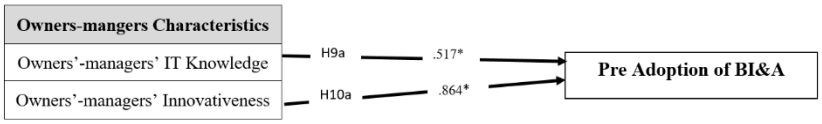

Figure 4. 25 Owners'/Managers' Characteristics Pre-Adoption Hypotheses Results

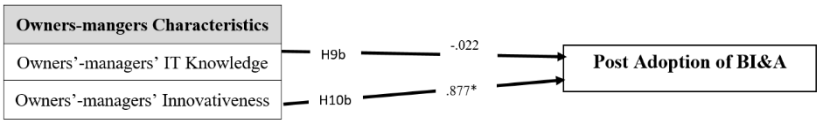

Figure 4. 26 Owners'/Managers' Characteristics Pre-Adoption Hypotheses Results

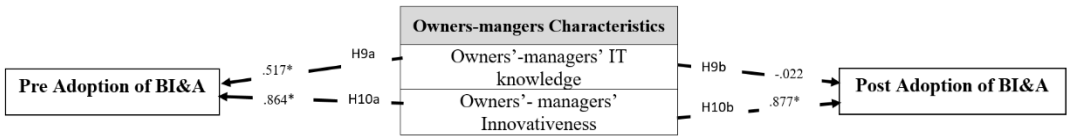

Figure 4. 27 Owners'/Managers' Characteristics Pre and Post-Adoption Hypotheses Results

4.6 Models Summary

Figure 4.28 and 4.29 and Table 4.31 and 4.33 show the complete model testing. Figure 4.28 and Table 4.31 show all influencing factor hypotheses for the pre-adoption stage. Figure 4.29 and Table 4.33 show the influencing factor hypotheses for the post-adoption stage.

For the pre-adoption stage, the regression results (Table 4.30 Model 1 summary) exhibit an overall significant model $p < .01$. However, not all predictors included in the model proved to be statistically significant. For instance, the regression coefficients in Table 4.31 for Compatibility and Competitive Pressure were not significant predictors of the dependent variable. It was found that the predictors with the highest magnitude were Innovativeness ($\beta = .864$, $p < .01$), External Support ($\beta = .572$, $p < .01$), Resource Availability ($\beta = .527$, $p < .01$), IT Knowledge ($\beta = .517$, $p < .01$), and Relative Advantage ($\beta = .171$, $p = .427$). If Innovativeness increases by one standard deviation, the dependent variable will increase by .864 sigma. Similarly, if External Support increases by one standard deviation, the dependent variable will increase by .572 standard deviations, along with the other factors.

For the post-adoption stage, the regression results (Table 4.31 Model 2 summary) exhibit an overall significant model $p < .01$. However, not all predictors included in the model were statistically significant. For instance, looking at the regression coefficients in Table 4.33, Relative Advantage, Complexity, Compatibility, Enterprise Size, and IT Knowledge were not significant predictors of the dependent variable. It was found that the predictors with the highest magnitude were Resource Availability ($\beta = 1.337$, $p < .01$), Innovativeness ($\beta = .877$, $p < .01$), Observability ($\beta = .837$, $p < .01$), External Support ($\beta = .791$, $p < .01$) , and Competitive Pressure ($\beta = . 465$, $p < .01$). If Resource Availability increases by one standard deviation, the dependent variable will increase by 1.337 sigma. Similarly, if Innovativeness increases by one standard deviation, the dependent variable will increase by .897 standard deviations, along with the other factors.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig. F Change
1	.806[a]	.649	.640	1.011	.000

Table 4. 31 Pre-Adoption Model 1 Summary

Model 1	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Relative Advantage	.884	.224	.427	3.949	.000	Supported
Complexity	-.518	.190	-.269	-2.723	.007	Supported
Observability	.646	.156	.320	4.155	.000	Supported
Compatibility	.054	.122	.014	.444	.658	Not Supported
Enterprise Size	.145	.046	.103	3.185	.002	Supported
Resource Availability	.982	.147	.527	6.663	.000	Supported
Competitive Pressure	.011	.115	.007	.096	.924	Not Supported
External Support	.825	.161	.557	5.130	.000	Supported
IT knowledge	.778	.187	.517	4.165	.000	Supported
Innovativeness	1.489	.196	.864	7.595	.000	Supported

Table 4. 30 Model 1 Results of Hypotheses Testing (Pre-Adoption)

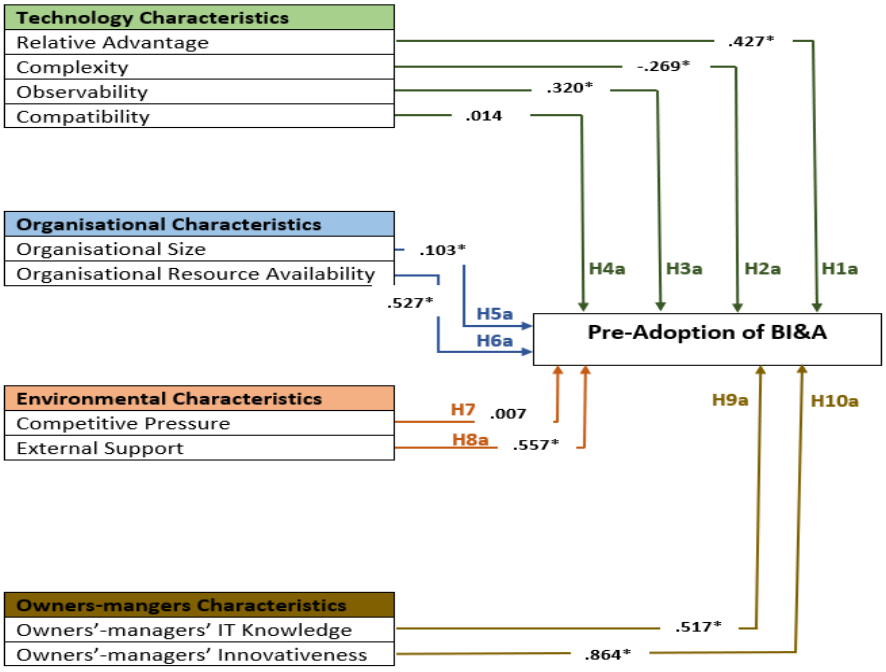

Figure 4. 28 **Model 1 Results of Hypotheses Testing (Pre-Adoption)**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig. F Change
2	.886[a]	.786	.774	.421	.000

Table 4. 32 Poste-Adoption Model 2 Summary

Model 2	Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.(p-value)	Result
Relative Advantage	.039	.078	.017	.498	.619	Not Supported
Complexity	.047	.278	.054	.169	.866	Not Supported
Observability	.844	.247	.837	3.415	.001	Supported
Compatibility	-.184	.280	-.116	-.656	.513	Not Supported
Enterprise Size	.037	.028	.047	1.313	.191	Not Supported
Resource Availability	1.334	.327	1.337	4.084	.000	Supported
Competitive Pressure	.433	.071	.465	6.116	.000	Supported
External Support	.828	.232	.791	3.577	.000	Supported
IT knowledge	-.019	.278	-.022	-.068	.946	Not Supported
Innovativeness	.704	.096	.877	7.328	.000	Supported

Table 4. 33 Model 2 Results of Hypotheses Testing (Post-Adoption)

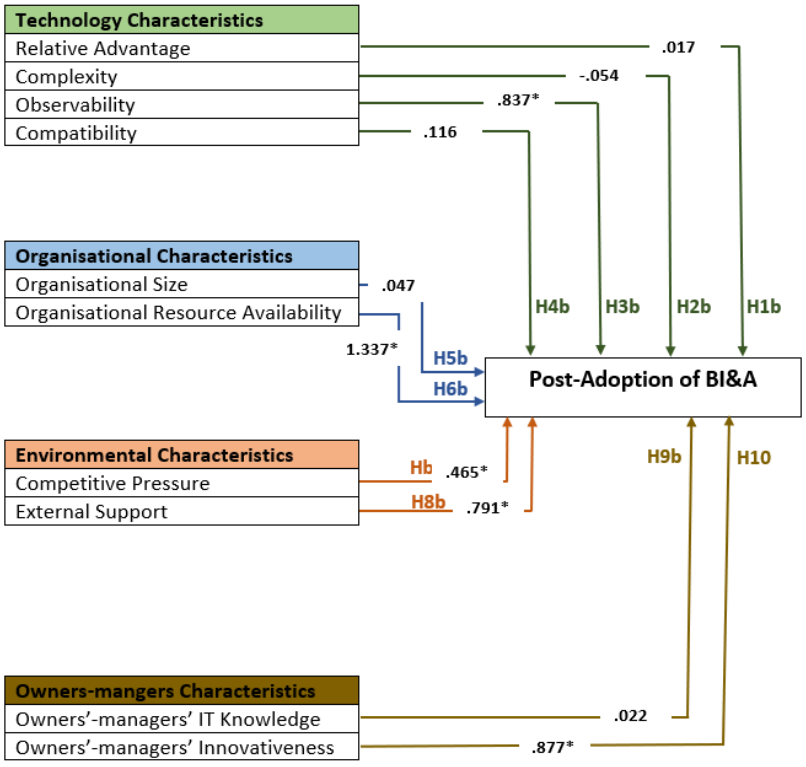

Figure 4. 29 Model 2 Results of Hypotheses Testing (Post-Adoption)

4.7 Chapter Summary

Chapter 4 provided the quantitative data results, which included the demographic information of the participants, followed by the verification of the questionnaire data, and finally the outcomes of the study hypotheses, which were verified using multiple linear regression analysis. Firstly, the demographics of the 569 participants, 375 for the pre-adoption group and 194 for the post-adoption group, were discussed in detail. The data were then verified by conducting a normality test to attain an acceptable normal distribution. Also, the data were verified by conducting the reliability test to guarantee that the survey tool was effective in collecting reliable data; the internal consistency was checked by using Cronbach's Alpha coefficient. Moreover, content and construct validity tests were conducted, in order to test whether variables accurately measure the content they were designed to assess. Finally, the results of the research hypotheses were tested by using multiple linear regression analysis. Two hypotheses (H4a and H7a) were not supported in the pre-adoption stage, whereas five hypotheses (H1b, H2b, H4b, H5b, and H9b) were not supported in the post-adoption stage. These results will be gone over in more detail in Chapter 6. The forthcoming chapter will present the qualitative results to explain and further validate the quantitative results.

5 Chapter Five: Qualitative Data Results

5.1 Introduction:

This chapter sets out the results of the data gathered in the interviews with participants. This chapter aims to explain and further validate the quantitative results. Interviews with 19 pre- and post-adopters of BI&A systems in Saudi SMEs were conducted, and thematic coding frequency analysis was applied. This chapter is broadly divided into two sections: brief details of the interview participants, and the qualitative findings. The report of the qualitative findings is divided into three sections. The first section aims to validate and further test the quantitative results. The second section aims to explain unexpected quantitative results, and the third section aims to identify new factors that could affect the adoption and use of the BI&A systems in SMEs in SA.

5.2 Interview overview:

Nineteen interviews were conducted with owners/managers of SMEs located in SA. The sample was collected via the survey questionnaires. At the end of the survey questionnaires, there was a question as to whether the participant would like to participate in the interview: if yes, the participant provided his/her email; more details of the interview guide development, population, and sampling, data collection procedure, and analysis can be found in Chapter Three. The participants were from pre- and post-adoption groups. However, the researcher focused on the post-adoption group interviewees as they have experience in using the BI&A system and have a broad overview of which factors affected their adoption and use of the BI&A system as they went through both stages: pre- and post-adoption. In the pre-adoption group, the participants were chosen on the basis of on their adoption intention. Some plan to adopt a BI&A system soon, and others have no intention to adopt a BI&A system in their enterprise. In the post-adoption group, the participants were chosen depending on their experience using the BI&A system in place at their enterprises. Two different levels were identified based on their amount of experience using the BI&A system:

- The initial adopters, these being owners/managers with less than three years of experience with the BI&A system, which they use in a very simple way.
- The advanced adopters, these being owners/managers with more than five years of experience with the BI&A system, and they use the BI&A system in an advanced way.

The interviews aimed to validate and explain the survey results and identify new factors relevant to the research objectives. The interview questions were reviewed by three external experts and modified based on their feedback. All the interviews took place conducted in

Arabic and translated to English. The participants' identities were kept hidden by using alphanumeric codes, i.e., P1, P2, P3, etc., for pre-adopters, PSI1, PSI2, PSI3, etc., for post-adopters (Initial) and PSA1, PSA2, PSA3, etc., for post-adopters (Advanced) (please refer to Table 5.1 for the interviewees' classification). For interview data, NVivo software was used to process the transcribed data. The thematic analysis technique was used to analyse the interviews. The main themes or factors were extracted from the proposed model and the survey results. Also, some new factors and sub-factors have been identified.

Classification	Code	Number
Pre-adopters	P	7 interviewees: P1 to P7
Post adopters (Initial Adopters)	PSI	7 interviewees: PSI1 to PSI7
Post adopters (Advanced Adopters)	PSA	5 interviewees: PSA1 to PSA5

Table 5. 1 Classification of Interviewees

5.3 Brief Details of the Participants

The Table 5.2, below, shows brief details of the interview participants. In the pre-adoption group, P1 to P7, the participants came from different education levels, backgrounds, and sectors. Most of the participants, 6 out of 7, were owners and managers simultaneously in their respective enterprises. The enterprise size of the participants was mainly small, 4 out of 7; two were medium, and one micro. Please refer to Chapter 2 for the SME definition.

In the post-adoption group (initial adopters), PSI1 to PSI7, most participants were bachelor's holders, 5 out of 7, one had a diploma and one, a master's degree. The participant's experience using the BI&A system in each enterprise was three years or less. Excel was this group's most-used software for analysis, and only one participant used Microsoft Power software. The enterprise size of the participants was three small and three medium-sized, with only one micro-sized enterprise.

Finally, in the post-adoption group (advanced adopters), from PSA1 to PSA5, three participants were bachelor's holders and two were master's holders. The participants' experience using the appropriate BI&A system was more than five years, and two participants had more than ten years of experience. Two participants were using Microsoft Power for analysis, two were using Excel software, and only one was using Tableau software.

Group	Code	Education	Experience	Sector	BI&A system	Owner/ manager	Enterprise Size
Pre- adopters	P1	Bachelor's / science	_	Food	_	Owner/manager	Small
	P2	High school	_	Furniture	_	Owner/manager	Micro
	P3	Diploma / IT	_	Furniture	_	Owner/manager	Small
	P4	Diploma / Human resource	_	Clothes	_	Owner/manager	Small
	P5	Bachelor's / Business	_	Food	_	Manager	Medium
	P6	Bachelor's / Business	_	Clothes	_	Owner/manager	Small
	P7	High school	_	Food	_	Owner/manager	Medium
Post adopters Initial Adopters	PSI1	Diploma / Business	One year	Paints	Excel	Owner/manager	Small
	PSI2	Bachelor's / science	2 years	Furniture	Microsoft Power	Owner/manager	Medium
	PSI3	Bachelor's / Agriculture	One year	Cleaning chemicals	Excel	Owner/manager	Micro
	PSI4	Bachelor's /Agriculture	2 years	Clothes	Excel	Owner/manager	Small
	PSI5	Master's / Business	3 years	Plastics	Microsoft Power	Manager	Medium
	PSI6	Bachelor's / Business	Less than one year	Clothes	Excel	Manager	Medium
	PSI7	Bachelor's / Art	One year	Furniture	Excel	Manager	Small

Post adopters Advanced Adopters	PSA1	Bachelor's / Finance	More than 10 years	Gibson board	Excel / Microsoft Power	Owner/manager	Medium
	PSA2	Master's / IS	More than 10 years	Plastics	Tableau	Owner	Medium
	PSA3	Bachelor's / IT	6 years	Food	Excel	Owner/manager	Medium
	PSA4	Bachelor's / Arabic Language	More than 5 years	Food	Microsoft Power	Manager	Small
	PSA5	Master's / Chemical Engineering	5 years	Furniture	Excel	Owner/manager	Medium

Table 5. 2 Brief Details of the Interviewees

5.4 Qualitative Findings

The interviews aimed to validate and explain the survey results and identify new factors relevant to the research objectives. Therefore, the results were divided into three sections. The first section aims to validate and further test the quantitative results. The second section aims to explain the unexpected quantitative results, and the third section aims to identify new factors that could affect the adoption and use of BI&A systems in SMEs in SA.

As explained earlier, in Chapter 3, thematic analysis was chosen as the method for analysing qualitative data gathered via semi-structured interviews. This kind of analysis can reflect on participants' perspectives, experiences, and understanding of issues while evaluating how events, realities, experiences, and meaning have developed (Braun & Clarke 2006).

Sections below explain the qualitative findings:

5.4.1 Section one: validate and further test the quantitative results.

The interviews were transcribed, and the audio files were played and replayed to confirm the transcribed interview. Then, the main ideas were gathered, and the data were coded and clustered into the identified themes; more details about the analysis steps are in Chapter 3. Table 5.3, below, summarises the analysis result and explains whether the qualitative results support the research's hypothesis or not. Also, Table 5.4, below, explains whether the qualitative results are consistent with quantitative results to validate and further test the quantitative results.

Theme	Sub-theme	Supporting the hypothesis			
		In pre adoption		In post adoption	
Relative Advantage	• BI&A system reduces the cost of operations. • BI&A system helps to provide competitive information. • BI&A system improves business processes and makes it possible to make a better decision. • BI&A system is useful in the enterprise.	H1a	Supported	H1b	Not Supported
Complexity	• BI&A system requires a lot of effort. • BI&A system is clear and understandable. • Complexity of the skills required to use BI&A system.	H2a	Mixed	H2b	Not Supported
Observability	• Seeing BI&A system used in other enterprises. • Aware of the existence of BI&A tools in the market. • Observable results of using BI&A system.	H3a	Supported	H3b	Supported
Compatibility	• BI&A compatible with organisational culture and values. • BI&A compatible with my enterprise's IT infrastructure. • BI&A compatible with all aspects of enterprise work.	H4a	Mixed	H4b	Mixed
Enterprise Size	• Enterprise Size	H5a	Supported	H5b	Not Supported
Resource Availability	• Technological resources. • Financial resources. • Training and IT support. • Human resources.	H6a	Supported	H6b	Supported
Competitive Pressure	• Degree of competition in our industry. • Pressure from competitors. • BI&A system helps maintain business competitiveness in the market.	H7a	Mixed	H7b	Supported

External Support	• Existence of businesses that provide BI&A system technical support. • Technology vendors that actively market the BI&A system. • Technology vendors promotion of BI&A system and free training sessions.	H8a	Supported	H8b	Supported
IT knowledge	• Using a computer at home and at work. • Knowledge and skills of computers and IT. • Technical skills to use a new technological system such as BI&A system.	H9a	Supported	H1b	Not Supported
Innovativeness	• Looking for ways to experiment new technology. • First to explore new IT. • Hesitant to try out new information technologies.	H10 a	Supported	H2b	Supported

Table 5. 3 The Qualitatively Supported and not supported research hypotheses

Factors	Supporting the Quantitative results			
	In pre-adoption		In post-adoption	
Relative Advantage	H1a	Yes	H1b	Yes
Complexity	H2a	Mixed	H2b	Yes
Observability	H3a	Yes	H3b	Yes
Compatibility	H4a	Mixed	H4b	Mixed
Enterprise Size	H5a	Yes	H5b	Yes
Resource Availability	H6a	Yes	H6b	Yes
Competitive Pressure	H7a	Mixed	H7b	Yes
External Support	H8a	Yes	H8b	Yes
IT knowledge	H9a	Yes	H9b	Yes
Innovativeness	H10a	Yes	H10b	Yes

Table 5. 4 The Qualitatively Supported and not supported the Quantitative results

5.4.2 Section tow: explain the un-expecting quantitative results.

Some of the proposed research hypotheses were not supported in our quantitative analysis results and needed further explanation. Therefore, the researcher contacted the interviewees to probe these results and provide a big-picture image of the current status of the adoption and use of BI&A systems in Saudi SMEs.

The following table summarises the explanation that emerged from the discussion of the interviews:

Stage	Factors	Quantitative Results	Qualitative Explanation
Pre-adoption	Compatibility	Not Supported	Unawareness on the part of the pre-adopters of the actual BI&A requirements and needs.
	Competitive Pressure	Not Supported	Saudi Arabia's SMEs are in the first stage of adoption of BI&A systems. Most owners/managers are using their intuition in making business decision. This reflects that the Saudi SMEs are not in a competitive environment yet.
Post-adoption	Relative Advantage	Not Supported	Most of the survey participants were initial adopters. For the initial adopters, the benefits of using the BI&A system fall below their expectations. This is because these benefits need time to become visible.
	Complexity	Not Supported	The post-adopters are aware of the complexities of their BI&A system, which make them ready to deal with these challenges. The BI&A system is not complex, but you need analytical skills to get the most advantage from it.
	Compatibility	Not Supported	Most the BI&A users in Saudi' SMEs are using the system in very simple way by using their existing data: no creativity exist, which causes them to misunderstand the compatibility of BI&A systems with their actual need.
	Enterprise Size	Not Supported	As the enterprise grows, the lack of flexibility within the organisation increases, and data analysis processes become more complex, which may affect the process of using BI&A systems more intensively.
	IT knowledge	Not Supported	Not all users who have IT knowledge have the required data analysis skills.

Table 5. 5 Explanation of the Unexpected Quantitative Result

5.4.3 Section Three: identify new factors.

The semi-structured interview discussion also highlighted some new factors that were not addressed in this study but might be a suitable subject for further studies. The Creswell (2003) generic procedures mentioned in Chapter 3 were used to identify new factors (themes).
Other factors that came up included:

In the post-adoption stage:

Data quality : Data quality is defined as correspondence between needs and the available data (Fourati-Jamoussi & Niamba 2016). The data quality is a significant factor in the successful use of the BI&A system. The BI&A system user relies on the quality of the data in order to make an appropriate and timely business decision (Dawson & Belle 2013). This factor was mentioned frequently by interviewees.

In both pre-adoption and post-adoption stage.

Government Support: in a number of countries, the government has provided incentives to encourage the use of information technology (Al-Weshah & Al-Zubi 2012; Chaveesuk & Horkondee 2015). In many other nations, however, insufficient government assistance has created a hurdle (Chaveesuk & Horkondee 2015; Kartiwi & MacGregor 2007; Lama, Pradhan & Shrestha 2020). In developing countries with high income, such as SA, this factor could significantly impact the adoption and use of BI&A systems, as stated by the interviewees. Currently, the SA government is pushing hard & encouraging the SME sector to utilize advanced technologies in their business. Improving the SME sector is a goal of the 2030 Vision. The government and SMEs have a reciprocal aim, which means the governmental support will improve the SME sector; in return, the government will achieve its goal in this sector.

5.5 Factors Discussion

This section will explain in greater detail how respondents rated the importance of these criteria for the adoption and use of BI&A systems in Saudi SME's. As explained earlier, in Chapter 3, in the pre-adoption stage the researcher asked both the pre-adopters and the post-adopters, because post-adopter interviewees have experiences in using BI&A systems and have a wide perspective on which factors affected their adoption and use of the BI&A system as they went through both stages of pre- and post-adoption. In the post-adoption stage, the researcher asked the post-adopters only.

5.5.1 Relative Advantage:

5.5.1.1 Relative Advantage in pre-adoption:

In general, there was agreement on the positive effect of the relative advantage in owners'/mangers' decisions to adopt BI&A systems in their enterprises among the interviewees. The important of this factor was consistently mentioned by interviewees. Table 5.6, below, explains the interviewees agreement, coded as a tick (√).

Relative Advantage	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Reduce the cost of operations.	√	√	√	√	√	√			√	√	√		√		√	√	√	√	√	15
Provide competitive information.	√	√		√		√		√			√			√	√	√	√	√		11
Improve business processes and make a better decision.		√	√		√	√		√		√		√	√	√	√	√		√	√	13
BI&A system is useful in the enterprise.	√	√	√	√	√	√		√	√	√			√	√	√	√	√	√	√	16

Table 5. 6 Pre-Adoption Stage Relative Advantage Interviewees Agreement

The following instances of responses illustrate the positive effect of relative advantage on the adoption of BI&A systems by Saudi's SMEs.

"Now we are using our intuition to make a business decision which does not always direct us to the right or the best decision. Therefore, I believe the BI&A system will help us to make our decision faster with numbers' evidence" **P2**

"The expected benefit of using the BI&A system is the main reason I decided to use the system on my enterprise, especially to reduce the operation's cost. When non-adopters are aware of the advantages of using the BI&A system, then he/she will adopt the system directly." **PSA4**

5.5.1.2 Relative Advantage in post-adoption:

The relative advantage of using BI&A systems is related to the post adopters' adoption level (Initial adopters or Advanced Adopters). For the Initial adopters, the benefits of using the BI&A system are below their expectations. And this is because these benefits need time to show themselves. For the advanced adopters, the benefit of using the BI&A system was more evident. Also, the advanced adopters agree that their perceptions of the usefulness of the BI&A system in their first adoption stage (initial) were different as compared to the current stage. As

mentioned in Chapter 3 section 3.6.3, this study concentrates on the initial adoption stage as most of the survey participants, 92%, were initial adopters, which means the relative advantage has no positive influence on the utilization of BI&A systems in Saudi SMEs.

Table 5.7, below, explains the interviewees' agreement, coded as a tick (√).

Relative Advantage	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI 1	PSI2	PSI 3	PSI4	PSI5	PSI 6	PSI7	PSA 1	PSA2	PSA 3	PSA4	PSA 5	
Reduce the cost of operations.		√				√		√			√	√	5
Provide competitive information.				√	√		√	√	√	√	√		6
Improve business processes and make a better decision.	√			√	√		√	√	√		√	√	8
BI&A system is useful in the enterprise.	√					√		√	√	√	√	√	7

Table 5. 7 Post-adoption Stage Relative Advantage Interviewees' Agreement

The following answer examples point to the influence of relative advantage on utilization of BI&A systems in Saudi SMEs:

"I have been using the analysis for almost one year, no changes happen to my company, the profit, and the workflow remains the same, yes there is a slight change in data display which helps me in making a decision, but overall, the effort is more than the profit" **PSI5**.

" *You have to be creative and expert in using the BI&A system to know the real advantages; otherwise, the results of using the BI&A system will be disappointing. And this is the problem with the BI&A system. You got disappointed on the first dates because you cannot notice any valuable benefits or changes*." **PSA1**

5.5.2 Complexity

5.5.2.1 Complexity in pre-adoption:

For the pre-adopter interviewees, their perceptions of the complexity of BI&A systems affect their adoption decisions. Some of the pre-adopters found that the high complexity of BI&A systems is the reason for resisting their adoption on the part of the owners/managers. Other pre-adopters believe that the BI&A system is easy and the complexity is not the reason for opposing before the use of BI&A system adoption. Also, when the researcher asked the post-

adopter interviewees about their perceptions of the complexity of the BI&A system before they adopted it, their answers were mixed. Therefore, we obtained mixed results from the interviewees on the effect of complexity in the pre-adoption stage.

Table 5.8, below, explains the interviewees' agreement, coded as a tick (√).

Complexity	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
BI&A system requires a lot of effort.	√			√		√	√		√		√	√		√			√	√	√	11
BI&A system is clear and understandable.		√	√		√			√		√			√		√	√				8
The complexity of the skills required to use the BI&A system.	√			√		√	√		√		√	√		√				√	√	10

Table 5. 8 Pre- Adoption Stage Complexity Interviewee' Agreement

The following answer examples point to the mixed results regarding complexity's effect on adoption of BI&A systems in Saudi SMEs:

" *BI&A system is a highly technical system and requires analytics and advanced computer skills to use it* "**P4**

"My perceptions of the BI&A system is that it is not a complex system as you can use Excel to analyse your data, most of the enterprises now have their data already existing in Excel files which will make the analysis process easier" **P3**

*"Using the BI&A system is like playing chess; the rules are easy but knowing the rules is not enough to make you win. The same thing in BI&A system, knowing the concept of the system is easier than actually working with the system."***PSI3**

5.5.2.2 Complexity in post-adoption:

In general, there was agreement among the interviewees as to the non-effect of complexity in owners'/mangers' utilization of BI&A systems in their enterprises. The post-adopters are aware of the complexities of the system, which make them ready to deal with these challenges. Also, they added that the BI&A system is not complex, but it requires them to have analytical skills. Table 5.9, below, explains the interviewees' agreement, and these are ticked by a tick mark (√).

Complexity	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI 6	PSI7	PSA1	PSA2	PSA3	PSA4	PSA5	
BI&A system requires a lot of effort.			√		√			√	√				4
BI&A system is clear and understandable.	√	√		√		√	√	√	√	√	√	√	10
The complexity of the skills required to use the BI&A system.			√				√			√	√	√	5

Table 5. 9 Post- Adoption Stage Complexity Interviewees' Agreement

The answer examples below point to the non-effect of complexity on utilization of BI&A systems in Saudi's SMEs:

" At my enterprise, I frequently use the BI&A system, so in general, I think using the BI&A system is easier than I expected, and all difficulties disappear over time" **PSI1**

"the BI&A system is not complex, but you need to have analytical skills to get the most advantage from it. Also, when you use an appropriate analysis tool, the BI&A system will be better and easier. In my enterprise, when we have started using Microsoft Power, our operational process becomes easier and smoother" **PSA4**

5.5.3 Observability

5.5.3.1 Observability in pre-adoption:

The interviews revealed, as illustrated in Table 5.10, that the tangibility of the results of using BI&A system leads to rapid adoption of a BI&A system. The visible results will have a big impact on the pre-adopter decision to adopt the BI&A system. Therefore, observability has a positive impact in adoption of BI&A systems in Saudis SMEs.

Table 5.10, below, explains the interviewees' agreement, coded as a tick (√).

Observability	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Seeing BI&A system used in other enterprises.	√		√	√	√	√		√	√	√	√		√	√	√	√	√	√	√	16
Aware of the existence of BI&A tools in the market.		√	√		√			√	√	√	√		√	√	√	√	√	√	√	14
Observable results of using BI&A system.	√		√	√	√	√		√	√	√	√		√	√	√	√	√	√	√	16

Table 5. 10 Pre-Adoption Stage Observability Interviewees' Agreement

The following answer examples point to the influence of observability on utilization of BI&A systems in Saudi's SMEs:

"Even though I have no interest in using the BI&A system, I think it is a good idea to see others using it. In my opinion, seeing others using the system and recognising the changes in their work and income will affect my adoption decision" **P7**.

"My decision on using the BI&A system was because of the observable results at the other enterprises. The observable results affect my decision to adopt the system and now have the same effect of using this system more intensively at my enterprise" **PSA2**

5.5.3.2 Observability in post-adoption:

Similar results were revealed by interviewees in post-adoption stage. Most of them agree of the positive effect of the visible results on utilization of the BI&A system.

Table 5.11, below, explains the interviewees' agreement, coded as a tick (√).

Observability	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Tota 1
Interviewees codes	PSI 1	PSI 2	PSI3	PSI 4	PSI 5	PSI 6	PSI7	PSA 1	PSA 2	PSA3	PSA 4	PSA5	
Seeing BI&A system used in other enterprises.	√	√	√	√		√	√	√	√	√	√	√	12
Aware of the existence of BI&A tools in the market.	√	√	√	√		√	√	√	√	√	√	√	12
Observable results of using BI&A system.	√	√	√	√	√	√	√	√	√	√	√	√	13

Table 5. 11 Post- Adoption Stage Observability Interviewees' Agreement

The answer examples below point to the influence of observability on utilization of BI&A system in Saudi's SMEs:

"I have been using the system for almost two years, with no tangible results or changes. If there were big changes in my profit it would be a big support to use the system more intensively" **PSI3**

"*Our business is new in our community, and few manufacturing companies work on Gibson board. Therefore, we share our reports because any failure of any Gibson board company could affect the reputation of this business in our community. These reports are the primary reason that makes us use the BI&A system more creatively and intensively, because we saw how other companies work with data and the changes in their workflow*" **PSA1**

5.5.4 Compatibility

5.5.4.1 Compatibility in pre-adoption:

In general, there was disagreement among the interviewees regarding the positive effect of the compatibility factor on owners'/mangers' decisions to adopt BI&A systems at their enterprises, which lead to mixed results.

Table 5.12, below, explains the interviewees' agreement, coded as a tick (√).

Compatibility	**Pre-adopters**							**Post-adopters Initial Adopters**							**Post-adopters Advanced Adopters**					**Total**
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI4	PSI 5	PSI6	PSI7	PSA1	PSA2	PSA 3	PSA4	PSA5	
BI&A compatible with organisational culture and values.	√			√		√	√		√		√	√		√			√	√	√	11
BI&A compatible with my enterprise's IT infrastructure.		√	√	√				√		√			√		√	√		√	√	10
BI&A compatible with all aspects of enterprise work.	√		√	√		√					√	√		√				√		8

Table 5. 12 Pre- Adoption Stage Compatibility Interviewees' Agreement

The following answer examples point to the mixed results regarding compatibility's effect on adoption of BI&A systems in Saudi SMEs:

" My understanding about the BI&A system is that the BI&A system is not a mandatory system, and we can grab the data from our system and make analysis by using Excel. No required changes in our current system " **P4**

"In order to be ready to use the BI&A system, I need to be sure that it is in line with my IT infrastructure and my IT skill. If it does not contradict my current system and skills, then it would be easy for me to understand the system and then make a decision to adopt it." **P2**

5.5.4.2 Compatibility in post-adoption:

The interviewees in the post-adoption stage also gave mixed results about the positive effect of the compatibility factor on owners/mangers' utilization of BI&A systems in their enterprises.

Table 5.13, below, explains the interviewees' agreement, coded as a tick (√).

Compatibility	**Post-adopters Initial Adopters**							**Post-adopters Advanced Adopters**					**Total**
Interviewees codes	PSI1	PSI 2	PSI3	PSI4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
BI&A compatible with organisational culture and values.		√	√	√	√		√		√	√	√	√	9
BI&A compatible with my enterprise's IT infrastructure.	√		√			√		√	√		√	√	7
BI&A compatible with all aspects of enterprise work.				√			√		√		√	√	5

Table 5. 13 Post- Adoption Stage Compatibility Interviewees' Agreement

The answer examples below point to the mixed results around compatibility's effect on utilization of BI&A system in Saudi SMEs:

"With huge current changes in SA, there is a big direction in using advanced technology such as BI&A systems in the enterprises. So, using such technology is compatible with our current cultures and values. Nevertheless, we still have a weak IT infrastructure in our enterprises. For example, our enterprise does not have a central database that can be easy to use and share. Our data come from different platforms, which makes the analysis process harder" **PSI5**

"Most of the BI&A users in Saudi SMEs are using the system in a very simple way by using their existing data, and they do not make any effort to make any changes on their system that make them feel the BI&A system is compatible with their IT infrastructure, culture, and values, while other users understand the system requirements and all required changes on their current system. Therefore, in general, they are missing an understanding of BI&A system requirements from the owners or managers in SMEs" **PSA4**

5.5.5 Enterprise Size

5.5.5.1 Enterprise Size in pre-adoption:

Most of the interviewees stated that the firm size has a positive effect on SMEs' adoption of BI&A systems. Enterprises with higher number of employees and greater revenue are more likely to adopt a BI&A system in their companies.

Table 5.14, below, explains the interviewees' agreement, coded as a tick (√).

Enterprise Size	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Enterprise Size	√		√	√	√	√		√		√	√	√	√	√	√	√	√	√	√	16

Table 5. 14 Pre-Adoption Stage Enterprise Size Interviewees' Agreement

The following answer examples point to the influence of enterprise size on adoption of BI&A systems in Saudi SMEs:

"Yes, without doubt, the enterprises with a higher number of employees will have more chance to adopt advanced technology systems such as the BI&A system, as the encouragement could come from any employee within the enterprise. The chance of sharing ideas and experiences will be higher compared to the companies with a low number of employees" **P6**

"The enterprises with a higher number of employees and revenue are more likely to have more data in their systems. Therefore, the need to take advantage of these data will be higher than at the enterprise with fewer employees or [less] revenue, which will definitely affect their adoption decision positively" **PSI7**

5.5.5.2 Enterprise Size in post-adoption:

In general, there was agreement among the interviewees on the non-effect of the enterprise size on owners/mangers' utilization of the BI&A system in their enterprises. Below, there are examples of some of the interviewee's justifications; these justifications are explained more deeply in Chapter 6.

Table 5.15, below, explains the interviewees' agreement, coded as a tick (√).

Enterprise Size	**Post-adopters Initial Adopters**							**Post-adopters Advanced Adopters**					**Total**
Interviewees codes	PSI1	PSI 2	PSI3	PSI4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Enterprise Size		√	√			√				√			4

Table 5. 15 Post-Adoption Stage Enterprise Size Interviewees' Agreement

The answer examples below point to the non-effect of enterprise size on utilization of BI&A systems in Saudi SMEs:

"The enterprise size will greatly affect the owner's decision to adopt the BI&A system, but there is no visible effect of the enterprise size on using the system more intensively in the post-adoption stage. I have more than 200 employees at my enterprise; when the enterprise grows, the lack of flexibility within the departments increases, and data analysis processes become more complex; this affects the process of using the BI&A system more intensively" **PSI5**

"I have around 53 employees in my enterprise, and I use the Tubule software frequently. I think the extent of use of data analysis tool is related to the skills the user has more than the number of employees at your enterprise. Some SMEs. have a high number of employees and a massive amount of data, but they use their tool in a very simple way" **PSA2**

5.5.6 Resource Availability

5.5.6.1 Resource Availability in pre-adoption:

The interviews revealed, as illustrated in Table 5.16, that the resources availability leads to rapid adoption of BI&A systems. The SMEs usually suffer for lack of resources that include finance, IT, and human resources. Therefore, when these resources are available at an enterprise, the adoption chance will be higher according to the interviewees.

Table 5.16, below, explains the interviewees' agreement, coded as a tick (√).

Resource Availability	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI4	PSI 5	PSI6	PSI7	PSA1	PSA2	PSA 3	PSA4	PSA5	
Technological resources	√		√		√	√	√		√		√		√		√	√	√			11
Financial resources.		√			√	√	√		√	√		√		√		√	√		√	11
Training and IT support	√	√				√		√		√	√		√			√		√	√	13
Human resources	√		√	√	√		√	√	√	√	√	√	√	√	√	√	√	√	√	18

Table 5. 16 Pre-Adoption Stage Resource Availability Interviewees' Agreement

The answer examples below point to the influence of resource availability on adoption of BI&A systems in Saudi SMEs:

"We have many data that's come from our daily customers, but I have no interest in using technologies. If I decide to implement the BI&A system, I will need to buy a new one as our current system is quite old. Also, we will need a specialist to install the system and a permanent employee that can deal with that system……..yes, if I have all these resources, the decision to adopt the BI&A system will be easier" **P7**

"I have the intention to adopt the BI&A system at my enterprise soon. Now we are in the evaluation stage to determine the system requirements. Cleaning and centralising the data need specialists; if we have experts, our adoption and evaluation will be smoother……. No, I do not think the BI&A system is expensive. We are planning to use Excel, which is already available in our systems. Also, now I am enrolled in free data analysis courses that Monsha'at has provided." **P3**

5.5.6.2 Resource Availability in post-adoption:

The majority of the interviewees noted that the availability of resources had a favourable impact on SMEs' use of BI&A systems. The interviewees in the post-adoption stage have concentrated on training and human resources more than financial and technological resources. Table 5.17, below, explains the interviewees' agreement, coded as a tick (√).

Resource Availability	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI 6	PSI7	PSA1	PSA2	PSA3	PSA4	PSA5	
Technological resources			√		√	√			√		√		5
Financial resources.		√		√		√	√	√		√			6
Training and IT support	√	√		√		√		√	√	√	√	√	9
Human resources	√	√	√	√	√	√	√	√	√	√	√	√	12

Table 5. 17 Post-Adoption Stage Resource Availability Interviewees' Agreement

The following answer examples point to the influence of resource availability on utilization of BI&A systems in Saudi SMEs:

"Data analyst or data analysis skills are required to get out the most of BI&A systems. Proper, efficient data analysis will result in utilizing BI&A more efficiently, which means more meaningful and robust data & information to build your decision on. Once the system has been installed and established, it does not require much money for maintenance as in SMEs the data load is not like big companies, which need a higher system and scheduled maintenance". **PSA5**

"It is not doubted that employees' skills and qualifications are more important than the number of employees (quantity). In addition, maintaining and improving skills and knowledge of employees via continuous training programs and courses will increase the efficient use of BI&A systems." **PSI1**

5.5.7 Competitive Pressure

5.5.7.1 Competitive pressure in pre-adoption:

In general, there was disagreement among the interviewees as to the positive effect of the competitive pressure factor in owners'/mangers' decisions to adopt BI&A systems in their enterprises, which lead to mixed results.

Table 5.18, below, explains the interviewees' agreement, coded as a tick (√).

Competitive Pressure	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
The degree of competition in our industry.	√		√	√		√			√				√	√				√		8
Pressure from competitors	√		√	√		√		√	√				√			√		√		9
BI&A system helps maintain business competitiveness in the market.	√		√	√							√	√		√	√	√		√		9

Table 5. 18 Pre-Adoption Stage Competitive Pressure Interviewees' Agreement

The following answer examples highlight of the mixed results around competitive pressure's influence on adoption of BI&A systems in Saudi SMEs:

" The number of companies that use BI&A systems is still low. Most SMEs rely heavily on intuition rather than a data analysis system. As a result, we lose the competitive value between companies. But this competitiveness increased after adopting the system because the user is keener to gain accurate information to make business decisions" **PSA3**

"The competitive pressure in SA these days is higher than before. There is high competition between businesses in using advanced technology. These days, there are huge waves of opening private businesses by young people, especially with the recent government support.

Therefore, most businesses are willing to use the BI&A system to gain a competitive advantage in the market." **P3**

5.5.7.2 Competitive pressure in post-adoption:

Most of the interviewees stated that the competitive pressure had a favourable impact on SMEs' use of BI&A systems. They were in agreement that the SME in a competitive environment is more likely to increase its utilization of BI&A systems.

Table 5.19, below explain the interviewees agreement, as a tick (√).

Competitive Pressure	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI 6	PSI7	PSA1	PSA2	PSA3	PSA4	PSA5	
The degree of competition in our industry.		√	√	√	√	√	√	√	√	√		√	10
Pressure from competitors		√	√	√	√	√	√	√	√	√		√	10
BI&A system helps maintain its competitiveness in the market.	√	√				√		√	√	√	√	√	9

Table 5. 19 Post-Adoption Stage Competitive Pressure Interviewees' Agreement

The answer examples below point to the influence of competitive pressure on utilization of BI&A systems in Saudi SMEs:

"Our business has four competitors; our enterprise tries to offer the best services due to competition. Therefore, we try to use more features of the BI&A system to produce more competitive information" **PSI5**

"My use of the BI&A system has increased extremely because of the pressure we faced with our competitors. I was using the system just for an administrative task to generate reports. Now I use the Tableau system that allows me to do a multi-dimensional view of data" **PSA2**

5.5.8 External Support

5.5.8.1 External Support in pre-adoption:

In general, there was agreement among the interviewees on the positive effect of external support on owners'/mangers' decisions to adopt BI&A systems in their enterprises. Saudi SMEs are motivated to adopt a BI&A system when more external support is expected.

Table 5.20, below, explains the interviewees' agreement, coded as a tick (√).

External Support	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI4	PSI 5	PSI6	PSI7	PSA1	PSA2	PSA 3	PSA4	PSA5	
The existence of businesses that provide BI&A system technical support.	√	√	√		√	√	√	√	√		√		√	√	√	√	√	√	√	16
Technology vendors that actively market the BI&A system.		√			√	√	√		√	√		√	√	√		√	√		√	12
Technology vendors' promotion of BI&A system and free training sessions.	√	√	√			√		√	√	√	√		√	√	√	√		√	√	14

Table 5. 20 Pre-Adoption Stage External Support Interviewees' Agreement

The answer examples below represent the influence of external support on adoption of BI&A systems in Saudi SMEs:

"The BI&A system is a very advanced technology, and I cannot make my decision to adopt the system without third-party help. Therefore, the existence of any technology vendors that provide free training sessions will be helpful ". **P2**

" *I am good at using technology, but in a system such as BI&A, I will need external help as I do not have internal IT experts in my company. Employing an IT or data analysis specialist will be costly to my company*" **P3**

5.5.8.2 External Support in post-adoption:

Most of the interviewees indicated that a positive influence could be seen of the external support on utilization of BI&A systems in SMEs, which means both adopter and pre-adopter are seeking external help to use and adopt BI&A system.

Table 5.21, below, explains the interviewees' agreement, coded as a tick (√).

External Support	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI 6	PSI7	PSA1	PSA2	PSA3	PSA4	PSA5	
The existence of businesses that provide BI&A system technical support.		√		√		√		√	√	√			11
Technology vendors that		√	√		√		√		√	√		√	11

actively market the BI&A system.													
Technology vendors promotion for BI&A system and free training sessions.	√		√	√		√			√		√	√	13

Table 5. 21 Post-Adoption Stage External Support Interviewees' Agreement

The following answer example is typical as regards the influence of external support on utilization of BI&A systems in Saudi SMEs:

"*We started our data analysis using Excel, but after attending many external courses and training sessions, we switched to Microsoft Power. At that time, we started the actual data analysis at a very advanced level, so to answer your question, external help is essential to use the system sincerely. Unless you have a data analysis specialist in your company, and that is very rare in SMEs in general as they have limited resources* " **PSA1**

5.5.9 IT knowledge

5.5.9.1 IT knowledge in pre-adoption:

The interviews revealed, as illustrated in Table 5.22, that the owners'/managers' IT knowledge leads to rapid adoption of BI&A systems. When the owner or manager has greater IT experience, they are more inclined to be creative and that will affect their decision to adopt a BI&A system.

Table 5.22, below, explains the interviewees' agreement, coded as a tick (√).

IT knowledge	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Using a computer at home and work.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	19
knowledge and skills of computers and IT.		√			√	√	√		√	√	√	√		√		√	√		√	12
Technical skills to use a new technological system such BI&A system.	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	17

Table 5. 22 Pre-Adoption Stage IT knowledge Interviewees' Agreement

The answer examples below typify the influence of IT knowledge on adoption of BI&A systems in Saudi SMEs:

"When I have sufficient IT knowledge, my confidence and capacity will push me to try new advanced technology such as the BI&A system. Unfortunately, I do not have this knowledge. Therefore, deciding to adopt the BI&A system was hard for me." **P5**

"When the owner or manager has greater IT experience, they are more inclined to be creative and dare to use technologies, which will affect their decision to adopt a BI&A system." **PSI3**

5.5.9.2 IT knowledge in post-adoption:

In general, there was agreement among the interviewees on the non-effect of IT knowledge on owners/mangers' utilization of the BI&A system at their enterprises. The interviewees were agreed that general IT knowledge is not sufficient to use the BI&A system more intensively. Table 5.23, below, explains the interviewees' agreement, coded as a tick (√).

IT knowledge	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI 6	PSI7	PSA1	PSA2	PSA3	PSA4	PSA5	
Using a computer at home and work.				√				√	√	√			4
knowledge and skills of computers and IT.		√	√			√			√				4
Technical skills to use a new technological system such BI&A system.	√	√	√	√		√			√				6

Table 5. 23 Post-Adoption Stage IT knowledge Interviewees' Agreement

The answer examples below highlight the non-effect of IT knowledge on utilization of BI&A systems in Saudi SMEs:

"General IT knowledge is insufficient to use the BI&A system more intensively. You must have data analysis skills to use the system more and get the most advantage from it; not all users with IT knowledge have the required data analysis skills." **PSA5**

"Your IT knowledge will affect your decision to adopt the BI&A system but does not affect your extensive use of the system after adoption. The extensive use is more likely related to the system outcome, which is related to your creativity in playing with data, not your general IT knowledge" **PSI7**

5.5.10 Innovativeness

5.5.10.1 Innovativeness in pre-adoption:

Most of the interviewees reported a positive influence of innovativeness on adoption of BI&A systems in SMEs. The interviewees concurred that personal IT innovation is a significant factor in the adoption of BI&A systems by SMEs.

Table 5.24, below, explains the interviewees' agreement, coded as a tick (√).

Innovativeness	Pre-adopters							Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	P1	P2	P3	P4	P5	P6	P7	PSI 1	PSI2	PSI3	PSI 4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA 4	PSA5	
Looking for ways to experiment new technology.	√	√	√		√	√	√		√		√	√	√		√	√	√	√		14
The first to explore new IT.		√			√	√	√		√	√	√	√		√		√	√		√	12
Hesitant to try out new information technologies.	√	√	√		√	√		√	√	√	√	√	√	√	√	√	√	√	√	17

Table 5. 24 Pre-Adoption Stage Innovativeness Interviewees' Agreement

The following answer examples point to the effect of innovativeness on adoption of BI&A systems in Saudi SMEs:

" *Personally, I like to explore and try out new technology. Even at my home, I have a lot of advanced technology and sensor devices,….. in my opinion, if you are innovative, the chance to adopt the BI&A system will be too high*." **P2**

"*If you are innovative, that means you like changes and try new things, including changing device programs and the workflow. This means this will affect the innovative pre-adopter opinion to adopt the BI&A system and the post-adopter to use the system more innovatively, which will fulfil their internal desire for change and renewal."* **PSA2**

5.5.10.2 Innovativeness in post-adoption:

Similar results were revealed by interviewees in post-adoption stage. Most of them agree on the positive effect of personal innovativeness on utilization of BI&A systems.

Table 5.25, below, explains the interviewees' agreement, coded as a tick (√).

Innovativeness	Post-adopters Initial Adopters							Post-adopters Advanced Adopters					Total
Interviewees codes	PSI1	PSI2	PSI3	PSI4	PSI5	PSI6	PSI 7	PSA1	PSA2	PSA3	PSA4	PSA5	
Looking for ways to experiment new technology.		√		√	√	√	√	√	√	√	√	√	10

The first to explore new IT.		√	√		√		√		√	√	√	√	8
Hesitant to try out new information technologies .	√	√	√	√	√	√	√	√	√	√	√	√	12

Table 5. 25 Post-Adoption Stage Innovativeness Interviewees' Agreement

The answer examples below describe the influence of innovativeness on employment of BI&A systems in Saudi SMEs:

"Using a BI&A system is connecting with your innovativeness. When you have a sense of innovation, then you are more likely to apply distinctive and risky solutions and find a new way to deal with your enterprise data. This is especially so in the BI&A system, where playing with data is the key to the successful use of the system to gain competitive information." **PSI7**

"The main idea and aim to using a BI&A system at your enterprise is to transfer the un meaningful row data to valuable information. It would help if you always used different analysis techniques to achieve this aim. For non-innovators, it is hard to change their daily routine for them, and they are not seeking to find new data analysis solutions. However, the innovators, they are always seeking new data analysis solutions." **PSA4**

5.6 Chapter Summary

The overall aim of the present chapter was to explain and further validate the quantitative results by presenting and analysing the qualitative data results. Earlier in this chapter, the interview overview was presented, followed by brief details of the interview participants that include participant code, their education level, BI&A experience, work sector, kind of BI&A system, position, and enterprise size. Then, interview findings were presented; these were split across three sections. The first one aimed to validate and further test the quantitative results, therefore thematic analysis was applied here to explain whether the qualitative results support the research's hypothesis or not, then the researcher compared the qualitative and quantitative results in order to explain whether the qualitative results are consistent with quantitative results. Most of the quantitative results were supported by qualitative results except for H2a, H4a, H7a, and H4b. The results of the interviews of these four hypotheses were mixed. In the second section, the interviewees explained the unexpected quantitative results. Finally, new points that could influence the adoption and use of BI&A systems in SMEs in SA were identified. The results of this chapter and Chapter 4 will be discussed in detail in the next chapter along with research outcomes and conclusions.

6 Chapter Six: Discussion, Implications and Conclusions

6.1 Introduction

This chapter discusses the findings of the quantitative and qualitative investigations and relates them to the current literature on BI&A system adoption and use in SMEs. Thus, a complementary discussion of the findings is possible. This chapter begins with a summary of the research problem, as well as the research questions and hypotheses, followed by a discussion of the significant results and how they are related with essential factors that impact the adoption and usage of BI&A systems in Saudi SMEs. Later in the chapter, the research contributions and implications are discussed. The chapter ends with noting the study's limitations and pointing out future research opportunities.

6.2 Reviewing the Research Problem, Questions and Hypotheses

Literature reviews show that there is a shortage of studies on BI&A systems adoption and use in general (Bach, Čeljo & Zoroja 2016; Grublješič, Coelho & Jaklič 2019) and in SMEs in specific (Ahmad et al., 2020; Almusallam & Chandran, 2020; Wee et al., 2022a). Also, there is a dearth of studies in the context of developing countries such as SA (Ain et al., 2019, Aldossari & Mokhtar, 2020a). Furthermore, most studies only capture a snapshot of user attitudes at a certain point of user exposure to technology, in relation to adoption or continuing usage behaviour. The findings of these snapshots show that the barriers to and drivers of IS adoption differ from those of continuous technology use (Bhattacherjee & Lin 2015). However, little is known about how well the factors that influence intention to adopt (pre-adoption) also predict extensive use (post-adoption) of the same technology. Consequently, there is a significant need to address these gaps. Therefore, the aim of this research is to investigate the pre- and post-adoption factors that influence owners'/managers' decisions to adopt and use BI&A systems at their SMEs in the Saudi context. To achieve this aim, a research model was proposed; this model contain the main factors that affect the SMEs' adoption and use level of BI&A systems. In relation to the aim, this study primarily addresses the following question:

What are the critical factors that influence BI&A systems pre- and post-adoption by Saudi SMEs?

In order to answer the research question, an intensive literature review in the area of BI&A systems adoption and use in SMEs was conducted. Following the intensive literature review, a systematic literature review SLR was carried out that provided comprehensive knowledge about the present domain of BI&A adoption, theory, model, and frameworks. Also, the

influences on the adoption and use of BI&A systems in big companies and in SMEs have been discussed and categorised. As a result of the intensive literature review and SLR, the research model and hypothesis were generated. To probe and validate the research model, an explanatory sequential mixed method was utilized. This method starts with quantitative research, analyses the results, then conducts qualitative research. Therefore, the survey was able to probe and validate the research model. The interviews were then used to explain and further test and validate the quantitative results.

The main research question is subdivided into pertinent sub-questions. Table 6.1, below, displays the sub-questions, related factors, and hypotheses addressed in this thesis.

Research Questions	Characteristics	Factor	Adoption Stage	Hypotheses
How do the technology characteristics (Relative Advantage, Complexity, Compatibility, and Observability) affect the BI&A system's pre- and post-adoption in Saudi SMEs? How do these critical factors influence SMEs differentially in pre- and post-adoption stages?	Technological	Relative Advantage	Pre-adoption	**H1a:** Relative Advantage has a positive effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H1b:** Relative Advantage has a positive effect on post-adoption of BI&A systems in SMEs.
		Complexity	Pre-adoption	**H2a:** Complexity has a negative effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H2b.** Complexity has a negative effect on post-adoption of BI&A systems in SMEs.
		Observability	Pre-adoption	**H3a:** Observability has a positive effect on pre-adoption of BI&A systems in SMEs
			Post-adoption	**H3b**: Observability has a positive effect on post-adoption of BI&A systems in SMEs.

		Compatibility	Pre-adoption	**H4a:** Compatibility has a positive effect on pre-adoption of BI&A systems in SMEs
			Post-adoption	**H4b**: Compatibility has a positive effect on post-adoption of BI&A systems in SMEs
What role do the organisational characteristics (Resource Availability and Enterprise size) play in BI&A system pre- and post-adoption in Saudi SMEs? How do these critical factors influence SMEs differentially in pre- and post-adoption stages?	Organisational	Organisational size	Pre-adoption	**H5a:** Organisational size has a positive effect on pre-adoption of BI&A SMEs.
			Post-adoption	**H5b:** Organisational size has a positive effect on post-adoption of BI&A in SMEs.
		Organisational Resource Availability	Pre-adoption	**H6a:** Organisational Resource Availability has a positive effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H6b**: Organisational Resource Availability has a positive effect on post-adoption of BI&A systems in SMEs.
How do environmental characteristics (Competitive Pressure and External Support) impact BI&A	Environmental	Competitive Pressure	Pre-adoption	**H7a:** Competitive Pressure has a positive effect on pre-adoption of BI&A systems in SMEs.

system pre- and post-adoption in Saudi SMEs? How do these critical factors influence SMEs differentially in pre- and post-adoption stages?			Post-adoption	**H7b**: Competitive Pressure has a positive effect on post-adoption of BI&A systems in SMEs.
		External support	Pre-adoption	**H8a:** External support has a positive effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H8b**: External support has a positive effect on post-adoption of BI&A systems in SMEs.
How do owner/managers characteristics (IT knowledge and innovativeness) of SMEs affect BI&A pre- and post-adoption in SA? How do these critical factors influence SMEs differentially in pre and post-adoption stages?	Owners/managers	IT Knowledge	Pre-adoption	**H9a:** Owners'-managers' IT Knowledge has a positive effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H9b**: Owners'-managers' IT Knowledge has a positive effect on post-adoption of BI&A systems in SMEs.
		Innovativeness	Pre-adoption	**H10a:** Owners'-managers' Innovativeness has a positive effect on pre-adoption of BI&A systems in SMEs.
			Post-adoption	**H10b**: Owners'-managers' Innovativeness has a positive effect on post-adoption of BI&A systems in SMEs.

Table 6. 1 Review of Research Questions and Hypothese

6.3 Discussion of Research Findings

6.3.1 Discussion of Descriptive statistic results

The majority of BI&A systems users are owners or managers in high-level positions in the organisation in SMEs. Hence, the owners/managers in SMEs are more likely to have a dual identity in describing the technology adoption: the potential sponsor and the actual adopter of BI&A systems (Luo 2016). Therefore, the owners'/managers' actions will influence the enterprise performance. In this study, most of the participants in the pre-adoption group held owner/manager positions, 77.86%, with 17.86% being owner and 3.4% being manager, and only 0.8% holding other positions. In the post-adoption group, many of the participants were owners/managers, 43.8%, followed by the owners with 36.1%. 16.5% were managers, and only 3.6% were in other positions. The highest percentage for the enterprise size in pre-adoption group was the enterprises with 1 to 5 employees, while in the post-adoption group it was the enterprises with 51 to 100 employees. This indicates that in SA the enterprises that have BI&A systems are more likely to have higher numbers of employees compared to enterprises that do not have BI&A systems. Also, in enterprises with lower number of employees the owner is more likely to have an owner-manager position while the enterprises with higher number of employees hire a manager to help the owner in business processes. The result of the participants' gender and age in both pre- and post-adoption groups were similar: most participants were males with age between 26 and 60 years old in both groups. This shows that the age and gender do not show any significant effect between the two groups pre- and post-adoption.

The post-adopters are more educated compared to the pre-adopters, as shown in Chapter 4 section 4.3.4; most post-adopters hold bachelor's, master's, and PhD degree, which is consistent with the reviewed research where it found that most BI&A system users (post-adopters) are typically educated people who tend to have great experience and skills around the system applications (Grublješič, Coelho & Jaklič 2019; Luo 2016).

In the post-adoption stage, most participants have two years or less experience in using BI&A tools and they merely use the system for reporting and simple inquiry functions for data view rather than using advanced data analysis technique to find relevant information and provide predictive outcomes. Also, most participants (73.70%) are using Excel tools for analysis in

SMEs and this is consist with previous studies who find that most of BI&A system users in SMEs are using the Excel as BI&A tool for analysis (Tutuneaa & Rus, 2012; Tatić et al., 2018; Wee et al., 2022a), and while Excel tools are easy to put in place, simple to use, and competent at providing quick results, they are essentially prototype tools built to assist with individual productivity as opposed to tools suitable for enterprise-wide use. According to Vetana (2010), the majority of businesses have come round to the view that mistakes in data input and calculations may be pervasive throughout the company when utilising Excel and other spreadsheet software. As a result, we can confirm that Saudi SMEs are still in the initial stage of use of BI&A systems. Therefore, in order to increase the level of adoption and use of BI&A system in Saudi SMEs, the government, IT vendors, SMEs owners, and IT consultants have to look to the influences on the adoption and use of BI&A systems. In the present thesis, ten factors have been investigated, as discussed in the following sections.

6.3.2 Factors affect the adoption and use of BI&A system in Saudi SMEs

In Chapter 4 section 4.5, the test of the research model showed that in the pre-adoption stage, out of all ten proposed factors, two factors were not supported, compatibility and competitive pressure while in the post-adoption stage, five factors were not supported, relative advantage, complexity, compatibility, enterprise size, and owners'/managers' IT Knowledge. The model shown in Figure 2.10 of Chapter 2 is changed and displayed in Figure 6.1, below, based on these results.

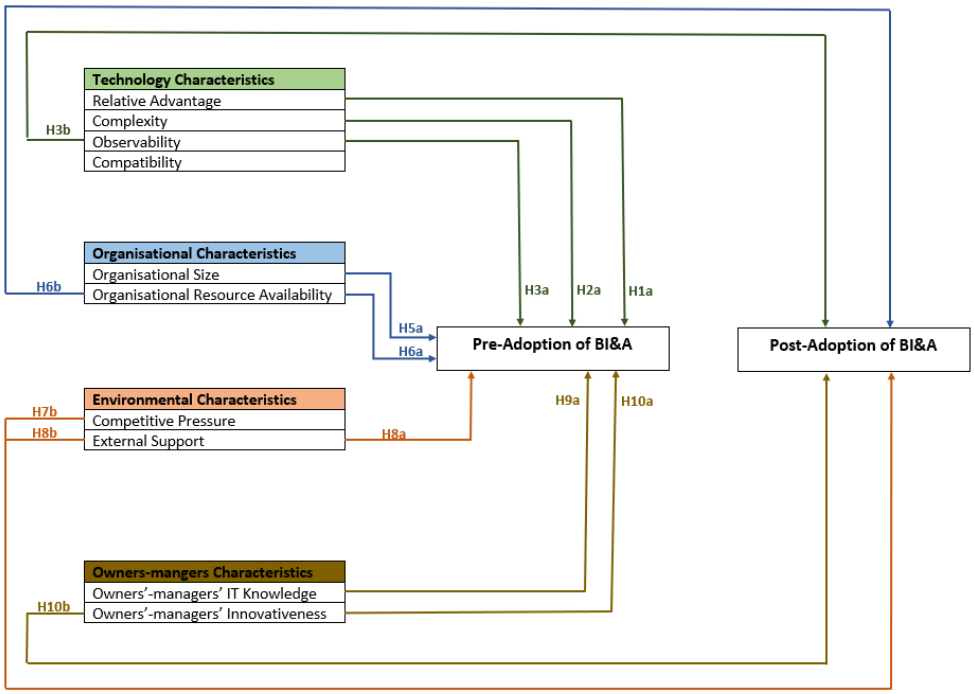

Figure 6. 1 Pre- and Post-Adoption Model Hypotheses Testing

6.3.2.1 Technology Characteristics

The results of this study show that, within technology characteristics, the compatibility was the only non-significant factor in the pre-adoption group, while in the post-adoption group the compatibility, relative advantage, and complexity were not significant factors.

The relative advantage was significant in the pre-adoption group, and this concurs with previous studies (Ahmad et al., 2016; Boonsiritomachai et al., 2016; Puklavec et al., 2014; Qushem et al., 2017; Simon & Suarez, 2022) and is in line with Rogers' DOI theory. SMEs have limited resources for IT investment, and for the owners/managers to make a decision to adopt a BI&A system, they have to know its advantage over existing practices. When business owners and managers have the correct information and understand the benefits, their adoption decisions level is higher. This has been confirmed by most of the interviewees as they agree that when there is any evidence that using the BI&A system will reduce operational costs and facilitate their business process, this will affect their adoption decision positively. On the other hand, P7 argued that the SME is not like big companies; in general SMEs generate a small amount of data, so there is no need to use the BI&A system, meaning that the expectation benefit of using the BI&A system in SMEs is low. We can argue that the positive effects of using BI&A systems in SMEs have been proven by many scholars (Boonsiritomachai et al., 2016; Md Hatta et al., 2015; Puklavec et al., 2014; Wee et al., 2022b) and have been found as

the most significant predictor of BI&A system adoption (Simon & Suarez, 2022; Boonsiritomachai et al., 2016; Ahmad et al., 2016). Moreover, the SMEs can take advantage of using the BI&A system not by relying on their own data only: outsourced data help SMEs in predicting and being aware of the market's direction to gain competitive advantage.

Surprisingly, relative advantage was not a significant factor in the post-adopters group. This aligns with Puklavec, Oliveira and Popovič (2018) study as they found that relative advantage was non-significant in their study. This has been explained by interview participants. Most advanced post-adopter participants agree that the relative advantage in using BI&A systems is related to the user's post-adopter adoption level (Initial adopters or Advanced Adopters). For the initial adopters, the benefits of using the BI&A system are below their expectations. This is because these benefits of using BI&A systems take time before they are shown. The Saudi SMEs use BI&A, but they have not yet reached a point where the system helps them in advanced decision making (please prefer to Chapter 4 section 4.3.10). The process of preparing the data, making a connection between them, and finding valuable information to make business decision needs time, which could make the users doubt the advantages of using the system. 92.2% of participants are using the BI&A system for basic reporting and they keep the data in a standardised format rather than using multi-dimensional analysis to provide predictive outcomes or track what is going on to generate an automatic report. Therefore, there is a lack of the understanding of the real value that can be obtained from BI&A systems in Saudi SMEs.

Complexity was likewise significant in the pre-adopter group. This result is in line with Rogers' DOI theory and it is consistent with previous studies (Boonsiritomachai et al., 2016, Hou, 2014a; Simon & Suarez, 2022) as these found the high complexity of BI&A system to be the reason for resisting its adoption by many an owner/manager. Although BI&A systems are becoming increasingly user-friendly, they are still complex and difficult to use in the perception of pre-adopters (Yoon et al., 2017; Simon & Suarez, 2022). For the pre-adopters, their perceptions of the complexity of BI&A system affects their adoption decision and they believe that they cannot adopt the BI&A system without external IT help and training. The pre-adopters must still possess knowledge and abilities in other areas to produce accurate results and increase their adoption chance (Olszak & Ziemba, 2012). For instance, BI&A needs expertise in data preparation and fundamental statistics skills. This need is problematic for SMEs since they lack internal expertise and IS professionals (Ghobakhloo et al., 2011; Thong, 1999). However, some pre-adopter interviewees believe that the BI&A system has become easier and

user friendly and that complexity is not the reason for opposing BI&A system adoption. Therefore, we have inconclusive results from the interviewees about the effect of complexity in pre-adoption stage. As this research relies more on the quantitative results it is possible to conclude that although BI&A systems are becoming increasingly user-friendly, they are still complex and difficult to use in the perception of Saudi SME pre-adopters. As mentioned in chapter 2 section 2.5.4, the Saudi government has provided a number of workshops and courses for SME's owners to improve their IT & analysis skills to run their system, yet there is need to provide more courses and make them more accessible; also Saudi government has to be sure that the SMEs owners/managers are aware about the availability of these courses to increase their analysis skills which will affect their perception of the complexity of the BI&A system that will lead to more adoption chance for BI&A system in SMEs . Moreover, BI&A systems must be straightforward and simple to use without much requirement for IT help and training specially for the SME's owner/manager who suffer of shortage of resources. BI&A system simplicity and easy to use systems should be considered by IT vendors to be able to increase their market and increase the level of BI&A adoption in SMEs, respectively.

For the post-adopters, the complexity has no significant effect on their decision to extent use of BI&A systems at their enterprise. Some of the previous studies have the same results (Daradkeh & Al-Dwairi 2017; Hou 2016; Sujitparapitaya, Shirani & Roldan 2012). This research result shows that BI&A system users (post-adopters) are more educated compared with pre-adopters and they have experience and skills needed for BI&A system use; most post-adopters hold bachelor's, master's, and PhD degrees. These attributes make the users aware of the complexities of BI&A systems, and they could solve the inherent problems and difficulties to make them ready to deal with these challenges. Furthermore, this result is consistent with Karahanna, Straub and Chervany (1999) study, which outlined that this factor has more impact on the potential adopters to adopt new technology than the users to use the systems extensively.

Observability was significant in both group, pre- and post-adopters. The tangibility of the results of using BI&A systems has led to rapid adoption in both groups. This result is in line with Rogers' DOI theory, and it is consistent with the earlier studies (Boonsiritomachai et al. 2016; Grublješič, Coelho & Jaklič 2019; Hou 2014b; Jaklič, Grublješič & Popovič 2018). In order to assess the relative benefit of technology, enterprises may have investigated the success of initiatives undertaken by trading partners or competitors. When pre-adopters realise the results of adopting technological innovation systems, they are more willing to take on the

systems wholly. Moreover, as is mentioned in Chapter 2 section 2.2.5, the results of using BI&A systems are indirect and can be observed in the long run; therefore, the visible results will have a big impact on the post-adopters to use the system extensively. This result may suggest that the more the pre-adopters know that BI&A systems are available in the market, the greater the likelihood that they will adopt BI&A systems in their enterprises. For the limited resources of SMEs owners/managers, they believe that BI&A is not mandatory or essential to run their business. Thus, they should be convinced by giving them tangible results from other enterprises in the same sector. Before implementing a new technology for their business, Saudi SME's will do investigation. It is essential that they get the chance to obtain information on BI&A technology. The producers, suppliers, or sellers of the technology must provide the required information. Also, the more the post-adopters know that BI&A systems are available in the market and notice their visible results in operation, the more intensively they will use BI&A systems in their enterprises.

Compatibility was not significant in either group, pre- or post-adopters. This result diverges from Rogers' DOI theory and with most previous studies (Bhatiasevi & Naglis 2018; Chang, Hsu & Shiau 2013; Ghobakhloo & Tang 2013; Sin Tan et al. 2009). Compatibility has been found to be a very important determinant of innovation technology adoption in studies of SMEs. If present systems are incompatible with BI&A solutions, migrating and implementing data will require a significant amount of time and money. This should be emphasised more in small businesses with limited resources, but this research's results go in the opposite direction: it found that the compatibility is not significant for both pre- and post-adopters. In order to explain this result, we asked the interviewees, and we received inconclusive results. For the pre-adoption stage, some of the interviewees agree that the BI&A system is compatible with their system and culture. For example, P4 stated *"my understanding about the BI&A system is that the BI&A system is not mandatory system and simply we can grab the data from our system and make analysis by using Excel. No required changes in our current system*". On the other hand, other interviewees found BI&A complicated and requiring a lot of changes in their systems and workflow. Also, the researcher asked the advanced adopters about both stages (pre- and post-adoption stages) as the advanced adopters have experience and they have gone through all adoption stages. The advanced adopters were agreed that the weakness of the compatibility factor is due to the unawareness of the pre-adopters of the actual BI&A requirements and needs. Some individuals believe that BI&A is not compatible with their current system as they believe BI&A is sophisticated technology that requires an advanced

system to work with it. On the other hand, others believe BI&A is compatible with their current IT infrastructure as they believe BI&A is simple and all that is required is extracting data from the current system & analysing them in MS Excel. In the post-adoption stage the advance adopters also explain that most of the BI&A users in Saudi SMEs are using the system in a very simple way by using their existing data and they do not make any effort to make any changes to their system to make them feel the BI&A system is compatible, while other users understand the system requirements and all required changes on their current system. As result, it can be seen that there is misunderstanding of BI&A system requirements by the owner/manager pre- and post-adopters in Saudi SMEs, which leads to inconclusive results about the effect of this factor in adoption and use of BI&A systems in Saudi SMEs, which suggests that this factor needs further investigation.

In addition to the four proposed technical factors, in this research's interviews the data quality factor has been mentioned frequently in the post-adoption stage. Some previous researchers also find that data quality has a big impact on the user utilisation level; it has been identified as one of the critical success factors for BI&A systems in companies (Hamidinava et al., 2023; Dawson & Belle, 2013; Eder & Koch, 2018; Wieder & Ossimitz, 2015). PSI4 stated that*" if you don't have quality data set or if you have a poor design of data, that will result in confusing results and poorly use of BI&A system"*. Also, PSI2 stated that*" the data quality is one of the obstacles that affect the level of BI&A system utilisation. If your current data doesn't connect with your needs and aims of using the BI&A system, then your usage of the BI&A system will be low"*. Therefore, this study suggest that the data quality could have a great impact on BI&A usage in Saudi SMEs.

6.3.2.2 Organisational characteristics

Within organisational characteristics, resource availability was significant a factor in both group, pre- and post-adoption, while the enterprise size was a significant factor in the pre-adoption group but not significant in the post-adoption group.

Resource availability was a significant factor in both pre- and post-adoption groups, and this is not an unexpected result. Most previous studies have found that limited resources are the primary reason that affects the adoption and use decision on IS (Chang et al. 2015; Oliveira & Martins 2010), especially in SMEs as they usually suffer from a lack of resources that include finance, IT, and human resources (Bhaird & Lucey 2010a; Boonsiritomachai et al. 2016). This

research's results show that the need for IT specialists, training, and IT support has a great impact on the pre-adoption decision to adopt a BI&A system and for post-adopters to use the system more extensively. Although the cost has been considered a very low impact factor in adoption and use in SMEs (Ayoubi & Aljawarneh 2018; Llave 2019; Md Hatta et al. 2015; Puklavec, Oliveira & Popovič 2018), it seems this is not the case in Saudi SMEs according to this study's survey results. Also, most of the interviewees in both groups mentioned the lack of data analysis specialists training more than the cost of BI&A system. The lack of finance has not been mentioned frequently by the interviewees in both groups, which could be because of the support that has been given to the Saudi SMEs by the government in the pre-adoption stage. As mentioned in Chapter 2 section 2.5.4, most VC funding was directed to tech-related sectors and the SME sector is one of the greatest beneficiaries of these funds. Moreover, in the post-adoption stage, once the system has been installed and established, it does not require much money for maintenance as in SMEs the data load is not like that of big companies, which need higher system and scheduled maintenance.

The enterprise size plays an influential role on adopting innovation technology (G. Buonanno et al. 2005; Jang, Lin & Pan 2009; Ramamurthy, Sen & Sinha 2008). Enterprise size might be a critical component in business intelligence efficiency, according to Qushem et al. (2017). In this study, the enterprise size was a significant factor in the pre-adoption group but not significant in the post-adoption group. In the pre-adoption stage, as explained by the interviewees, the enterprises with a higher number of employees or/and revenue are more likely to have more data in their systems. Therefore, the need to take advantage of these data will be higher than at the enterprises with fewer employees or less revenue. In the post-adoption group the enterprise size has no effect on using BI&A systems more intensively. Even though the enterprises with higher number of employees and turnover need to analyse data more frequently, it is found that size of enterprise does not have a direct influence on the use of BI&A systems in Saudi SMEs. The explanation of this result has been described by the interviewees, as the enterprise grows, the lack of flexibility within the enterprise has increased, and data analysis processes becomes more complex, which may affect the process of using BI&A systems more intensively.

6.3.2.3 Environmental characteristics

Within environmental characteristics, the competitive pressure was not a significant factor in the pre-adoption group but significant in post-adoption group, while the external support was a significant factor in both pre- and post-adoption groups.

Competitive pressure has long been regarded as an essential driver of technology dissemination in the literature on innovation diffusion (Boonsiritomachai et al. 2016; Gu , Cao & Duan 2012; Hwang et al. 2004; Oliveira & Martins 2010). The SMEs buffeted by the winds of competition are more likely to adopt and use innovation technologies. In the pre-adoption group this research found that the competitive pressure is not significant. The Saudi SMEs are still in the very first stages of adopting innovation technology, and still, many SMEs owners and managers use their intuition in making business decisions, which reflects that Saudi SMEs are not in a competitive environment yet. Some previous studies reached the same result as they found no evidence that competitive pressure is a predictor of technological innovation adoption (Ghobakhloo & Ching 2019; Oliveira, Thomas & Espadanal 2014). The interviewees explained this result; for example, one of the advanced adopter interviewees stated that *"the number of companies that use BI&A systems in SA is still low. Most SMEs depend heavily on their intuition rather than using data analysis system. As a result, we lose the competitive value between companies. But the competitiveness increased after adopting the system because the user is more keen to gain accurate information to make business decision*". Other interviewees believe that the competitive pressure in SA these days is high even for non-users, especially in the SME sector with the recent changes in SA: with all the technology support from the government, the competitive pressure became higher which definitely affects their adoption decision, same result has been obtained by Aldossari and Mokhtar (2020), as they discussed the issues related to the intention to adopt the Enterprise Resource Planning (ERP) and BI in Saudi SMEs and they found that the increasing competitive pressure has prompted many Saudi enterprises to adopt modern business technology including ERP and BI system. The adoption of the BI&A system will leave competitors behind the first mover, and those that implement BI&A in a timely manner will gain competitiveness and the drive to exceed competitors (Aldossari & Mokhtar, 2020). This research reached inconclusive results as to the effect of competitive pressure on pre-adopters' decisions to adopt BI&A systems in Saudi SMEs among interviewees. Therefore, this factor needs further investigation in the pre-adoption stage, while in the post-adoption stage the competitive pressure, in this study, has been proven to be a key factor affecting the user decision to intensively use BI&A systems in Saudi SMEs. This aligns with the TOE framework and with previous work (Boonsiritomachai et al. 2016; Gu , Cao &

Duan 2012; Hwang et al. 2004; Oliveira & Martins 2010). In the face of greater competition, Saudi SMEs are more inclined to extensively use BI&A system tools.

External support was a significant factor in both pre- and post-adoption groups. The study result is consistent with the previous studies (Hong & Zhu 2006; Lee & Larsen 2009; Puklavec, Oliveira & Popovič 2018). This means both adopters and non-adopters are seeking external help to use and adopt BI&A systems. The perspective of the pre-adopters about the difficulties and complexity of BI&A systems is the main reason that makes them feel that external support is crucial to adopt a BI&A system. Even the interviewees were utterly in agreement with this point, for example P2 stated that "*The BI&A system is a very advanced technology, and I can't make my decision to adopt the system without third party help*". Also, P3 stated that *I" am good in using technology but in system such as BI&A I will need external help as in my company I don't have internal IT experts*". Also, in order to understand this result in the post-adoption stage we asked the post-adopters if there is need for external support to use the system more intensively. **PSA1** stated that "*We started our data analysis by using Excel, but after attending many external courses and training session we switched to Microsoft Power. At that time, we started the real data analysis in very advanced level, so to answer your question, yes, the external help is very important to use the system deeply. Unless you have data analysis specialist in you company, and that is very rare in SMEs in general as they have limit resources*", the same point of view outlined by other post-adopter interviewees. It can be concluded that the Saudi SMEs are motivated to adopt and intensively use BI&A systems when more external support is existent or expected.

In addition to the two proposed environmental factors, in this research's interviews the government support has been mentioned frequently by interviewees. Some previous researchers also find that government support has a big impact in technology adoption, and it has been identified as one of the critical success factors in companies (Chaveesuk & Horkondee 2015; Kartiwi & MacGregor 2007; Lama, Pradhan & Shrestha 2020). In SA, the government is pushing hard & encouraging the SME sector to utilize advanced technologies in their business by providing financial support, free courses, and workshops (Monsha'at 2021). Most of the interviewees were not aware of all these government services and support and they asked for such support. However, the government should increase the awareness among beneficiaries about all support and services they need. Nevertheless, this factor can be studied in further research to find the root cause and determine if the government does not deliver such

information to the beneficiaries or if there are any other reasons for the non-benefit of Saudi SMEs from such government support.

6.3.2.4 Owners'/mangers' characteristics

Within owners/managers' characteristics, the owners'/managers' IT Knowledge was a significant factor in the pre-adoption group but not significant in post-adoption group, while the owners'/managers' innovativeness was a significant factor in both pre- and post-adoption groups.

The significance of the owners'/managers' IT knowledge factor in the pre-adoption group is consistent with the previous studies in IS (Deng & Chi 2014; Drew 2003; Ghobakhloo, Arias-Aranda & Benitez-Amado 2011; Thong 1999). When the owner or manager has greater IT experience, they are more inclined to be creative and that will affect their decision to adopt a BI&A system. On the other hand, the owners'/managers' IT knowledge was not a significant factor in the post-adoption group. In this research survey sample, most of the participants in the post-adoption stage are educated: 87% of the participants have a bachelor's degree or higher. Other researchers also agree that most BI&A users are educated (Grublješič, Coelho & Jaklič 2019; Luo 2016). This means the participants have sufficient IT knowledge, but their adoption level is variable, which mean the IT knowledge factor is not a crucial factor for post-adopters to intensively use the BI&A system. The explanation for this result was illustrated by the interviewees, as they said that general IT knowledge is not enough to use BI&A systems more intensively. You must have data analysis skills to use the system more and get the greatest advantages from it. Not all users who have IT knowledge have the required data analysis skills.

Owners'/managers' innovativeness was a significant factor in both adoption groups, pre- and post-, which means that personal innovativeness has positive influence on user and non-user alike to adopt and use BI&A systems. This result is in line with most previous studies that found the personal innovativeness to do a good job of predicting a user's view on the usage of new technology (Chang, Hsu & Shiau 2013; Chen 2013; Dutta, Gwebu & Wang 2015; Thong 1999), even for researchers who examine this factor in SMEs context (Boonsiritomachai et al. 2016). Also, Ghobakhloo and Tang (2013) applied their study to Iranian manufacturing SMEs and they found the owners'/managers' innovativeness to be a significant determinant of e-commerce adoption. A similar result also came from our interviewees. For example, P2 who has the intention to adopt a BI&A system shortly, stated "*Personally, I like to explore and tryout a new technology. Even at my home I have a lot of advanced technology and sensor*

devices…..in my opinion yes, if you are innovative, the chance to adopt BI&A system will be so high". Also, **PSA2** (advanced post-adopter) stated that "*if you are innovative that means you like changes and try new thing, that include changing devices, programs, and even change the workflow. Which means this will affect the innovative pre-adopter opinion to adopt BI&A system and for post-adopter to use the system in more innovative way, which will fulfil their internal desire for change and renewal"*. Because of the substantial importance of owners/managers in deciding the adoption and use of BI&A systems for their firms, Saudi SMEs with inventive and risk-averse owners tend more often to implement unique and risky solutions.

It can conclude our discussion by saying that, although the SMEs are becoming a fertile area of data, as yet the adoption and usage level is low in SA. Most of the SMEs' owners/managers rely on their intuition and networks rather than using BI&A systems. Therefore, due to their limited financial and human resources, SMEs should adopt an iterative and incremental investment strategy. This means businesses should begin with straightforward use cases and achieve BI&A results before either including more functionality or undertaking more difficult BI&A activities. Also, most of the post-adopters are at the initial adoption level and their usage of their BI&A system is simple and uncreative. When SMEs expand, more data become available, presenting the potential for BI&A usage, and achieving higher business value. Thus, the current study will help in understanding the key factors that affect adoption level for pre- and post- adopters. In this study, the technology characteristics were more significant in the pre-adoption stage. Three out of four factors were supported, which is partially in line with the DOI theory, while in the post-adoption stage only the observability was supported. Moreover, there is prominence of the organisational and owners'/managers' characteristics in the pre-adoption stage and environmental characteristics in post-adoption stage which is in line with TOE framework and IS adoption model for small business. These reflect the power of this research integrated model.

6.4 Study Implications

Understanding technology adoption and use has been extensively covered in the IT literature. This research has expanded earlier research in these fields to the BI&A system. This study focuses specifically on owners'/managers' decisions to adopt and extensively use BI&A systems in Saudi SMEs. It was undertaken to give a theoretical contribution in the domain of BI&A system adoption and to discover practical contributions for SMEs operating in the Saudi

Arabian context. This research provides significant contributions to both theory and practice, which can be summarised in the following sections.

6.4.1 Theoretical contributions:

- Firstly, although there is increased interest and attention by researchers given to BI&A adoption and use in recent years (Boonsiritomachai et al., 2016; Puklavec et al., 2014; Siemen et al., 2018; Aldossari & Mokhtar, 2020; Simon & Suarez, 2022; Grublješič & Jaklič, 2015; Hou, 2014b; Jayakrishnana et al., 2018), the number of studies in SMEs in general is still scant (Llave, 2019; Almusallam & Chandran, 2020), as evidenced by the literature review and the systematic literature review in Chapter 2. The factors controlling BI&A adoption and use in large companies have been widely studied compared to those in SMEs (refer to table 2.7 in chapter 2). Therefore, this study contributes to the current body of knowledge by studying the adoption and use of BI&A systems among SMEs. This will add to the growing worldwide awareness of SME innovation adoption.
- Secondly, several models of BI&A adoption and use in SMEs have been suggested in the literature (Md Hatta et al., 2015; Puklavec et al., 2014) and we build onto them to propose BI&A adoption model to explain the technology, organization, environment and individual factors of BI&A system in SMEs in developing country which is rarely studied in literature (Llave, 2019). This study presents empirical evidence for SMEs owners/managers, government and IT vendors about the factors affecting the diction to adopt or continue use of BI&A in the enterprises.
- Thirdly, the integration of the TOE framework (Tornatzky & Fleischer, 1990), DOI theory (Rogers, 1983), and IS adoption model for small business (Thong, 1999) is empirically evaluated within the context of SMEs. This research contributes to the theory by confirming the appropriateness of combining theories such as TOE framework, DOI theory, and IS adoption model for small business for investigating the adoption and use of BI&A in SMEs (Boonsiritomachai et al., 2016; Md Hatta et al., 2015). This provides a more holistic view of the Saudis owners and managers perspective on BI&A system adoption. Integrating the constructs of TOE framework, DOI theory, and IS adoption model for small business into a single research model offers a richer theoretical basis for explaining the adoption and use of BI&A system in SMEs. As this model combines the TOE framework to classify variables in their respective contexts, technological, organisational, environmental, and the technologies

factors from DOI theory and the individual classification and factors from IS adoption model for small business this integration is rarely studied in the literature (Ain et al., 2019). More than half of the model's enabling factors have a major impact on BI&A adoption in Saudi SMEs. Specifically, the technology factors, that proposed by DOI theory, had a big influence in pre-adopters' decision to adopt BI&A system at their enterprises. Moreover, there is prominence of the organisational and owners'/managers' characteristics in the pre-adoption stage and environmental characteristics in post-adoption stage; these reflect the power of the integrated of the TOE framework and IS adoption model for small business in the research model.

- Fourthly, this study has investigated the pre- and post-adoption of BI&A systems in the same context, two stages rarely investigated together (Bhattacherjee & Lin, 2015, Karahanna et al., 1999). Most studies in the literature investigated the adoption and use of BI&A system in the pre-adoption stage (Simon & Suarez, 2022, Aldossari & Mokhtar, 2020) or in different post-adoption stages only (Boonsiritomachai et al., 2016). However, little is known about how well the factors that influence intention to adopt (pre-adoption) also predict extensive use (post-adoption) of the same technology. Therefore, this study will help BI&A stakeholders to identify the factors that are more likely to enhance BI&A system adoption and extensive use in SMEs.

- Finally, to the researcher's knowledge this is the first study to explore how Saudi SMEs adopt and use BI&A systems. Saudi Arabia is one of the high-income developing countries. Also, with the recent huge changes in Saudi Arabia's economic perspectives and major support from the Saudi government to the SME sector in order to encourage the SMEs' adoption and use of such innovation technology (more details in Chapter 2 section 2.4.5), this makes Saudi Arabia a unique and fertile environment for studying the adoption and use of innovation technology in SMEs such as BI&A system. Therefore, this study's results will add more value to the literature and could be used as a reference for developing countries.

6.4.2 Practical Contributions

- The findings of this study show that four out of ten factors are critical factors in both pre- and post-adoption groups. Observability, organisational resource availability, external support and owners'/managers' innovation are critical factors affecting both groups. SMEs usually suffer from lack of resource; therefore, the owner/manager should be aware about the importance of having skilful IT specialists, training for the

current stuff. Also, for the government and IT provider should provide external help and make them available via different channels such as online help canter, courses, and call canter., whereas relative advantage, complexity, organisation size, and owner's/managers' IT knowledge are factors playing roles in the pre-adoption group only. On the other hand, competitive pressure has an impact on post-adoption groups only and compatibility has no effect on any group. Based on this, the Saudi government, IT vendors, IT consultant and enterprise owners/managers should be aware about the factors affecting pre- and post-adaption as some of these are ongoing factors that must be monitored and maintained to ensure the stability, consistency, and continuity of BI&A use in SMEs.

- The IT vendors can see from the technology perspective that complexity is an important adoption factor in pre-adoption stage. SME owners/managers usually lack IT skills. Therefore, IT vendors must continue to ensure that their products fit well with SMEs characteristics and needs. For owner/manager who adopt or are looking to adopt BI&A system, this study demonstrates that they must have a solid current IT infrastructure by providing systems that have enough space for data storage, well organized database and this system must support the data analysis tools. Also, the staff should have the essential IT-skills. If current or new staff lack IT abilities, then training must be offered. Also, for Saudi government in order to increase the use of BI&A system in SMEs there is a need to provide more courses and make them more accessible. Additionally, the Saudi government must ensure that SMEs owners/managers are aware of the availability of these courses to improve their analysis skills, which will influence their likelihood of adoption and extensive use of BI&A in SMEs.
- The research model can be used as a guide for IT providers, the Saudi government, and SME owners in the attempt to further the adoption and use of BI&A systems. Also, this model could be used as a reference or guide for future research in a growing area of academic inquiry. Moreover, the findings of this study may be utilised to build BI&A system adoption strategies with the aim of attaining a more extensive usage of BI&A systems, which will result in a greater return on SMEs' investment in SA or other countries.

6.5 Limitations and Future Research

As with most empirical studies, this study is not without its limitations.

- This study has a cross-sectional design, which means analysis of data collected from a population at a specific time. In this study, the pre-adopter's group are different to the post-adopters; therefore, further research could conduct a prospective study or retrospective study on the same enterprises starting from the pre-adoption state all the way to the post-adoption phase or the reverse.
- The SMEs in this study were not dealt with in isolation, in terms of each enterprise's sectors. Manufacturing, for example, is categorised as one of the most data-intensive sectors (Mulvenna 2022), which may affect the decision of adoption and the use of BI&A systems in the enterprises; therefore, further research could consider the enterprise's sectors.
- The sample is limited to the country of Saudi Arabia, which means the study reflects only the situation in this country. Another study could be applied to another country with a context distinct from SA. This might assist in determining the degree to which the current findings can be extended to other places.
- This study has considered ten factors possibly affecting the adoption and use of BI&A system in SMEs based on the comprehensive literature review. Another study could include factors that are not deeply considered in this research model for future research such as data quality and government support.

6.6 Conclusion

The primary objectives of this research were to understand the factors that influence the owner/manager decision to adopt and make extensive use of BI&A systems in Saudi SMEs. Also, it aimed to compare these factors in both adoption stages, pre- and post-adoption. In order to achieve these objectives and answer the research questions, an integrated model has been proposed and examined in both pre- and post-adoption stages. Key factors have been identified and compared in both stages. Using an explanatory sequential mixed-method approach, data were collected, starting with surveys, and followed by interviews with the owners/managers of SMEs located in SA. Our results showed that the relative advantage, complexity, observability, enterprise size, resource availability, external support, IT knowledge, and innovativeness are proven to be significant factors in the pre-adoption stage, while the compatibility and competitive pressure were not significant in the survey results, but we obtained inconclusive results for these two factors in the interviews. In the post-adoption stage our results showed

that, observability, resource availability, competitive pressure, external support, and innovativeness prove to be significant factors while relative advantage, complexity, enterprise size, and IT knowledge do not. Also, compatibility in the post-adoption stage was not significant in our survey results but we gathered inconclusive results for this factor in our interviews. This study's contribution is found in the context of its investigation. SMEs have made a significant contribution to economic progress. However, it is well known that SMEs' adoption of BI&A systems is scant, as evidenced by the literature. Moreover, this study investigated the pre- and post-adoption of BI&A systems in the same context, which are rarely investigated together. Also, to our knowledge this is the first study to explore how Saudi SMEs adopt and use BI&A systems. In addition, the integration of the TOE framework, DOI theory, and IS adoption model for small business is shown to be beneficial and applicable in predicting and explaining owners' and managers' adoption and usage of BI&A systems in Saudi's SMEs. The findings of this study may be utilised to build BI&A system adoption strategies with the aim of attaining a more extensive usage of BI&A systems, which will result in a greater return on SME investment in SA or other countries. Also, the study's findings may be used as a reference for SME owners/managers and consultants for leading effective BI&A adoption and utilization. In addition, the present thesis concludes with certain limitations that are worth debating and recommendations for future research to strengthen and expand the findings generated herein.

Appendix

Appendix A: Pre-adoption Survey outline of questions

INFORMATION SHEET AND CONSENT FORM

Assessment of Pre- and Post-adoption Factors of Business Intelligence Systems and analytics in SMEs

Dear participant

My name is Maryam AlMusallam, I am a PhD student at University of Technology Sydney (UTS). My supervisor is Dr. Sojen Pradhan. This study is a part of my research degree. The purpose of this study is to determine what factors influenced the adoption and use of business intelligence systems among small and medium enterprises (SMEs) within Saudi Arabia (SA). The result of this research will help BIS system providers to understand those factors. These factors could also assist decision makers of each SMEs in a long run.

I would like to invite you to complete a survey. It is expected that the questionnaire will take about 10 minutes to complete. If you agree to be part of the research and to research data gathered from this survey to be published in a form that does not identify you, please continue with answering the survey questions. Participation in this study is voluntary. It is completely up to you whether or not you decide to take part. You can change your mind at any time and stop completing the survey without consequences.

If you have concerns about the research that you think we can help you with, or if you want to access the research results please feel free to contact me via maryam.almusallam@student.uts.edu.au or my supervisor via sojen.pradhan@uts.edu.au.

Also, for a local contact person, you may contact Dr.Manal AlFwuaires, Assistant Professor at King Faisal University, Saudi Arabia via malfwuaires@kfu.edu.sa

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 9772 or Research.ethics@uts.edu.au and quote this number ETH20-4996

Part 1: Demographic Information						
1	Age	18 – 25	26 – 35	36 – 45	46 – 60	> 60
2	Gender	Male			Female	
3	Education Level	Below high school	High school	Diploma	Bachelor	Master	PhD
4	Enterprise size (Employees number)	1_5	6 – 49	50 -100	101-200	200 -250
5	Annual revenue	0-3 Million SR	3-40 Million SR	40-200 Million SR	More than 200 Million SR	
6	Positions (you can take more than one position)	Owner	Manager	Other(Please specify)		
7	Do you have system, website or any social media applications for your enterprise?	yes	No			
8	Do you capture and monitor data in your system or that's come from website , social media or other resources?	Yes	No			
9	Do you analyse these data to make business decision?	Yes	No			
10	Please indicate when are you planning to use ant analyse tool in your enterprise?	Within one to two year	Within two to three years	Within four to five years	More than five years	No intention to use any analyse tool

Please rate the following based on Likert Scale where 1 is strongly disagree and 5 is strongly agree

Part 2: Owners-manager Characteristics							
A	**Owners'-managers' IT Knowledge**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	I use a computer at home and work						Boonsiritomachai(2014) Dutta et al., (2015)
2	I have good knowledge and skills of Computers and information systems in general						
3	I have the necessary technical skills to use a new technological system such as data analysis tools.						
B	**Owners'-managers' Innovativeness**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	If I heard about a new technology, I would look for ways to experiment with it						Agarwal & Prasad, (1998) Boonsiritomachai(2014)
2	Among my peers, I am usually the first to explore new information technologies devices.						
3	In general, I am hesitant to try out new information technologies						
Part 3: Technology Characteristics							
A	**Observability**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	I have seen data analysis used in other enterprises.						Moore & Benbasat (1991) Boonsiritomachai(2014)
2	I am aware of the existence of data analysis tools in the market.						
3	The results of using data analysis are apparent to me.						

B	Compatibility	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly agree (5)	References
1	Analysing data is compatible with organisational culture and values						Moore & Benbasat (1991) Ghobakhloo and Tang (2011) Boonsiritomachai(2014)
2	Using data analysis will fits well with how the enterprise functions.						
3	Data analysis is compatible with my enterprise's IT infrastructure.						
4	Using data analysis is compatible with all aspects of my work.						
C	**Complexity**	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly agree (5)	References
1	Using data analysis requires a lot of effort						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	Using tools for analysing data are clear and understandable.						
3	The skills required to use data analysis are too complex.						
4	Using data analysis will be easy.						
D	**Relative advantage**	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly agree (5)	References
1	Analysis of data will help my enterprise to reduce the cost of operations						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	Data analysis will help to provide competitive information in our industry						
3	Data analysis will help to improve business processes and make a better decision.						

4	The data analysis will be useful in my enterprise.						

Part 4: Organisational Characteristics							
A	**Organisational Resource Availability**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	My enterprise has the technological resources to process data analysis.						Iacovou, Benbasat & Dexter (1995) Boonsiritomachai(2014)
2	My enterprise will provide financial resources to adopt data analysis.						
3	Training and IT support will contribute to build higher levels of data analysis adoption.						
4	There are no difficulties in finding all the necessary resources such as people and time to implement data analysis process.						

Part 5 : Environmental Characteristics							
A	**Competitive Pressure**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	The degree of competition in our industry placed pressure on the enterprise's decision to adopt data analysis process.						Grandon & Pearson (2004) Boonsiritomachai(2014)
2	I knew that my enterprises rivals were already using this process.						
3	The enterprise need to utilise data analysis to maintain its competitiveness in the market.						
4	Analysing data will give my enterprise a competitive advantage						

B	Competitive Pressure	Strongly disagree (1)	Disagree (2)	Neither (3)	Agree (4)	Strongly agree (5)	References
1	There are different businesses in the community, which provide technical support for effective use of data analysis.						Premkumar and Roberts (1999) (Puklavec et al. 2018)
2	I am aware of technology vendors that are actively market analysing tools by providing incentives for adoption.						
3	technology vendors also promote data analysis tools by offering free training sessions						

Open Questions:

- Please specify any other obstacles or motivation for your enterprise in adopting data analysis process (if applicable):
- How Covid-19 affected your decision to adopt data analysis in your enterprise?

Thank you for participating in the survey and providing valuable information

I may need to interview you in the future, would you participate?

If yes, could you please write your email?

Appendix B: Post-adoption Survey outline of questions

INFORMATION SHEET AND CONSENT FORM

Assessment of Pre and Post-adoption Factors of Business Intelligence Systems and analytics in SMEs

Dear participant

My name is Maryam AlMusallam, I am a PhD student at University of Technology Sydney (UTS). My supervisor is Dr. Sojen Pradhan. This study is a part of my research degree. The purpose of this study is to determine what factors influenced the adoption and use of business intelligence systems among small and medium enterprises (SMEs) within Saudi Arabia (SA). The result of this research will help BI&A system providers to understand those factors. These factors could also assist decision makers of each SMEs in a long run.

I would like to invite you to complete a survey. It is expected that the questionnaire will take about 10 minutes to complete. If you agree to be part of the research and to research data gathered from this survey to be published in a form that does not identify you, please continue with answering the survey questions. Participation in this study is voluntary. It is completely up to you whether or not you decide to take part. You can change your mind at any time and stop completing the survey without consequences.

If you have concerns about the research that you think we can help you with, or if you want to access the research results please feel free to contact me via maryam.almusallam@student.uts.edu.au or my supervisor via sojen.pradhan@uts.edu.au.

Also, for a local contact person, you may contact Dr.Manal AlFwuaires, Assistant Professor at King Faisal University, Saudi Arabia via malfwuaires@kfu.edu.sa

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 9772 or Research.ethics@uts.edu.au and quote this number ETH20-4996

Part 1: Demographic Information						
1	Age	18 – 25	26 – 35	36 – 45	46 – 60	> 60
2	Gender	Male			Female	
3	Education Level	Below high school	High school	Diploma	Bachelor	Master	PhD
4	Enterprise size (Employees number)	1_5	6 – 49	50 -100	101-200	200 -250
5	Annual revenue	0-3 Million SR	3-40 Million SR	40-200 Million SR	More than 200 million SR	
6	Positions (you can take more than one position)	Owner		Manager	Other (Please specify)	
7	Do you have system, website or any social media applications for your enterprise?	yes			No	
8	Do you capture and monitor data in your system or that's come from website, social media or other resources?	Yes			No	
9	Do you analyse these data to make business decision?	Yes			No	
10	How long have you been analysing your data?	Less than one Year	1-2 Years	2-3 Years	3-4 years	5 Years and more
11	**What answer is that best describes your enterprise's usage of a data analysis system tool to make a business decision:**	**(a) we use** basic data analysis software to generate reports or spreadsheets. **(b) we use** data analysis software that keeps data in a standardised format and provides restricted user access to inquiries (For example, the marketing function would deal with sales.) **(c) we use** data analysis software that keeps data in a standardised format that allows us a multi-dimensional view of data (For example, sales data can be analysed in terms of geography or time.)				

		(d) we use data analysis software that can do multi-dimensional analysis, find relevant information and provide predictive outcomes. **(e) we use** data analysis software that allows users to keep track of what is going on and generates an automatic exception report when something strange happens.				
12	Which tools do you use to analyse the data?	Excel	SAP business objective	Microsoft Power BI	Tableau	Other (Please specify)
13	How often BI&A system are used in your business?	High Infrequent	Slight Infrequent	Neutral	Slight Frequent	High Frequent

Please rate the following based on Likert Scale where 1 is strongly disagree and 5 is strongly agree

Part 2: Owners-manager Characteristics

A	**Owners'-managers' IT Knowledge**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	I use a computer at home and work						Boonsiritomachai(2014) Dutta et al., (2015)
2	I have good knowledge and skills of Computers and information systems in general						
3	I have the necessary technical skills to use a new technological system such as data analysis tools.						
B	**Owners'-managers' Innovativeness**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	If I heard about a new technology, I would look for ways to experiment with it						Agarwal & Prasad, (1998) Boonsiritomachai(2014)
2	Among my peers, I am usually the first to explore new information technologies devices.						
3	In general, I am hesitant to try out new information technologies						

Part 3: Technology Characteristics							
A	**Observability**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	I have seen data analysis used in other enterprises before I adopt it.						Moore & Benbasat (1991) Boonsiritomachai(2014)
2	After seen the result of use data analysis in practise, I would have no difficulty describing the outcomes to others.						
3	The results of using data analysis were apparent to me before I adopt it.						
B	**Compatibility**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	Analysing data is compatible with organisational culture and values						Moore & Benbasat (1991) Ghobakhloo and Tang (2011) Boonsiritomachai(2014)
2	Using data analysis fits well with how the enterprise functions.						
3	Data analysis is compatible with my enterprise's IT infrastructure.						
4	Using data analysis is compatible with all aspects of my work.						
C	**Complexity**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	Using data analysis requires a lot of effort						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	Using tools for analysing data are clear and understandable.						
3	The skills required to use data analysis are too complex.						

4	Using data analysis is easy.						
D	**Relative advantage**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	Analysis of data is help my enterprise to reduce the cost of operations						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	Data analysis helps to provide competitive information in our industry						
3	Data analysis helps to improve business processes and make a better decision.						
4	The data analysis is useful in my enterprise.						

Part 4: Organisational Characteristics							
A	**Organisational Resource Availability**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	My enterprise has the technological resources to process data analysis.						Iacovou, Benbasat & Dexter (1995) Boonsiritomachai(2014)
2	My enterprise provided financial resources to adopt data analysis.						
3	Training and IT support contributed to build higher levels of data analysis adoption.						
4	There are no difficulties in finding all the necessary resources such as people and time to implement data analysis process.						

Part 5 : Environmental Characteristics							
A	**Competitive Pressure**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	The degree of competition in our industry placed pressure on my enterprise's decision to adopt data analysis process.						Grandon & Pearson (2004) Boonsiritomachai(2014)
2	I knew that my enterprise's rivals were already using this data analyses tools.						
3	My enterprise need to utilise data analysis to maintain its competitiveness in the market.						
4	Analysing data gave my enterprise a competitive advantage						

B	**External Support**	**Strongly disagree (1)**	**Disagree (2)**	**Neither (3)**	**Agree (4)**	**Strongly agree (5)**	**References**
1	There are different businesses in the community, which provide technical support for effective use of data analysis.						Premkumar and Roberts (1999) (Puklavec et al. 2018)
2	I am aware of technology vendors that are actively market analysing tools by providing incentives for adoption.						
3	Technology vendors also promote data analysis tools by offering free training sessions						

Open Questions:

- Please specify any other obstacles or motivation for your enterprise in using data analysis process (if applicable):
- How Covid-19 affected your usage of data analysis in your enterprise?

Thank you for participating in the survey and providing valuable information

I may need to interview you in the future, would you participate?

If yes, could you please write your email?

Appendix C: Pre-adoption Interview Guide

Interview outline of questions

Firstly, thank you for your participation, it is most appreciated. My name is Maryam AlMusallam, a PhD candidate at the University of Technology Sydney (UTS). I am conducting a research study for my PhD thesis under supervision of Dr.Sojen Pradhan. My research is about the assessment of the factors that influence owners/managers decision to use BI&A in Saudi's SMEs. The purpose of this interview today is to learn more and explore about your knowledge about the BI&A system. The interview will take about 30 to 45 min.
The interview will be recorded and subsequently de-identified via the creation of an interview transcript. You have an opportunity to review the transcript in order to ensure accuracy of data and redact any information that you do not wish to be included in the research.

All this information will be treated confidentially, only the researchers involved in this project will have access to the information. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission except if required by law. I and the supervisor plan to analyse and discuss the results for academic purposes. In my publication, information will be provided in such a way that you cannot be identified.

Are you agree with this?

Do you have any questions before we begin?

Personal Information:
Your Enterprise size:
Sector
Are you: Owner/Manager?

Part 1 (Owner-managers' characteristics)

Is it okay to let me know what sort of relevant (qualifications do you have / kind of tools do you use, data storage)?
How do you manage your data and work process?
Do you have good knowledge and skills of using computers and information systems in general? (IT_Knowledge)
Among your peers, are you the first to explore new information technologies devices? For example if you heard about a new technology, you would look for ways to experiment with it? (Innovativeness)
Have you heard about the BI&A system? Do you have any plan to use it at your enterprise?

Part 2 (Technology characteristics):

How did you come to know about this systems? Is that because of someone in the industry (or other companies) using it before? Were the results of using these tools in other enterprises apparent to you? (Observability)
Do you think using data analysis tools (BI&A) is compatible with all aspects of your work that include organisational culture, values and IT infrastructure? (Compatibility)

Could you please tell me about the effort that you needed it to understand BI&A system? In general do you think it is hard to understand the BI&A system? (Complexity)
Do you think the BI&A system is useful tool for your enterprise? Why? (Relative advantage)

Part 3 (Organisational characteristics):

Are there any difficulties in finding all the necessary resources such as people, financial, training, IT support and time to adopt the BI&A process? (Organisational Resource Availability)
Does the size of your enterprise affect your decision to adopt BI&A? (Size)

Part 4 (Environmental characteristics):

Are there any different businesses in the community, which provide technical support for effective use of BI&A process? (External Support)
Can you tell me about your competitors in your industry? Did they place any pressure on your enterprise's decision to implement the BI&A system? (Competitive Pressure)

Part 5 General questions:

In your opinion, what are the major problems that had impacts on adopt and use of the BI&A system in your enterprise? In contrast, what factors that had positive impacts on BI&A system adoption?
Finally, How did Covid-19 affect your adoption decision for the BI&A system in your enterprise?

Appendix D: Post-adoption Interview Guide

Firstly, thank you for your participation, it is most appreciated. My name is Maryam AlMusallam, a PhD candidate at the University of Technology Sydney (UTS). I am conducting a research study for my PhD thesis under supervision of Dr.Sojen Pradhan. My research is about the assessment of the factors that influence owners/managers decision to use BI&A in Saudi's SMEs. The purpose of this interview today is to learn more and explore about your experiences with and BI&A adoption. The interview will take about 30 to 45 min.
The interview will be recorded and subsequently de-identified via the creation of an interview transcript. You have an opportunity to review the transcript in order to ensure accuracy of data and redact any information that you do not wish to be included in the research.

All this information will be treated confidentially, only the researchers involved in this project will have access to the information. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission except if required by law. I and the supervisor plan to analyse and discuss the result for academic purpose. In my publication information will be provided in such a way that you cannot be identified.

Are you agree with this?

Do you have any questions before we begin?

Personal Information:

- Your Enterprise size:
- Sector
- Are you: Owner/Manager?

Part 1 (Owner-managers' characteristics, Work experience, Kind of tools, How often does he/she use this tool):

- Would you like to tell me your work experience, more to do with your involvement in Business Intelligence and Analytics systems or tools? We would appreciate if you can tell us more about the systems you are experienced with?
- Is it okay to let me know what sort of relevant (qualifications do you have / kind of tools do you use, How often do you use this tool)?
- How does that particular system work?
- When did you start using that BI&A system in your company?
- Before implementing BI&A, would you be able to give me some details of how those processes were managed? Why did you or someone in the company decided to implement BI&A systems/tools at that time?
- Do you have good knowledge and skills of using computers and information systems in general? Before you adopted the BI&A system, had you had the same level of skills in using computers and information systems in general? (IT_Knowledge)
- Among your peers, are you the first to explore new information technologies devices? For example if you heard about a new technology, you would look for ways to experiment with it? (Innovativeness)

Part 2 (Technology characteristics):

- How did you come to know about this systems? Is that because someone in the industry (or other companies) using it before? Were the results of using these tools in other enterprises apparent to you before you adopted it? What about now? (Observability)
- While implementing the systems, what were the challenges you faced?, Did you have to change a lot of existing systems…? What were they? Were there any other challenges after the implementation? Is using BI&A compatible with all aspects of your work that include organisational culture, values and IT infrastructure (Compatibility)
- Could you please tell me about the effort that you needed it to understand BI&A system? In general, do you think it is hard to understand the BI&A system? What about before you adopted it? You thought it wold be easy to use BI&A tools? (Complexity)
- Before your implementation of the BI&A system, did you think the BI&A system a useful tool for your enterprise? Why? What about now, does the BI&A system help the enterprise to reduce the cost of operations or to improve business processes and make a better decision? (Relative Advantage)

Part 3 (Organisational characteristics):

- Was the implementation of the BI system expensive? What about after the implementation, does the system require financial support for (maintenance, paying new devices or hiring new employees)? Are there any difficulties in finding all the necessary resources such as people, training, IT support and time to adopt and use BI&A processes (Organisational Resource Availability)
- Did the size of your enterprise affect your decision to adopt BI&A or to extend its use after adoption? (Size)

Part 4 (Environmental characteristics):

- If there was external support, would you mind telling more? When did you contact them? How regularly they are available for help? How has that helped for the organisation? Did you know they existed before the implementation? In your opinion, in which stage would the enterprises need external support, before the implementation or after? Why? (External Support)
- Can you tell me about your competitors in your industry? Did they place any pressure on your enterprise's decision to implement the BI&A system? Or now, do they place any pressure to use the BI&A system more extensively in your enterprise? (Competitive Pressure)

Part 5 General questions:

- In your opinion, what are the major problems that had impacts on adoption and use of BI&A systems in your enterprise? In contrast, what factors that had positive impacts on BI&A system adoption and use level?
- Finally, How has Covid-19 affected your usage of the BI&A system in your enterprise?

Appendix E: INFORMATION SHEET AND CONSENT FORM FOR INTERVIEW

Assessment of Pre and Post-adoption Factors of Business Intelligence and Analytics Systems in SMEs

UTS HREC APPROVAL NUMBER ETH20-4996

What is the research study about?

This research is being conducted as a part of my research degree. The purpose of this research/interview is to determine to what extent the factors within the technology-organization-environment (TOE) framework, and Diffusion of Innovation (DOI) Theory influenced the adoption and use of business intelligence and analytics (BI&A) systems among small and medium enterprises (SMEs) within Saudi Arabia (SA)
You have been invited to participate in this study because of your experience or knowledge in using BI&A system.
This interview is the second stage of my research, as I conducted a survey in the first stage.

Note: your email have been obtained from the survey that you voluntarily filled out with your agreement to do the interview

Who is conducting this research?

My name is Maryam Almusallam and I am a student at UTS. My supervisor is Dr. Dr.Sojen Pradhan his email address is sojen.pradhan@uts.edu.au**.**

Inclusion/Exclusion Criteria

Before you decide to participate in this research study, we need to ensure that it is ok for you to take part. This research includes managers or owners from small and medium enterprises located in Saudi Arabia.

Do I have to take part in this research study?

Participation in this study is voluntary. It is completely up to you whether or not you decide to take part.
If you decide to participate, I will invite you to

- Participate in a 30 to 45 minutes semi-structured interview that will be audio recorded and transcribed

Are there any risks/inconvenience?

Yes, there are some risks/inconveniences. You may have access to sensitive or classified information and have concerns regarding confidentiality of your personal information. The interview will be recorded and subsequently de-identified via the creation of an interview transcript. You have an opportunity to review the transcript in order to ensure accuracy of data and redact any information that you do not wish to be included in the research.
All this information will be treated confidentially, only the researchers involved in this project will have access to the information.

What will happen to information about me?

All this information will be treated confidentially, only the researchers involved in this project will have access to the information. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission except if required by law. I and the supervisor plan to analyse and discuss the result for academic purpose. In my publication information will be provided in such a way that you cannot be identified.

What if I have concerns or a complaint?

If you have concerns about the research that you think I or my supervisor can help you with, please feel free to contact me on: maryam.almusallam@student.uts.edu.au and my supervisor on sojen.pradhan@uts.edu.au

Or, if you would prefer to contact someone locally, you may contact Dr. Manal AlFwuaires, Assistant Professor at King Faisal University, Saudi Arabia via: malfwuaires@kfu.edu.sa

If you would like to talk to someone who is not connected with the research, you may contact the Research Ethics Officer on 02 9514 9772 or Research.ethics@uts.edu.au and quote this number ETH20-4996

Appendix F: CONSENT FORM

UTS HREC APPROVAL NUMBER ETH20-4996

I _____ agree to participate in the research project Adoption Factors of Business Intelligence Systems in SMEs being conducted by Maryam Almusallam (maryam.almusallam@student.uts.edu.au) and my supervisor on Dr Sojen Pradhan (sojen.pradhan@uts.edu.au) from University of Technology Sydney (UTS), Australia

I have read the Participant Information Sheet.

I understand the purposes, procedures and risks of the research as described in the Participant Information Sheet.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I agree to participate in this research project as described and understand that I am free to withdraw at any time.

I understand that the collected data from this study will not be published in a way that could identify participants.

I understand that I will be given a signed copy of this document to keep.

I agree to be:

☐ Audio recorded during the interview.

I agree that the research data gathered from this project may be published in a form that:

☐ May be used for future research purposes

I am aware that I can contact *Maryam Almusallam* or *Dr Sojen Pradhan or Dr Manal AlFwuaires* if I have any concerns about the research.

_____ ____/____/____

Participant Name and Signature Date

Appendix G: Pre-Adoption Survey in Arabic

استبيان الدراسة الاستقصائية لما قبل استخدام نظام ذكاء الأعمال

عزيزي المشارك / عزيزتي المشاركة

اسمي / مريم المسلم وأنا طالبة دكتوراه في جامعة سيدني للتكنولوجيا .مشرفي الدراسي هو الدكتور/ سوجين برادان. هذه الدراسة جزء من درجتي البحثية، والغرض منها هو تحديد العوامل التي تؤثر في اعتماد وإستخدام أنظمة ذكاء الأعمال بين المؤسسات الصغيرة والمتوسطة داخل المملكة العربية السعودية. سوف تساعد نتائج هذا البحث مزودي أنظمة ذكاء الأعمال والتحليلات على فهم هذه العوامل. كما يمكن أن تساعد هذه العوامل صانعي القرار في المؤسسات الصغيرة والمتوسطة الحجم على المدى البعيد.

لذا أود أن أدعوك لإكمال هذا الإستبيان والذي سوف يستغرق حوالي عشر دقائق. إذا كنت موافقاً أن تكون جزءاً من البحث وأن تُنشر البيانات التي جُمعت من هذا الاستقصاء بصورة لا تحدد هويتك، فيرجى المتابعة بالإجابة على أسئلة الإستبيان. حيث أنه المشاركة في هذه الدراسة تطوعية، فالأمر عائد لك كلياً سواء قررت المشاركة أم لا، كما يمكنك تغيير رأيك في أي وقت والتوقف عن إكمال الاستبيان بدون أي تبعات.

إذا كان لديك أي سؤال او استفسار بخصوص البحث أو نتائج البحث فالرجاء عدم التردد بالتواصل معي على maryam.almusallam@student.uts.edu.au أو بالمشرف الدراسي الدكتور/ سوجين عبر sojen.pradhan@uts.edu.au

كما يمكنك التواصل مع الدكتورة/ منال الفويرس، أستاذ مساعد في جامعة الملك فيصل بالمملكة العربية السعودية من خلال malfwuaires@kfu.edu.sa كمرجع محلي وعلى علم بالبحث.

إذا كنت ترغب في التحدث إلى شخص محايد، فبإمكانك الاتصال ضابط أخلاقيات البحث في جامعة سيدني للتكنولوجيا من خلال الهاتف 0061295149772 أو البريد الالكتروني research.ethics@uts.edu.au واذكر هذا الرقم

ETH20-4996

الجزء 1: المعلومات الديموغرافية						
1	العمر	◯25-18	◯35-26	◯45-36	◯60-46	◯60 <
2	الجنس	◯ ذكر		◯ أنثى		
3	مستوى التعليم	دون المرحلة الثانوية	ثانوي	دبلوم	بكالوريوس	ماجستير	دون المرحلة الثانوية
4	حجم المؤسسة (عدد الموظفين)	5-1	49-6	100-50	200-101	250-200
5	العائدات السنوية	3-0 مليون ريال سعودي	40-3 مليون ريال سعودي	200-40 مليون ريال سعودي	أكثر من 200 مليون ريال سعودي	
6	المناصب الوظيفية (يمكنك تولي أكثر من منصب)	◯ المالك	◯ المدير	◯ غير ذلك (يُرجى التحديد)		
7	هل تملك نظاماً أو موقعاً إلكترونياً أو أي تطبيقات وسائط تواصل اجتماعي لمؤسستك؟	◯ نعم	◯ لا			

8	هل تقوم بجمع ورصد البيانات في نظامك أو التي تأتيك من الموقع الإلكتروني أو وسائل التواصل الاجتماعي أو الوسائل الأخرى؟	◯ نعم			◯ لا	
9	هل تحلل تلك البيانات لاتخاذ القرارات المتعلقة بالعمل؟	نعم			لا	
10	يرجى ذكر الوقت الذي تخطط فيه لاستخدام أي أداة تحليل البيانات في مؤسستك؟	خلال سنة إلى سنتين	خلال سنتين إلى ثلاث سنوات	خلال أربع إلى خمس سنوات	أكثر من خمس سنوات	ليست لدى نية في استخدام أي من أدوات التحليل

يرجى تقييم ما يلي والذي يستند إلى مقياس ليكرت حيث 1 أعارض بشدة و 5 أوافق بشدة

الجزء 2: صفات المالك-المدير

أ	معرفة المالكين والمديرين بتكنولوجيا المعلومات	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	أستخدم الحاسوب في المنزل والعمل						Boonsiritomachai (2014) Dutta et al., (2015)
2	أملك معرفة ومهارات جيدة في الحواسيب ونظم المعلومات بشكل عام						
3	أملك المهارات التقنية اللازمة لاستخدام نظام تكنولوجي جديد مثل أدوات تحليل البيانات.						

ب	مهارة المالكين والمديرين للابتكار	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	إذا سمعت عن تقنية جديدة، فسأبحث عن طرق لتجربتها						Agarwal & Prasad, (1998) Boonsiritomachai (2014)
2	عادة ما أكون أول من يستكشف أجهزة تقنيات المعلومات الجديدة من بين زملائي.						
3	أنا أتردد في العموم في تجربة تقنيات المعلومات الجديدة						

الجزء 3: خصائص التكنولوجيا

أ	قابلية الملاحظة	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	لقد رأيت تحليل البيانات مستخدم في مؤسسات أخرى.						Moore & Benbasat (1991) Boonsiritomachai (2014)
2	أنا على علم بوجود أدوات تحليل البيانات في السوق.						
3	نتائج استخدام تحليل البيانات واضحة بالنسبة لي.						

ب	التوافق	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	يتوافق تحليل البيانات مع ثقافتنا وقيمنا التنظيمية						Moore & Benbasat (1991) Ghobakhloo and Tang (2011)
2	سيتناسب استخدام تحليل البيانات جيداً مع آلية عمل المؤسسة.						

3	يتوافق تحليل البيانات مع البنية التحتية لتكنولوجيا المعلومات في مؤسستي.						Boonsiritomachai (2014)
4	يتوافق استخدام تحليل البيانات مع جميع جوانب عملي.						

ج	درجة التعقيد	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	يتطلب استخدام تحليل البيانات جهداً كبيراً						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai (2014)
2	استخدام الأدوات لتحليل البيانات واضح ومفهوم.						
3	المهارات اللازمة لاستخدام تحليل البيانات معقدة للغاية.						
4	سيكون استخدام تحليل البيانات سهلاً.						

د	الأفضلية النسبية	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	سيساعد تحليل البيانات مؤسستي على تقليل تكلفة العمل						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai (2014)
2	سيساعد تحليل البيانات على إتاحة معلومات تنافسية في مجالنا.						
3	سيساعد تحليل البيانات على تطوير العمليات التجارية واتخاذ قرار أفضل.						
4	سيكون تحليل البيانات مفيداً في مؤسستي.						

الجزء 4: الخصائص التنظيمية							
أ	توافر الموارد التنظيمية	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	مؤسستي لديها الموارد التكنولوجية لمعالجة تحليل البيانات.						Iacovou, Benbasat & Dexter (1995) Boonsiritomachai (2014)
2	ستوفر مؤسستي موارد مالية لاعتماد تحليل البيانات.						

3	سيساهم دعم التدريب وتكنولوجيا المعلومات في بناء مستويات أعلى من اعتماد تحليل البيانات.						
4	ليس هنالك صعوبات في إيجاد جميع الموارد الضرورية مثل الأشخاص والوقت لتنفيذ عملية تحليل البيانات.						

الجزء 5: الخصائص البيئية							
أ	**الضغوط التنافسية**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	شكلت درجة المنافسة في مجالنا ضغطاً على قرار المؤسسة باعتماد عملية تحليل البيانات.						Grandon & Pearson (2004) Boonsiritomachai (2014)
2	كنت على علم أن منافسي مؤسستي قد سبق لهم استخدام هذه الأدوات لتحليل البيانات.						
3	تحتاج المؤسسة إلى استغلال تحليل البيانات للحفاظ على قدرتها التنافسية في السوق.						
4	سيقدم تحليل البيانات لمؤسستي ميزة تنافسية.						
ب	**الدعم الخارجي**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	هناك شركات مختلفة في إطار المجتمع توفر الدعم التقني للاستخدام الفعال لتحليل البيانات.						Premkumar and Roberts (1999) (Puklavec et al. 2018)
2	لدي علم بموردي التكنولوجيا الذين يسوقون على نحو فعال لأدوات التحليل من خلال تقديم حوافز لاعتمادها.						
3	يروج بائعو التكنولوجيا أيضاً لأدوات تحليل البيانات من خلال تقديم دورات تدريبية مجانية						

أسئلة مفتوحة:

- يرجى تحديد أي صعوبات أو حوافز أخرى قابلتها مؤسستك لتبني عملية تحليل البيانات (إن وجدت):

- كيف أثر وباء كوفيد-19 على قرارك في تبني تحليل البيانات في مؤسستك؟

شكرا لكم للمشاركة في الدراسة الاستقصائية وتقديم معلومات قيمة

قد أحتاج مستقبلاً إجراء مقابلة معك في المستقبل، هل ستقوم بالمشاركة؟

□ نعم □ لا

إذا كان جوابك بنعم، فهل يمكنك كتابة بريدك الإلكتروني من فضلك؟

Appendix H: Post-Adoption Survey in Arabic

استبيان الدراسة الاستقصائية لما بعد استخدام نظام ذكاء الأعمال

عزيزي المشارك / عزيزتي المشاركة

اسمي / مريم المسلم وأنا طالبة دكتوراه في جامعة سيدني للتكنولوجيا .مشرفي الدراسي هو الدكتور/ سوجين برادان. هذه الدراسة جزء من درجتي البحثية، والغرض منها هو تحديد العوامل التي تؤثر في اعتماد وإستخدام أنظمة ذكاء الأعمال بين المؤسسات الصغيرة والمتوسطة داخل المملكة العربية السعودية. سوف تساعد نتائج هذا البحث مزودي أنظمة ذكاء الأعمال والتحليلات على فهم هذه العوامل. كما يمكن أن تساعد هذه العوامل صانعي القرار في المؤسسات الصغيرة والمتوسطة الحجم على المدى البعيد.

لذا أود أن أدعوك لإكمال هذا الإستبيان والذي سوف يستغرق حوالي عشر دقائق. إذا كنت موافقاً أن تكون جزءاً من البحث وأن تُنشر البيانات التي جُمعت من هذا الاستقصاء بصورة لا تحدد هويتك، فيرجى المتابعة بالإجابة على أسئلة الإستبيان. حيث أنه المشاركة في هذه الدراسة تطوعية، فالأمر عائد لك كلياً سواء قررت المشاركة أم لا، كما يمكنك تغيير رأيك في أي وقت والتوقف عن إكمال الاستبيان بدون أي تبعات.

إذا كان لديك أي سؤال او استفسار بخصوص البحث أو نتائج البحث فالرجاء عدم التردد بالتواصل معي على maryam.almusallam@student.uts.edu.au أو بالمشرف الدراسي الدكتور/ سوجين عبر sojen.pradhan@uts.edu.au

كما يمكنك التواصل مع الدكتورة/ منال الفويرس، أستاذ مساعد في جامعة الملك فيصل بالمملكة العربية السعودية من خلال malfwuaires@kfu.edu.sa كمرجع محلي وعلى علم بالبحث.

إذا كنت ترغب في التحدث إلى شخص محايد، فبإمكانك الاتصال ضابط أخلاقيات البحث في جامعة سيدني للتكنولوجيا من خلال الهاتف 0061295149772 أو البريد الالكتروني research.ethics@uts.edu.au واذكر هذا الرقم

ETH20-4996

الجزء 1: المعلومات الديموغرافية						
1	العمر	◯25-18	◯35-26	◯45-36	◯60-46	◯60 <
2	الجنس	ذكر			أنثى	
3	مستوى التعليم	دون المرحلة الثانوية	ثانوي	دبلوم	بكالوريوس	ماجستير	دكتوراه
4	حجم المؤسسة (عدد الموظفين)	5-1	49-6	100-50	200-101	250-200
5	العائدات السنوية	3-0 مليون ريال سعودي	40-3 مليون ريال سعودي	200-40 مليون ريال سعودي	أكثر من 200 مليون ريال سعودي	
6	المناصب الوظيفية (يمكنك تولي أكثر من منصب)	◯ المالك	◯ المدير	◯ غير ذلك (يُرجى التحديد)		
7	هل تملك نظاماً أو موقعاً إلكترونياً أو أي	◯ نعم	◯ لا			

	تطبيقات وسائط تواصل اجتماعي لمؤسستك؟					
8	هل تقوم بجمع ورصد البيانات في نظامك أو التي تأتيك من الموقع الإلكتروني أو وسائل التواصل الاجتماعي أو الوسائل الأخرى؟	◯ نعم			◯ لا	
9	هل تحلل تلك البيانات لاتخاذ القرارات المتعلقة بالعمل؟	◯ نعم			◯ لا	
10	منذ متى و أنت تقوم بتحليل البيانات الخاصة بك؟	◯ أقل من سنة	◯ سنة-سنتين	◯ سنتين- 3 سنوات	◯3 -4 سنوات	◯ خمس سنوات وأكثر.
11	ما هي أفضل إجابة تصف استخدام مؤسستك لأداة نظام تحليل البيانات لاتخاذ قرار متعلق بالعمل:	◯ نستخدم برامج تحليل البيانات الأساسية لإنشاء تقارير أو جداول بيانات. ◯ نستخدم برامج تحليل البيانات التي تحفظ البيانات بتنسيق موحد وتوفر وصول مستخدم مقيد للاستفسارات (مثلاً: سيكون تعامل موظف التسويق مع المبيعات). ◯ نستخدم برامج تحليل البيانات التي تحفظ البيانات بتنسيق موحد يسمح لنا برؤية متعددة الأبعاد للبيانات (مثلاً: يمكن تحليل بيانات المبيعات من حيث التوزيع الجغرافي أو الوقتي). ◯ نستخدم برامج تحليل البيانات التي يمكنها إجراء تحليل متعدد الأبعاد، وإيجاد المعلومات ذات الصلة وتقديم نتائج توقعيه. ◯ نستخدم برامج تحليل البيانات التي تسمح للمستخدمين بتتبع ما يجري وإنشاء تقرير استثناء ذاتي عند حدوث شيء غريب.				
12	ما الأدوات التي تستخدمها لتحليل البيانات؟	◯ برنامج إكسل	◯ SAP business objects	◯ Microsoft Power BI	◯ Tableau	◯ غير ذلك (الرجاء التحديد)

يرجى تقييم ما يلي والذي يستند إلى مقياس ليكارت حيث 1 أعارض بشدة و 5 أوافق بشدة

الجزء 2: صفات المالك-المدير

أ	معرفة المالكين والمدراء بتكنولوجيا المعلومات	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	أستخدم الحاسوب في المنزل والعمل						Boonsiritomachai (2014) Dutta et al., (2015)
2	أملك معرفة ومهارات جيدة في الحواسيب ونظم المعلومات بشكل عام						

3	أملك المهارات التقنية اللازمة لاستخدام نظام تكنولوجي جديد مثل أدوات تحليل البيانات.						
ب	مهارة المالكين والمدراء للابتكار	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	إذا سمعت عن تقنية جديدة، فسأبحث عن طرق لتجربتها						Agarwal & Prasad, (1998) Boonsiritomachai (2014)
2	عادة ما أكون أول من يستكشف أجهزة تقنيات المعلومات الجديدة من بين زملائي.						
3	أنا أتردد في العموم في تجربة تقنيات المعلومات الجديدة.						
الجزء 3: خصائص التكنولوجيا							
أ	الملاحظة	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	لقد رأيت تحليل البيانات مستخدم في مؤسسات أخرى قبل اعتماده لدينا						Moore & Benbasat (1991) Boonsiritomachai(2014)
2	بعد رؤية نتيجة استخدام تحليل البيانات بصورة عملية، لا أقابل صعوبة في وصف النتائج للآخرين.						
3	نتائج استخدام تحليل البيانات كانت واضحة بالنسبة لي قبل اعتماده لدينا						
ب	التوافق	أعارض بشدة (1)	غير موافق (2)	محايد (3)	أوافق (4)	أوافق بشدة (5)	المراجع
1	يتوافق تحليل البيانات مع ثقافتنا وقيمنا التنظيمية						Moore & Benbasat (1991) Ghobakhloo and Tang (2011)
2	يتناسب استخدام تحليل البيانات جيداً مع آلية عمل المؤسسة.						

3	يتوافق تحليل البيانات مع البنية التحتية لتكنولوجيا المعلومات في المؤسسة						Boonsiritomachai(2014)
4	يتوافق استخدام تحليل البيانات مع جميع جوانب عملي.						
ج	**درجة التعقيد**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	يتطلب استخدام تحليل البيانات جهداً كبيراً						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	استخدام الأدوات لتحليل البيانات واضح ومفهوم.						
3	المهارات اللازمة لاستخدام تحليل البيانات معقدة للغاية.						
4	استخدام تحليل البيانات سهل.						
د	**الأفضلية النسبية**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	يساعد تحليل البيانات مؤسستي على تقليل تكلفة العمل.						Davis (1989) Moore & Benbasat (1991) Boonsiritomachai(2014)
2	يساعد تحليل البيانات على إتاحة معلومات تنافسية في مجالنا.						
3	يساعد تحليل البيانات على تطوير العمليات التجارية واتخاذ قرار أفضل.						
4	إن تحليل البيانات مفيد في مؤسستي.						

الجزء 4: الخصائص التنظيمية							
أ	**توافر الموارد التنظيمية**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	مؤسستي لديها الموارد التكنولوجية لمعالجة تحليل البيانات.						Iacovou, Benbasat & Dexter

2	وفرت مؤسستي موارد مالية لاعتماد تحليل البيانات.						(1995) Boonsiritomachai(2014)
3	ساهم دعم التدريب وتكنولوجيا المعلومات في بناء مستويات أعلى من اعتماد تحليل البيانات.						
4	ليس هنالك صعوبات في إيجاد جميع الموارد الضرورية مثل الأشخاص والوقت لتنفيذ عملية تحليل البيانات.						

الجزء 5: الخصائص البيئية							
أ	**الضغوط التنافسية**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	شكلت درجة المنافسة في مجالنا ضغطاً على قرار مؤسستي باعتماد عملية تحليل البيانات.						Grandon & Pearson (2004) Boonsiritomachai(2014)
2	كنت على علم أن منافسي مؤسستي قد سبق لهم استخدام هذه الأدوات لتحليل البيانات.						
3	تحتاج مؤسستي إلى استغلال تحليل البيانات للحفاظ على قدرتها التنافسية في السوق.						
4	قدم تحليل البيانات لمؤسستي ميزة تنافسية.						

أ	**الدعم الخارجي**	**أعارض بشدة (1)**	**غير موافق (2)**	**محايد (3)**	**أوافق (4)**	**أوافق بشدة (5)**	**المراجع**
1	هناك شركات مختلفة في إطار المجتمع توفر الدعم التقني للاستخدام الفعال لتحليل البيانات.						Premkumar and Roberts (1999) (Puklavec et al. 2018)
2	لدي علم بموردي التكنولوجيا الذين يسوقون على نحو فعال لأدوات التحليل من خلال تقديم حوافز لاعتمادها.						
3	يروج بائعو التكنولوجيا أيضاً لأدوات تحليل البيانات من خلال تقديم دورات تدريبية مجانية						

أسئلة مفتوحة:

- يرجى تحديد أي صعوبات أو حوافز أخرى قابلتها مؤسستك في استخدام عملية تحليل البيانات (إن وجدت):
- كيف أثر وباء كوفيد-19 على استخدامك لتحليل البيانات في مؤسستك؟

شكرا لكم للمشاركة في الدراسة الاستقصائية وتقديم معلومات قيمة

قد أحتاج مستقبلاً إجراء مقابلة معك في المستقبل، هل ستقوم بالمشاركة؟

□ نعم □ لا

إذا كان جوابك بنعم، فهل يمكنك كتابة بريدك الإلكتروني من فضلك؟

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