Factors Impacting the Adoption and Implementation of Business Intelligence and Analytics Projects in Organizations

العوامل التي تؤثر على اعتماد وتنفيذ مشاريع تحليل البيانات في المنظمات

by

Noha Tarek Amer, Ph.D.

A thesis submitted in fulfilment

of the requirements for the degree of

DOCTOR OF PHILOSOPHY IN PROJECT MANAGEMENT

at

The British University in Dubai

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Thesis Supervisor
Dr Sherief Abdallah

Approved for award:

External Examiner

Professor Halim Boussabaine
Internal Examiner

Dr Abdulai Abukari
Chair of Examiners

Professor Abdullah Alshamsi
Chair of Research Degree Committee

Date: 9 October 2016

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Abstract

The main aim of this research is to increase the understanding of why some organizations invest in and adopt Business Intelligence and Analytics (BI&A) projects while others do not. BI&A projects are defined in this research as a set of tools responsible for analyzing data. This research is thus interested in understanding the adoption process of BI&A projects. The scope of this research is organizations operating in the United Arab Emirates (UAE) and the Gulf region.

Several models have been proposed to explain the adoption process in organizations. The technology adoption process could be summarized into three main phases: pre-adoption, adoption, and post-adoption. As most organizations undergo their endeavors in the form of a project, it is important to discuss the technology adoption process for a project. Thus, this research proposes three main stages to adopt BI&A projects in organizations: front-end management, project portfolio management, and project success. The literature has also identified different factors that impact each of the stages in this process. Specifically, the Technology-Organization-Environment (TOE) framework will be used to examine the impact of several technological, organizational, and environmental factors on the three project management stages (front-end management, project portfolio management, and project success). Therefore, this research proposes a research model that explains the adoption factors and process of BI&A projects in organizations.

The initial validation of the research model is conducted through the synthesis of the main factors that impact the adoption process of BI&A projects in organizations. The resulted research model is then validated through questionnaires and statistical analysis.

The results suggest (1) a BI&A project would be likely initiated in the the front-end management phase if: (a) the BI&A project is not complex, (b) the BI&A project is perceived as advantageous, (c) the BI&A project is perceived as compatible with the organization, (d) the organization has top management support, (e) the organization has good strategy and project management practices, (f) the organization has appropriate experience, (g) there is pressure from competition, and (h) there is good vendor support.

The results suggest that (2) a BI&A project is likely to be included in the project portfolio and implemented if: (a) the BI&A project is perceived as compatible, (b) the BI&A project is perceived as advantageous, (c) the organization has good top management support, (d) the organization has a supportive culture, (e) the organization has good strategy and project management practices, (f) the organization has enough resources, (g) the organization has appropriate experience, and (h) there is pressure from competition.

The results suggest that (3) a BI&A project is likely to be successful if the BI&A project is (a) compatible with the organization, (b) the organization has good top management support, (c) the organization has a supportive culture, (d) the organization has good strategy and project management practices, (e) the organization has enough resources, (f) the organization has appropriate experience, and (g) the organization has qualified infrastructure.

This research contributes to the existing body of literature by proposing a BI&A adoption process for projects specifically for organizations in the United Arab Emirates (UAE) and the Gulf.

نبذة مختصرة

الهدف الرئيسي من هذا البحث هو زيادة فهم لماذا تستثمر بعض المنظمات في اعتماد مشاريع ذكاء الأعمال وتحليل البيانات، في حين أن البعض الآخر لا.
تم تعريف مشاريع تحليل البيانات في هذا البحث على أنها مجموعة من الأدوات المسؤولة عن تحليل البيانات.

نطاق هذا البحث المنظمات العاملة في دولة الإمارات العربية المتحدة ومنطقة الخليج. وقد اقترحت عدة نماذج لشرح عملية التبني في المنظمات. يمكن تلخيص عملية اعتماد التكنولوجيا إلى ثلاث مراحل رئيسية : قبل اعتمادها ، والتبني، وبعد اعتمادها. وبما أن معظم المنظمات تخضع لمساعيها في شكل مشروع، فمن المهم مناقشة عملية اعتماد التكنولوجيا لهذا المشروع. وبالتالي، يقترح هذا البحث ثلاث مراحل رئيسية لتبني مشاريع تحليل البيانات في المنظمات: الإدارة المبدئية، إدارة المشاريع، ونجاح المشروع. وقد تم تحديد العوامل المختلفة التي تؤثر على كل مرحلة من المراحل في هذه العملية.

فعلى وجه التحديد، سيتم استخدام إطار تكنولوجيا منظمات البيئة لدراسة تأثير العديد من العوامل التكنولوجية والتنظيمية والبيئية على مراحل إدارة المشاريع الثلاثة (الإدارة المبدئية ، إدارة المشاريع، ونجاح المشروع). لذا، يقترح هذا البحث نموذج البحوث التي توضح العوامل التي يتم اعتمادها من مشاريع تحليل البيانات في المنظمات. ويجري التحقق من الصحة الأولية للنموذج الخاص بالبحوث من خلال التوليف الأدبي والذي يعد من أهم العوامل التي تؤثر على عملية اعتماد مشاريع تحليل البيانات في المنظمات. ثم يتم التحقق من صحة نموذج البحوث الذي نتج من خلال الاستبيانات والتحليل الإحصائي.

وتشير نتائج مشروع تحليل البيانات أنه سيتم على الأرجح في مرحلة الإدارة المبدئية إذا:
(أ) استقصاء المعلومات والمشروع ليس معقد.
(ب) ينظر إلى فائدة مشروع تحليل البيانات.
(ج) استقصاء المعلومات والمشروع ينظر إليها على أنها متوافقة مع المنظمة.
(د) لدى المنظمة دعم الإدارة العليا.
(ه) المنظمة لديها استراتيجية جيدة وممارسات إدارة المشاريع.
(و) التنظيم لديه الخبرة المناسبة.
(ز) هناك ضغط من المنافسة.

(ح) هناك دعم جيد.

وتشير النتائج إلى أن مشروع تحليل البيانات المحتمل يجب أن تقوم إدارة المشاريع بتنفيذها في الحالات التالية:
(أ) يعتبر استقصاء المعلومات والمشروع متوافق.
(ب) يعتبر استقصاء المعلومات والمشروع مفيد.
(ج) التنظيم الجيد يحظى بدعم الإدارة العليا.
(د) لدى المنظمة ثقافة داعمة.
(ه) المنظمة لديها استراتيجية جيدة وممارسات إدارة مشاريع واضحة.
(و) المنظمة لديها ما يكفي من الموارد.
(ز) المنظمة لديها خبرة مناسبة.
(ح) هناك ضغط من المنافسة.

النتائج تشير إلى أن مشروع تحليل البيانات المرجح أن يكون ناجح عند استقصاء المعلومات لمشروع وهو:
(أ) متوافق مع المنظمة.
(ب) لديه مؤسسة تدعم الإدارة العليا بشكل جيد.
(ج) المنظمة لديها ثقافة داعمة.
(د) لدى المنظمة استراتيجية جيدة وممارسات إدارة مشاريع واضحة.
(ه) المنظمة لديها ما يكفي من الموارد.
(و) التنظيم لديه خبرة مناسبة.
(ز) المنظمة لديها البنية التحتية المؤهلة.

يساهم هذا البحث في تبني مشروع تحليل البيانات ، وتحديداً للمنظمات بدولة الإمارات العربية المتحدة ودول الخليج.

Dedication

To mum and dad, siblings, and husband

Acknowledgments

I am grateful to Allah Almighty for His blessings and guidance throughout my life.

I would also like to express my gratitude to my professors Dr.Sherief Abdallah, Dr.Abubakr Suliman, and Dr.Richard Kirkham. This work would not have been completed without their help. I would like to extend my sincere appreciation to the rest of the staff in the British University in Dubai and Manchester University.

I would also like to thank my colleagues in the American University of Sharjah who guided me throughout my PhD journey.

Moreover, I would like to thank my friends who have helped and supported me emotionally throughout my journey.

Also, I would like to deeply thank my dad Tarek Amin Amer and my husband Ibrahim Muhammad for all of the help and support they provided me with throughout my PhD. Moreover, I am grateful for my family's support and patience with me.

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1-INTRODUCTION

1.1 Introduction

Business Intelligence and Analytics (BI&A) projects give many organizations a competitive edge through improved decision making (Laudon & Laudon 2011). Despite this benefit, not all organizations adopt and implement BI&A projects. Therefore, this research aims to understand why some organizations adopt BI&A projects while others do not.

Business Intelligence and Analytics (BI&A) projects are responsible for managing and organizing business data to enable ease of access and use (Laudon & Laudon 2004). BI&A projects include all the techniques, technologies, systems, practices, methodologies, and applications used to organize and analyze data (Chen et al. 2012*a*). These projects bring many benefits to organizations, such as improved decision making and better market understanding (Laudon & Laudon 2011). Therefore, it is important to understand: how to adopt and implement those projects in organizations and what the underlying factors that manipulate the stages in this process are.

Researchers are always searching for a successful model that explains the adoption of a certain technology in organizations (Rosli et al. 2012). A substantial amount of research has been carried out in the area of technology adoption in a variety of contexts, units of analysis, and from different perspectives (Basole et al. 2013). Nonetheless, there is still a lack of research that explains technology adoption for a project. Current technology adoption literature needs to account for the characteristics of a project rather than just a regular system. This is due to the fact that most organizations undertake huge endeavours in the form of a project (Jonas 2010). As this is a new field of research, it is better to start by proposing a research model for BI&A projects only. Moreover, and as the literature proves, different technologies require different models and different set of characteristics based on their nature (Jeyaraj et al. 2006). Therefore, it is crucial to propose a separate adoption model for BI&A projects.

The research presented in this thesis aims to model the adoption process of BI&A projects in organizations. A study of the adoption literature is carried out to propose a research model applicable for BI&A projects adoption in organizations. In sequence, the study also aims to recognize the factors that impact the adoption process of BI&A projects in organizations.

This chapter outlines the basic structure of the research. Section 1.2 provides an overview of the background of the research conducted in this dissertation. After that, section 1.3 highlights the current gaps in the literature and the problem statement. Next, section 1.4 lists and explains the research aims. Section 1.5 discusses the research questions and hypothesis based on the discussion of research aims in section 1.4. Section 1.6 motivates the novelty and significance of the study. Finally, section 1.7 summarizes the overall structure of the thesis.

1.2 Research background

According to the law of digital mass storage, data stored doubles every year (Laudon & Laudon 2011). Computer applications produce a significant amount of data which is in exponential growth (Alexander et al. 2011). There are also other sources of data such as the web, credit cards, mobiles, databases, documents...etc. The exponential increase in the amount of data resulted in big data which was introduced during 2010s (Watson & Marjanovic 2013). Big data is characterized by three main Vs; volume, velocity, and variety (Chen et al. 2012*a*). Big data is in big volumes, acquired at a high velocity, and includes various data formats such as images, text, audio...etc. This data, if analyzed correctly, could bring vast benefits to the organization (Laudon & Laudon 2011). BI&A projects aim to analyze data in order to make better decisions, understand market needs, improve operations, and provide a competitive edge (Laudon & Laudon 2011). Different organizations have implemented and benefited from big data evolution. For instance, social media utilizes BI&A projects with their targeted ads and friend suggestions. Also, e-commerce companies utilize these projects with suggested products (Laudon & Laudon 2011). Therefore, BI&A projects drive and promote core competencies of organizations (Feng et al. 2010).

Although BI&A projects are considered one of the main drivers for a competitive advantage, organizations face challenges to adopt and implement them. According to Basole et al. (2013), the challenges associated with these projects include high implementation cost, usage complexity, lack of proper organizational experience, and improper vendor support. These challenges can be solved by examining the determinants that increase the likelihood of adopting and implementing BI&A projects in organizations. The Information Systems (IS) literature studied several variables that impact the adoption of BI&A projects (Sujitparapitaya et al. 2012, Puklavec et al. 2014, Daryaei et al. 2013, Hartley & Seymour 2011, Jiang 2009).

Most of the technology adoption research focuses on the factors that impact the adoption of different systems (Young Choi et al. 2011) such as Business Intelligence systems (Seah et al. 2010), e-business (Jiang 2009), internet banking (Gopalakrishnan et al. 2003), and many others. However, to the best of our knowledge, the literature does not discuss the adoption of a BI&A as a project. Most organizations nowadays undertake huge endeavors in the form of a project (Jonas 2010). Unlike most of the technology adoption literature that discuss the adoption as a single step decision (Rogers 1983, Wang et al. 2010), this research discusses the adoption of a BI&A project as a series of steps.

The adoption decision process, introduced in 1962 by Rogers, occurs over two main stages: initiation and implementation (Mahler & Rogers 1999). Initiation is basically gathering knowledge about the technology, forming an attitude about it, and making a decision whether to implement it or not. Implementation occurs when the organization puts the technology into use. These two simple stages were then advanced to a 5 stages technology adoption process model; knowledge, persuasion, decision, implementation, and confirmation (Rogers 1983). Lee et al. (2009) proposed a simpler model for the adoption decision process that consists of three main stages: initiation, adoption, and routinization. This means that there are different variations by different authors on the technology adoption decision process. Therefore, all these variations could be categorized into three main stages: pre-adoption, adoption, and post-adoption (Ko et al. 2008). The pre-adoption stage is the initiation stage which includes a series of activities that supports creating awareness about the technology, recognizing a need for the technology, forming attitude towards the technology, and creating a proposal for technology adoption (Gopalakrishnan & Damanpour 1997). The next step, adoption, involves the decision to accept and implement the technology if it fits the organization (Meyer & Goes 1988). The post-adoption stage is the last stage in the adoption of the technology where it is utilized in a successful manner.

In the context of a project, these three stages are named: front-end management, project portfolio management, and project success. Front-end management is the first step in the technology adoption process where ideas are generated and then turned into a formal project. After that, the project portfolio management is the second stage in the technology adoption process where the project gets evaluated against other projects and eventually implemented. Finally, project success is the last step in the technology adoption process where the project is examined to be successful or not. It is important to study the adoption process for a project rather than a regular system. First, most organizations undertake huge endeavors in the form of a project (Jonas 2010). Also, in today's market, proactive management of projects is very important for organization to achieve a competitive advantage (Heising 2012).

There are different determinants that posses different impacts on different stages in the adoption process (King 1990). According to the Technology-Organization-Environment (TOE) framework proposed by Tornatzky & Klein (1982), these determinants could be grouped into three components: technology, organization, and environment. The technology component includes characteristics related to technology such as cost and complexity of the BI&A project. The organization component includes characteristics related to the organization such as top management support and experience of the organization. The environment component includes characteristics related to the external environment such as vendor support and competition in the industry (Basole et al. 2013).

Despite the growing recognition of BI&A projects in organizations, there is no study that examines BI&A projects adoption in organizations. Accordingly, there is a need to understand the underlying factors that impact the stages in this adoption process.

1.3 Problem statement

BI&A projects are very beneficial in organizations (Laudon & Laudon 2011). These projects help organizations in making decisions, understanding the market and the consumers, and achieving a competitive advantage (Chen et al. 2012*a*). It is important for organizations to adopt these projects and use them in daily operations to improve their performance (Laudon & Laudon 2011).

Despite the potential benefits of BI&A projects, not all organizations adopt them (Lee et al. 2014, Zeng et al. 2012). By not adopting these projects, organizations will miss out on the benefits of BI&A projects (Yeoh & Koronios 2010). Eventually, organizations will not be able to improve their effectiveness and innovation (Watson & Wixom 2007).

Therefore, it is important to understand the adoption process of a BI&A project in organizations. The adoption process is not a one-step process but rather a series of stages (Ko et al. 2008). This thesis aims to examine the adoption stages of a BI&A project in organizations along with the factors that impact each of these stages. This contribution will be depicted in the form of an empirically validated research model.

This research model will guide organizations on how to adopt BI&A projects. The model will also list the significant factors that impact the adoption stages. Research models have been well used in the literature to guide adoption processes such as in the work of: Paul Jones et al. (2013) in the adoption of enterprise applications, Hameed et al. (2012) in the adoption of IT innovation, Purna Sudhakar (2012) in the adoption of software projects, and others.

The research model is crucial to guide the adoption process of BI&A projects and help organizations benefit from their uses (Chen et al. 2012*a*).

1.4 Aims of the research

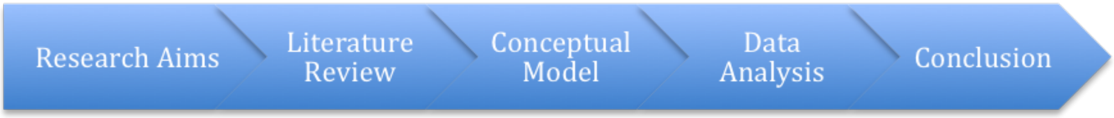
The primary aim of this research is to propose an empirically validated model that explains the adoption process of BI&A projects in organizations along with the determinants that impact each of the stages in this adoption process. Thus, the research aims are as follows:

- To describe the stages in the adoption process for a BI&A project in an organization
- To list and explain the technological factors that impact the adoption of a BI&A project in an organization
- To list and explain the organizational factors that impact the adoption of a BI&A project in an organization
- To list and explain the environmental factors that impact the adoption of a BI&A project in an organization
- To examine the differences between perceptions of respondents regarding how they view the adoption of a BI&A project in an organization

The first aim is to propose a research model that will explain the adoption process. Based on the above discussion, the adoption process is divided into three main stages: pre-adoption, adoption, and post-adoption. For a project, these stages are: front-end management, project portfolio management, and project success. Based on the Technology, Organization, Environment framework, these stages are impacted by three different groups of factors: technology, organization, and environment. Therefore, the second, third, and fourth aims are to empirically list and explain these three categories of factors. Finally, this research aims to examine if different groups of respondents have different perceptions about the BI&A adoption process.

The first aim will be achieved using a thorough literature review to understand, summarize, and define the adoption stages for a project. The rest of aims will

Figure 1.1: Research objectives



be achieved empirically using data collection (via questionnaires) and data analysis (via SPSS tool). The analysis techniques are briefly explained in the research methodology chapter and thoroughly explained in the analysis chapters. An overview of the research is shown in figure 1.1.

1.5 Research questions

Based on the aims discussed above, the study aims to answer the following research questions:

- Research question 1: What are the stages in the adoption process for a BI&A project in an organization?
- Research question 2: What are the technological factors that impact the adoption of a BI&A project in an organization?
- Research question 3: What are the organizational factors that impact the adoption of a BI&A project in an organization?
- Research question 4: What are the environmental factors that impact the adoption of a BI&A project in an organization?

- Research question 5: Are there differences between perceptions of respondents regarding how they view the adoption of a BI&A project in an organization?

1.5.1 Conceptual model

The proposed model is shown in figure 1.2. The figure depicts the adoption process in three stages: front-end management, project portfolio management, and project success. These phases are impacted by three main groups of independent variables: technology, organization, and environment. Further explanation to the model is explained in the proposed model chapter.

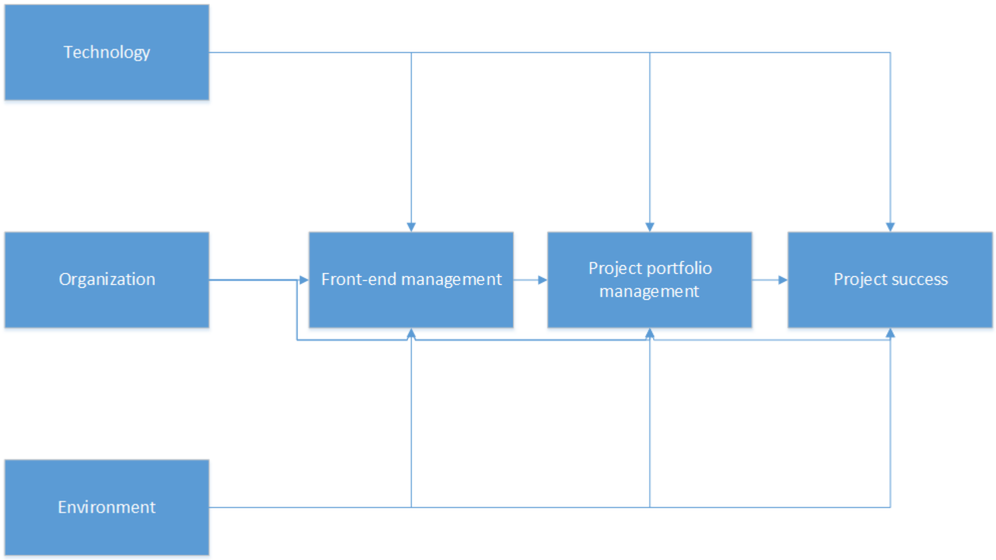
1.5.2 Hypothesis

The conceptual model is examined through the following main hypothesis:

- Some technology variables correlate and impact the adoption stages of a BI&A project
- Some organization variables correlate and impact the adoption stages of a BI&A project
- Some environment variables correlate and impact the adoption stages of a BI&A project

These hypothesis are statistically investigated using correlation, simple regression, multiple regression, and independent samples test. The results of these tests are

Figure 1.2: Proposed research model



elaborated in the analysis chapters.

1.6 Novelty of study

To the best of my knowledge, the current literature in the BI&A field is divided into the following: technical algorithms (Gudfinnsson et al. 2015), implementation frameworks (Feng et al. 2010), and critical success factors for a successful implementation (Dawson & Van Belle 2013). However, the literature does not discuss BI&A projects adoption through three main phases:front-end management, project portfolio management, and project success. These phases are inspired by the technology adoption stages: pre-adoption, adoption, and post-adoption (Ko et al. 2008).

Therefore, this research examines the factors that impact the adoption process of Business Intelligence and Analytics (BI&A) projects in organizations. Particularly, this study aims to assess the impact of technology factors (relative advantage, compatibility, complexity, cost), organization factors (strategy, project management practices, infrastructure, experience, top management, culture, resources), and environment factors (competition, vendor support, government) on the adoption process of BI&A projects (Basole et al. 2013).

The research is interested in organizations that already adopt BI&A projects and are operating in the Middle East, particularly the United Arab Emirates (UAE) and the Arabian Gulf region. Unlike most research that compares adopters to non-adopters (Kuan & Chau 2001, Lin 2014), this research is only interested in adopting organizations. During the pilot study, a lot of non-adopting organizations could not participate in the questionnaire as they do not have any experience with BI&A projects; thus, will not be able to answer the questions. Therefore, it is appropriate that only adopting organizations participate in the study. Eventually, non-adopting organizations can use the results of this research in implementing and adopting BI&A projects.

In a nutshell, the main contribution of this research is that it studies BI&A adoption as a project that is implemented in different phases. Typically, organizations take any significant endeavor such as the adoption of a certain technology in the form of a project (Jonas 2010). A lot of organizations have been implementing projects as a standard way of doing business (Gray & Larson 2008). The main technology adoption phases are: pre-adoption, adoption, and post-adoption (Ko et al. 2008). For a project, these adoption phases are: front-end management, project portfolio management, and project success. The proposed conceptual model, to the best of my knowledge, will add to the technology adoption literature by discussing it in the

Figure 1.3: Chapters outline

context of a project. Moreover, the research will utilize the Technology, Organization, Environment (TOE) framework to examine the impact of different factors on the adoption and implementation process of those BI&A projects in organizations. Eventually, this research will produce an empirically validated conceptual model that explain the adoption of BI&A projects in organizations.

1.7 Chapter outlines

This section will describe and provide a brief description of the chapters in this research. The outline of the chapters in this dissertation is shown in figure 1.3.

chapter 1-Introduction

(1.1) This chapter introduces the research. First, (1.2) it provides some background information related to the top of technology adoption. (1.3) After that, it highlights the current gaps in the literature through a problem statement. (1.4) Next, the aims of the research are listed. (1.5) Then, the research questions are listed. (1.6) After that, the novelty and significance of the study is described.

chapter 2-Business Intelligence & Analytics (BI&A) projects

(2.1) This chapter explains what Business Intelligence & Analytics (BI&A) projects are by providing a brief definition. (2.2) After that, the chapter explains the main technologies underlying BI&A projects. (2.3) Then, the main benefits of BI&A projects are listed and explained. After that, (2.4) the challenges and (2.5) recommendations to challenges are discussed. (2.6) Then, previous research related to BI&A project adoption is explained. (2.7) Finally, the future of BI&A projects through industry 4.0 is elaborated.

chapter 3-Literature Review

(3.1) The chapter starts by an introduction. Then, the chapter reviews the literature related to the (3.2) adoption decision process, specifically, (3.3) the three main stages of project adoption: front-end management, project portfolio management, and project success. After that, (3.4) the chapter lists and defines the main technology, organization, environment factors that impact these stages. (3.5) Then, the chapter describes/examines about the several technology adoption models. After that, the chapter summarizes (3.6) previous work in the technology adoption literature and (3.7) previous work in the TOE framework.

chapter 4-Proposed research model

(4.1) First, the introduction of the chapter is presented. (4.2) Then, the chapter explains the stages of BI&A project adoption. (4.3) After that, the chapter lists and defines the factors impacting those stages along with their hypothesis. (4.4) Next, the chapter provides an overall discussion of the proposed research model.

chapter 5-Research methodology

(5.1) This chapter starts by an introduction. (5.2) After that, the research philosophy of positivist approach is justified. (5.3) Next, the type of research motivating mixed methods is explained. (5.4) After that, the purpose of the research is discussed. Next, the questionnaire (5.5) structure and (5.6) design are explained. (5.7) After that, the questionnaire validity via pilot study is explained. (5.8) Then, the sampling and questionnaire distribution is outlined. (5.9) Finally, the main analysis techniques are briefly explained.

chapter 6-Descriptive analysis

(6.1) First, the introduction of the chapter is presented. (6.2) After that, the chapter presents the questionnaire. (6.3) Next, the chapter explains the data cleaning performed such as getting rid of outliers. (6.4) Then, reliability analysis is conducted. (6.5) After that, descriptive analysis and (6.6) ranking of the variables are explained. (6.7) The chapter ends with normality tests to validate the assumptions of the coming tests.

chapter 7-Factor analysis

(7.1) The chapter starts with an introduction. (7.2) After that, the chapter describes the factor analysis process adopted in this research. The analysis and findings are then presented for (7.3) independent variables alone and (7.4) all variables together.

chapter 8-Correlation and regression

(8.1) First an introduction is presented. (8.2) After that, correlation analysis is discussed to examine whether there are correlations between variables. (8.3) Then, simple regression analysis is done to see if there is an impact between dependent and independent variables. Next, multiple regression analysis is conducted to examine if there is an impact between dependent and independent variables relative to other variables.

chapter 9-Difference in perceptions between groups

(9.1) The chapter starts by introducing the topic. After that, (9.2) the equivalent hypothesis and (9.3) results are presented.

chapter 10-Discussion

(10.1) The chapter first introduces the topic. After that, the chapter answers the four research questions in this study in sections (10.2) and (10.3).

chapter 11-conclusion (11.1) The chapter starts with an introduction to the topic. (11.2) The chapter then provides a summary of the study. (11.3) After that, the chapter presents the contribution of the study to knowledge. (11.4) Next, the chapter explains policy implications. Finally, the chapter discusses (11.5) research limitations and (11.6) future research.

2-BUSINESS INTELLIGENCE PROJECTS

2.1 Introduction

Business Intelligence & Analytics (BI&A) projects are a set of technologies that use data and information to improve the performance of the business and drive a competitive advantage (Gudfinnsson et al. 2015). Managers want their data to have integration, consistency, trustworthiness, simplification, timeliness, protection, cost efficiency, granularity, breadth, and access (LaValle et al. 2013). Thus, BI&A projects transform data into meaningful information (Duan & Da Xu 2012). That is, BI&A projects transform data from quantity to quality (Yeoh & Koronios 2010). Some authors differentiate between Business Analytics and Business Intelligence projects. However, these two terms are used interchangeably (Gudfinnsson et al. 2015).

Although BI&A projects are not new in academia as they have been introduced in the late 1950s, only recently organizations became interested in the notion of analyzing their data (McBride 2014, Selene Xia & Gong 2014). The current adoption of BI&A projects in organizations is rather low (Vukšić et al. 2013). In fact, currently, BI&A projects experience an annual growth rate of 9.7% (Duan & Da Xu 2012). However, they are not fully adopted due to lack of a sound framework and the high failure rate in BI&A project implementations (Ramamurthy et al. 2008*a*, Seah et al. 2010). It is obviously challenging to achieve a successful BI&A project in an organization (Işık et al. 2013). However, it is expected that this notion of low-adoption will change in the future where executives will adopt BI&A projects to better communicate their business insights through visualizations and simulations (LaValle et al. 2013).

BI&A projects are the successors of older analysis projects. First, Management Information projects (MIS) projects were used to provide summary reports where management can do simple analysis. After that, Decision Support projects (DSS) projects were used to provide management with sensitivity and what-if analysis. Next, Executive Support projects (ESS) projects were used to help senior management with strategic decisions. Finally, BI&A projects were introduced with the focus on decision making capabilities (Zeng et al. 2012, Thamir & Poulis 2015, Laudon & Laudon 2011). Chen et al. (2012*a*) classify BI&A projects into three main categories: BI&A V1, BI&A V2, and BI&A V3. BI&A V1 is the first one which focuses on structured data and is built on traditional database management projects. BI&A V2 focuses on unstructured data and is built on web-based and cloud projects. BI&A V3 focuses on sensor based data and is built on mobile projects.

Organizations use BI&A projects differently. Gudfinnsson et al. (2015) summarize the application of a BI&A project in an organization into three main maturity levels: Aspirational, Experienced, and Transformed. Aspirational organizations are the furthest from achieving their analytics goals (LaValle et al. 2013). These organizations focus on cutting costs and improving the efficiency of their organization instead of building the necessary building blocks to perform analytics. Experienced organizations, as the name implies, have gained some experience in analytics. They have started to collect data and train employees to use BI&A projects efficiently. Transformed organizations are the most advanced in using BI&A projects. They are using the optimum building blocks to utilize their BI&A projects to achieve a competitive advantage.

This chapter discusses several aspects related to BI&A projects. First, it will describe the back-end technologies underlying the functionality of BI&A projects. These technologies include data warehouse, data mining, OLAP, and others. This will eventually lead to the discussion of the benefits of BI&A projects in organizations such as cost savings and improved efficiency. Obviously, and like any other IT implementation, there are several challenges that act as barriers to the adoption of BI&A projects in organizations. This chapter proposes several recommendations to remedy those challenges. After that, previous work from the literature in the field of BI&A adoption is discussed emphasizing the importance of this field. Last but not least, the future of BI&A applications in 4.0 is discussed where their need will be ever increasing.

2.2 Technologies

BI&A projects work through the ETL process. ETL refers to Extraction, Transformation, and Load. Extraction process is where the organization selects the sources and the data that will help them answer their specific questions. Transformation involves cleaning the data from redundancies and inconsistencies to prepare it for analysis. Load is the process that loads the BI&A project with the correct data for the analysis process to start (McBride 2014). There are technologies that build a complete BI&A project. First, there are data sources that collect data. These could be sensor data, transactional processing project, social media, enterprise projects...etc (Wixom & Watson 2001, Laudon & Laudon 2011). This data is then stored in large databases called data warehouses or data marts. Data warehouses store current and historical, internal and external data. Data mart, on the other hand, is more specific to a certain type of data. Technically, a data mart is a subset of a data warehouse (Laudon & Laudon 2011). Data warehouse and data mart are database technologies that are used to store data. This data is then analyzed using analytical and reporting tools such as data mining and OLAP. Each of these technologies are explained in details below.

- Data sources: data could come from any source such as relational databases, sensors, social media, market data, historical data, and operational data (Bahrami et al. 2012). This data comes in different velocity, volume, and variety (Chen et al. 2012*a*). Eventually, this results in what is known as big data (Laudon & Laudon 2011). Data is then stored in data warehouses or data marts. The process, technically, is known as extraction.

- Data warehouse or data mart: These technologies store historical and current, internal and external data (Duan & Da Xu 2012). A data warehouse gets data from data suppliers such as sensors and transactional projects. It then cleans, transforms, and stores them in place (Wixom & Watson 2001).

Like any other IT project, a data warehousing project fails due to organizational politics, lack of top management support, lack of user involvement, and weak funding (Wixom & Watson 2001, Seah et al. 2010). This raised a need to research factors that will enable a successful implementation of data warehousing projects. Wixom & Watson (2001) identified factors that correlate with perceived net benefits, organizations implementation success, project implementation success, and technical implementation success. The main factors that correlate with perceived net benefits are: high level of data quality and project quality. The main factors that correlate with organizational implementation success are: high level of project quality, high level of management support, high level of resources, and high level of user participation. The main factors that correlate with project implementation success are: high level of project quality, high level of resources, high level of user participation, and high level of team skills. Technical implementation success depends on high quality source projects and better development technology. Another study by Ramamurthy et al. (2008*a*) indicates that organizational commitment, size, absorptive capacity, relative advantage and low complexity of data warehouse projects are key determinants for the adoption of data warehouse. Another study by Hwang et al. (2004) indicates that top management, size, champion, internal business needs, and competitive environment would positively impact the adoption of data warehouse projects. Eventually, end users such as managers and data analysts will then utilize the stored data through reporting and analytics tools (Wixom & Watson 2001). There are several advancements that would improve the accessibility of data for analysis. For instance, SAP company introduced in-memory applications, HANA, as an improvement over the traditional data warehouse (Mihaela-Laura et al. 2014, Seibold et al. 2013). This will increase the speed of analysis as it saves the time wasted retrieving data from data warehouses to data analysis and reporting tools.

- Analytical and reporting tools: these tools are the actual analysis tools that are applied on the data. These tools include technologies such as Online Analytical Processing (OLAP), data mining, data visualization, simulations and scenario development, regression analysis, discrete choice modeling, mathematical optimization, historic trend analysis, forecasting, clustering, segmentation, standardized reporting, big data analytics, text analytics, web analytics, network analytics, mobile analytics, text mining, web mining, and multimedia mining (Selene Xia & Gong 2014, LaValle et al. 2013, Chen et al. 2012*a*). OLAP and data mining are two of the most well-used technologies in the BI&A field. OLAP is a set of front-end analysis tools that queries for multi-dimensional views in the data (Duan & Da Xu 2012, Hwang et al. 2004). OLAP is a query and reporting tool that allows for advanced modeling and optimization of data in businesses (Bahrami et al. 2012). Data mining is the core component of BI&A projects where it finds hidden patterns in data (Duan & Da Xu 2012, Hwang et al. 2004). Some of the output produced by data mining include forecasting, clustering, classification, text mining, web mining, association, and sequence (Laudon & Laudon 2011, Zeng et al. 2012). Data mining is a set of techniques to extract and identify useful information from large data sets (Selene Xia & Gong 2014). For example, walmart was able to use data mining in their purchase data to identify those shoppers who are likely pregnant (Laudon & Laudon 2011).

BI&A projects are well-discussed in the literature. Zeng et al. (2012) proposed an architecture framework for the technologies of BI&A projects. First, there are projects that generate data such as Enterprise Resource project (ERP), Supply Chain Management project (SCM), Customer Relationship Management project (CRM), and Transactional Processing project (TPS). This data is operational data that is generated every time an organization makes a transaction and is stored in a data warehouse. It is then analyzed via BI&A projects. Some of the BI&A tools available in the market are Microsoft SQL, Oracle DM, SAS enterprise miner, rapidminer, built-in ERP, enterprise edition, SPSS PASW modeler, Microsoft Excel, Matlab Selene Xia & Gong (2014). In this research, BI&A projects are divided into two groups: simple analysis and ERP. Simple analysis is where respondents use basic tools such as Microsoft Excel. ERP is where respondents use built-in analysis in their Enterprise Resource Planning (ERP) projects.

2.3 Benefits

The use of BI&A projects within different industries proved to be very beneficial. The benefits of BI&A projects include, but are not limited to, improved decision making, higher productivity, improved efficiency, accurate reporting, and empowering employees with the right knowledge. These benefits are discussed below in details.

- Improved decision making: BI&A projects supports the decision making process in an organization (Gudfinnsson et al. 2015). This is mainly because BI&A projects provide useful information to the organization (Duan & Da Xu 2012). Specifically, the right decision is performed when the right information is available to the right people at the right time (Evans et al. 2014). BI&A projects eventually empower knowledge workers to be able to fulfill their daily tasks efficiently (Vukšić et al. 2013).

- Improved efficiency: BI&A projects are used to improve efficiency (Duan & Da Xu 2012). That is, it improves the performance of the organization's business processes to increase effectiveness and efficiency in operations (Kaula 2015). In fact, top performing organizations use BI&A projects five times more than lower performers (LaValle et al. 2013). In addition, BI&A projects provide effective utilization of human resources and process efficiency (Neil Foshay 2014). BI&A projects also support faster and more accurate reporting, improved decision making, and eventually increased revenue (Selene Xia & Gong 2014). In numerical and tangible terms, BI&A projects result in a high return on investment rate (Bahrami et al. 2012). This is one of the very important measures management need to look at to evaluate the performance of a certain technology.

- Achieve a competitive advantage: BI&A projects collect and analyze data about new markets, technologies, customers, competitors, and social trends (Evans et al. 2014). This will drive the company to the right strategic decisions that will eventually achieve a competitive advantage. Eventually, BI&A projects discover strategic and tactical opportunities for the organization (Kaula 2015).

- Improved business relationships: BI&A projects manage relationships with different stakeholders (McBride 2014). More importantly, customer relationships is the key relationship any organization needs to build and support. BI&A projects also improve customer service by identifying their profiles and predicting their needs. It is important to use BI&A projects to help create a market strategy and manage customer relations (Shyandilya et al. 2014).

- Improved business monitoring: BI&A projects help in identifying key performance indicators (KPIs) where organizations can optimize and control their processes (McBride 2014). Also, these projects predict changes in product demand or detect an increase in a competitor's market share (Işık et al. 2013).

Different organizations have implemented and benefited from the use of BI&A projects. For instance, Facebook utilizes BI&A projects with their targeted ads and friend suggestions. Also, Amazon implements BI&A projects with suggested products (Chen et al. 2012*b*). Technically, Amazon analyzes the products customers purchases, where they buy from, what they buy with it, and when they buy it. Combining this data from different customers along with external data like the data obtained from social networks gives Amazon a unique power in servicing their customers (Laudon & Laudon 2011).

2.4 Challenges

Like any technological implementation, there are several impediments to the adoption and implementation of BI&A projects in organizations. These challenges are divided into two main categories: technological and managerial. Technological barriers include project compatibility with the current infrastructure of the organization, data cleaning and formatting, and vague maintenance process. Managerial barriers include high investment, inappropriate organizational culture for the BI&A project, and lack of top management support. These challenges are discussed below.

Technological challenges that will impact the adoption and implementation of BI&A projects are:

- Data nature: Organizations find it difficult to acquire data and manage it (Thamir & Poulis 2015). This results in poor data quality with incorrect values and lack of data integrity (Gudfinnsson et al. 2015). Neil Foshay (2014) indicates that managers lack confidence in making decisions in a timely manner due to lack of information availability. Managers also indicate that they typically lack access to quality information.

- Lack of appropriate IT infrastructure: BI&A projects need big databases to store data and powerful computers to analyze data. Back-end technological projects that are not compatible with BI&A projects and vague maintenance process for the BI&A projects are considered important challenges (Yeoh &

Koronios 2010). These challenge are very important as technical architecture and requirements may sometimes influence data selection for analysis and thus manipulate the results (McBride 2014, Korte et al. 2013)

Managerial challenges that will impact the adoption and implementation of BI&A projects are:

- Lack of top management support: Managers sometimes do not support the adoption of BI&A projects in their organizations. First of all, they only see tangible results after some time from using the project. This might lower their motivation to support the project's implementation. Also, there is lack of management bandwidth due to competing priorities (LaValle et al. 2013). Korte et al. (2013) identified lack of executive sponsorship as one of most important challenges to the implementation and adoption of BI&A projects.

- Lack of technical knowledge: Employees do not know how to use BI&A projects. Also, managers do not know how to modify their business processes to utilize these projects and do not know the crucial decisions that need to be made to implement these projects. Lack of project skills and technical knowledge do act as important impediments to the adoption and implementation of BI&A projects.

- Culture: Any organization that implements BI&A projects need to have an innovative culture where employees come up with new ideas and not resist change (Seah et al. 2010, Korte et al. 2013). Also, existing culture should encourage knowledge sharing (Gudfinnsson et al. 2015).

- Cost: BI&A projects are expensive; they also require high investments that need to be made in infrastructure, storage, and analysis of data (Evans et al. 2014). Unfortunately, and especially at the beginning of the implementation period, perceived costs outweigh projected benefits (LaValle et al. 2013, Selene Xia & Gong 2014)

- Lack of implementation methodologies: Managers do not know where to start if they want to implement a BI&A project in their organization (LaValle et al. 2013). There is a lack of methodologies and frameworks that will help integrate BI&A projects into the organization's current business processes (Evans et al. 2014). If not implemented correctly, BI&A projects will produce reports after the decisions have already been made (Evans et al. 2014, Selene Xia & Gong 2014).

- Lack of data privacy and security: privacy and security are two major concerns when it comes to data (Wang et al. 2010). The privacy problem can be mitigated by allowing customers the freedom to decide what to do with their data through privacy statements. Privacy statements should: give customers the option whether to store their data or not, give customers the option of viewing what is stored about them, enforcing security rules to protect customer's data, and indicating the duration for which this data is to be stored (Laudon & Laudon 2011). The second issue, security, concerns if data is hacked, the organization will be accused of big liabilities. Unfortunately, this problem cannot be eliminated completely as it is impossible to secure all the breaches that might be hacked. However, some of the proposed techniques are firewalls and anti-viruses along with hiring white hat hackers who would attempt to test the project against several vulnerabilities to ensure its robustness (Salomon 2003)

2.5 Recommendations to challenges

Different authors have proposed several suggestions to minimize the barriers that happen during the adoption and implementation of BI&A projects. Organizations need to maintain and organize their data in a continuous and growing data and analytics plan (Gudfinnsson et al. 2015). Organizations can either focus on small steps at the beginning and learn from their progress; that is, focus on achievable steps (LaValle et al. 2013). Or, they can attack the biggest first challenge, start with objectives and questions (not data), use BI&A tools to have insights of their data, add more tools to what they are currently using instead of replacing them, and plan for the future by setting up information agendas such as information policies, data architecture, and analytical tool kits (LaValle et al. 2013). In other words, organizations could pick spots where the highest value for them will be created and use reasons and benchmarks to prove that value. Measurement of BI&A project performance can also help determine its value and manage BI&A processes (Lönnqvist & Pirttimäki 2006).

Organizations can also minimize adoption costs by using cloud based BI&A projects which will help reduce the cost of building and maintaining those projects (Evans et al. 2014). There are also free tools such as Google Analytics and Active Campaign that organizations can use for a starter (Shyandilya et al. 2014).

Most importantly, organizations need to obtain senior management support and involvement throughout the whole adoption and implementation process. Change management can also be improved if BI&A business processes are embedded within the current business processes. This will be empowered if employees get the appropriate training to derive the maximum value of investing in a BI&A project (Gudfinnsson et al. 2015).

Technically, it is important to establish trust between data providers and data receivers (McBride 2014). It is also important to get BI&A reports before the actual decision making time. Thus, researchers now focus on real time BI&A reports (Evans et al. 2014).

2.6 Previous research in the adoption of BI&A projects

Lots of data with different variety, velocity, and volume drive the need for adopting BI&A projects (Işık et al. 2013). Different authors have studied the adoption process of BI&A projects in organizations. Wixom & Watson (2001) proposed a model with a list of determinants that will ease the adoption of BI&A projects in organizations. The model includes the following factors: top management support, business champion, sufficient resources, effective user participation, appropriate technical skills by employees, and the availability of the right data. Top management support was also highly supported by Seah et al. (2010). In fact, BI&A projects are usually initiated by the CEO, the CIO, the board of directors, or the functional managers (Vukšić et al. 2013). Another study by Yeoh & Koronios (2010) concluded seven main critical success factors for the adoption and implementation of BI&A projects: Committed management support, well-established business case, business champion and optimum team composition, iterative development approach, appropriate change management, flexible technical framework, and sustainable data quality. McBride (2014) identified availability of large databases, improved BI&A tools, popularity of BI&A projects, and economic factors as drivers to the adoption and implementation of BI&A projects in organizations. In the service sector specifically, BI&A applications are driven by understanding market characteristics (Vukšić et al. 2013). Another study by Işık et al. (2013) examines five different characteristics that influence the adoption of BI&A projects: data quality, integration of BI&A projects with other projects, user access, flexibility of BI&A projects, and risk support. Data quality refers to the consistency and comprehensibility of data. Integration of BI&A projects with other projects refers to linking the data and applications of various projects together. Also, it is important to give role-based access to users using BI&A capabilities to improve the task-fit between the project and the task of the user. During problems and exceptions, organizations need to be flexible by having lenient rules and regulations to better use the BI&A project. It is also useful if BI&A projects account for uncertainties to better support risk management in organizations. A study by Popovič et al. (2012) shows a strong evidence on the relation between data integration and analytical capabilities with BI&A project maturity. Data integration issues include data quality, security, management issues, data integration, and data transformation. Eventually, a matured

BI&A project would result in better information content quality (Popovič et al. 2012). A summary of the factors that influence the adoption and implementation of BI&A projects is shown in table 2.1.

Table 2.1: Factors impaction the adoption and success of BI&A projects and projects in organizations

Factor	Definition	References
Top management support	The support and motivation of management throughout the implementation process	(Seah et al. 2010, Vukšić et al. 2013, Yeoh & Koronios 2010)
Business champion	The availability of a business person in charge of taking care of the adoption and implementation process	(Yeoh & Koronios 2010)
Sufficient resources and BI&A tools	The organization needs to have enough financial and technical resources to adopt and implement a BI&A project	(Popovič et al. 2012, McBride 2014)
Effective user participation	The users who will use the project need to be involved in the project and given role-based access to support them with their tasks	(Işık et al. 2013)
Appropriate technical skills	The implementing team and the users (power and casual users) need to have appropriate skills to fully utilize the value of the project	(Popovič et al. 2012, Yeoh & Koronios 2010)
Availability of the right data	The right data needs to be available on the right time to support the decision making process	(Popovič et al. 2012, Işık et al. 2013, McBride 2014)
Integration of BI with other projects	The BI&A tool need to be compatible with other projects to easily exchange data	(Popovič et al. 2012, Işık et al. 2013)
Well-established business case	There should be a serious need with an appropriate study for the fit of the BI&A project in the organization	(Yeoh & Koronios 2010)
Flexibility of BI&A projects	BI&A projects need to be flexible to analyze different types of data to support different types of decisions	(Işık et al. 2013, Yeoh & Koronios 2010)
Risk support	The implementation process should support any risk that might happen and fix it at the right time and in the right way	(Işık et al. 2013)
Change management	The organization needs to support an iterative development process to embed the use of BI&A projects in the organizational business process	(Yeoh & Koronios 2010)
Popularity of BI&A projects	The more popular the use of BI&A projects in the market, the higher the chances it would be adopted	(McBride 2014, Vukšić et al. 2013)
Economic drivers	The need to better understand the competition and the customers to make more profits clarifies the objective of BI&A projects and increases the likelihood of adoption	(McBride 2014)

Another stream of research focuses on proposing action plans and frameworks to adopt BI&A projects in organizations. Data mining, a popular sub-technology of BI&A projects, have two main frameworks: CRISP-DM and SEMMA (Selene Xia & Gong 2014). CRISP-DM was introduced in the middle 1990s. It is iterative and includes the following steps: sample the right data that will achieve the objective in hand, explore, modify, model, and assess. SEMMA has the same steps as the CRISP model. The main difference between CRISP-DM and SEMMA is that CRISP-DM is more comprehensive while SEMMA focuses on specific identified goals. It is also important to model and structure information in business processes to better model those business processes (Kaula 2015).

Practically, BI&A projects adoption starts with problem identification, data acquisition, and analysis of data. Zeng et al. (2012) propose a framework for the adoption of BI&A projects. The steps of this model include problem description where organizations identify their main objectives from implementing the BI&A project, model and design the problem, pre-process data where the data is cleaned and prepared, apply the appropriate algorithm, visualize and interpret the results, and finally act on the results. Similarly, Lönnqvist & Pirttimäki (2006) propose a process model for the use of BI&A projects in organizations. The steps of their proposed model include identifying information needs, acquiring appropriate information, analyzing this information, and finally working on storing and analyzing this information.

2.7 The future of BI&A in industry 4.0

Industry 4.0 is the new flexible and agile manufacturing era where machines become very smart; thus producing high degree of customized products (Lee et al. 2015). The ancestors of industry 4.0 are industry 1.0, 2.0, and 3.0. Industry 1.0 depends mainly on automated machines and the notion of economies of scale. Whereas industry 2.0 is built on the idea of mass production and the use of electricity. Industry 3.0 evolved which utilized IT automation production tools to improve the efficiency and effectiveness of the manufacturing process. Now, industry 4.0 aims at improving the autonomy of machines by connecting them to reality and programming them as a collaborative community (Lee et al. 2014).

Smart manufacturing, also known as smart factory, is built using smart machines that have the following characteristics: self-awareness, self-prediction, self-comparison, self-reorganization, and self maintenance. These characteristics of smart machines are explained below (Lee et al. 2014).

- self-awareness: This attribute means that machines are embedded with sensors and are aware of the physical surrounding in their environment. Machines would be now aware of external events such as pressure, temperature, light, sound...etc.
- self-prediction: This characteristic means that machines can predict tasks; thus, modify their scheduling accordingly.
- self-comparison: Machines will be able to compare actual versus target output that is expected from them. This will enable feedback again into the project and recommend incremental improvements to reach targeted and desired outputs.
- self-reconfiguration: In industry 4.0, machines will be able, autonomously, to modify their parameter settings to account for different requirements.
- self-maintenance: This attribute identifies how machines would be able to automatically do updates and maintenance on their projects to minimize the likelihood of any potential downtime.

Industry 4.0 will bring along a lot of benefits. Specifically, it will improve the competition position of organizations due to the increased efficiency from self-awareness and reduced down time from self-maintenance. In addition, human resources will be better allocated as they would focus more on design and high level tasks rather than redundant costly tasks. This improved efficiency and productivity would highlight growth opportunities for different business segments such as supply chain and research and development (Brettel et al. 2014).

The era of industry 4.0 makes the use of BI&A tools. Smart machines will both use and generate huge amounts of data. Unlike human related data which were discussed in the previous sections of this chapter, BI&A tools in industry 4.0 era focuses on machine related data. If analyzed correctly, the autonomy of machines will be improved. That is, machines will be empowered with decision making capabilities to better improve their operations. For instance, BI&A analysis might suggest task arrangement where priorities of different tasks would change. This will result in lower labor costs as a lot of the machine related tasks such as set-up and maintenance would be automated. Also, the organizations would be empowered with knowledge about specific details of their production process. This will definitely create a better working environment and improve decision making. In addition, due to machine self-maintenance, downtime would be reduced drastically. This will result in saving energy and eventually reducing costs. More importantly, management would be more aware of the performance of the machines due to the transparency and organization of processes (Lee et al. 2014).

It is inevitable that BI&A projects would have an increasing demand in the future, especially with the rise of industry 4.0 notion. However, there will be several flags that managers need to take care of while implementing these tools in their organization. Firstly, the increase of data will raise a lot of security concerns. That is, the more the data, the stronger the security measures organizations need to consider to protect this data. This challenge can be tackled through the use of stronger security software that will implement the optimum measures to protect data (Salomon 2003). Secondly, another important challenge will be the need for high skilled labor who can program these machines and monitor their performance (Lee et al. 2014). This challenge could be tackled by training employees. Another challenge would be obtaining stake holders' approval to transform their organization to 4.0 and utilize the use of BI&A tools. Management should give proper incentives to the different stakeholders involved and implement change management to transform the organization to 4.0 (Laudon & Laudon 2011). There is also lack of standards in the industry. Responsible industrial bodies are too slow in developing applicable standard for industry 4.0 era (*Deliotte: Industry 4.0-challenges and solutions for the digital transformation and use of exponential technologies* n.d.). This challenge could be solved if big organizations collaborate together and achieve reliable standards quickly (Brettel et al. 2014).

2.8 Chapter summary

This chapter provided a detailed overview of BI&A projects. First, different definitions used in the literature are discussed. Then, the building technologies of BI&A projects are listed and explained. The chapter then lists the main benefits of using BI&A projects in organizations. Moreover, the challenges and recommendations of using BI&A projects are listed and discussed. Previous work in the literature related to the use of BI&A projects in organizations is discussed. Finally, the future of BI&A projects is discussed, especially in the industry 4.0 era where the need would be ever-since increasing.

3-LITERATURE REVIEW

3.1 Introduction

This chapter focuses on technology adoption. A lot of research has studied technology adoption related to specific information systems (Young Choi et al. 2011), such as Business Intelligence systems (Seah et al. 2010), e-business (Jiang 2009), internet banking (Gopalakrishnan et al. 2003), and many others. Adoption of technology is defined as potential users making a decision to adopt or reject a technology based on beliefs they form about the technology (Thong 1999). Therefore, this chapter explains the adoption process as a one step-view and as a process view. Based on that discussion, the adoption process for a BI&A project is divided into the following three stages: front-end management, project portfolio management, and project success. These stages are impacted by different factors that are categorized into technology, organization, and environment factors. The chapter also discusses the several models that explain the adoption of a certain technology. Such models include Technology Adoption Model (TAM), Technology Adoption Model 2 (TAM2), Perceived Characteristics of Innovation (PCI), and others. At the end, previous work in the technology adoption literature is discussed. The discussion leads to the explanation of the proposed research model explained in the next chapter.

3.2 One step view versus process view of adoption

Authors have measured adoption of technology in two main ways: one step view or process view. In the one step view, authors study the adoption as a one step decision that is done by organizations. That is, authors study the adoption as a YES adopt or NO adopt decision. In contrast, other authors study the adoption of a certain technology by organizations as a series of steps that need to be followed in order to fully adopt and implement the technology. These two paradigms, along with previous work in each field, are discussed below.

3.2.1 One step view

One step view means authors study the adoption as one decision: to adopt or not to adopt. This binary view of adoption, to adopt or not to adopt, was introduced by Rogers (1983).

Different authors have utilized this school of thought where the adoption decision is binary. For instance, Wang et al. (2010) studied the determinants of RFID adoption in the manufacturing industry as a single step decision. Thompson et al. (1991) measured innovation as a one step decision. Malhotra & Singh (2007) also studied the adoption of internet banking in banks in India as a one step decision. Moreover, Pan & Jang (2008) discussed the factors impacting the adoption of Enterprise Resource Planning (ERP) systems in Taiwan as a binary adoption decision, while Shahawai & Idrus (2010) studied the factors impacting the adoption of ERP systems in Malaysian SMEs as a single step decision. In addition, Chang et al. (2007) studied the factors impacting the adoption of electronic signature in hospitals as a one step decision. In addition, Ramamurthy et al. (2008*b*) proposed an empirical investigation that study the factors impacting the adoption of data warehouses as a single step decision. Also, Li et al. (2010) examined the acceptance of RFID in Chinese firms as a single step decision. Moreover, Borgman et al. (2013) studied the factors impacting the adoption and governance of cloud computing as a binary adoption decision. In addition, Oliveira & Martins (2010) studied the adoption of e-business in organizations residing in the EU as a single step decision, and many more. As these authors study the adoption of the technology/innovation as a one-step decision performed by organizations, to adopt or not to adopt, they usually use logistic regression to analyze their results. Their studies find the differences between adopters and non-adopters of the technology.

However, studying adoption as a one step decision is similar to looking at an incomplete picture. In fact, technology adoption is the decision to accept and use that technology (Rogers & Shoemaker 1971). It is also important to distinguish between the adoption process stages as different factors do posses different impacts on different stages in the adoption decision process (King 1990). Moreover, it is important to focus on multiple stages as technology is not truly adopted until it is in full use by the organization (Rogers & Shoemaker 1971). Therefore, it is only logical to consider the adoption decision process as a series of stages rather than a one binary variable (Tornatzky et al. 1990).

3.2.2 Process view

The other stream in the literature motivates studying the adoption of technology as a gradual process. The adoption process is rarely a single step process. Many organizations initially adopt technology without fully exploiting its functionality and fully adopting it (Zhu et al. 2006). Just like change management, anything new in the organization should be managed in an incremental step-by-step fashion. In addition, organizational resources are scarce and cannot be spent all at once in a single stage (Cool et al. 1997).

The adoption process view was initiated from the product development literature. One of the well-known product adoption processes is called stage-gate system (Cooper 1980). The stage gate starts with an idea that goes through different stages via gates. The gates act as a go/kill decision to decide whether to allow the adoption idea to pass to the next stage or not. Obviously, the more advanced the stage is, the tougher is the go/kill decision process. However, the go/kill decisions are very critical at the beginning as they might stop a fault product from proceeding and avoid wasting unnecessary resources (Cooper & Edgett 2003). Some authors adopt the stage-gate process discussed by Cooper (1980) by having their own definition of the stages.

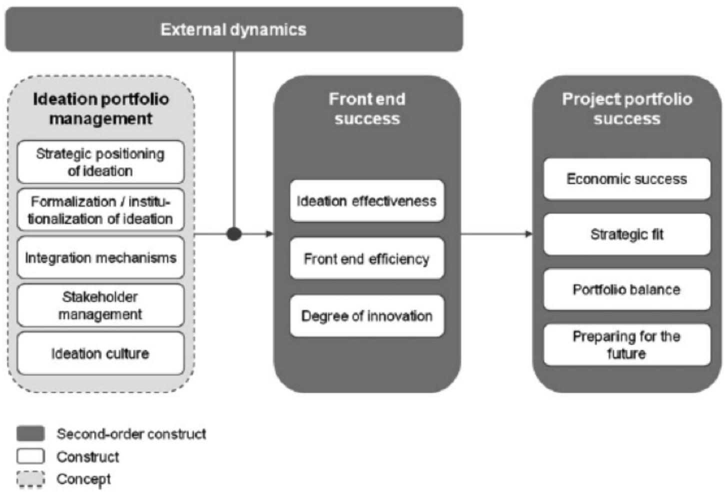
The adoption process stages are inspired by the literature from the product innovation field. The innovation decision process, introduced by Rogers (1983), occurs over two main stages: initiation and implementation. Initiation is basically gathering knowledge about the innovation, forming attitude about it, and making a decision whether to implement it or not. Implementation occurs when the organization puts the innovation into actual use. These simple two stages were then evolved to a five stages innovation decision process model: knowledge, persuasion, decision, implementation, and confirmation (Rogers 1983). In the knowledge stage, the organization gets to know about the innovation. In the persuasion stage, the organization starts by collecting information about the innovation and building an initial perception of it. In the decision stage, the organization makes a decision whether to adopt, reject, or postpone the adoption of the innovation. In the implementation stage, the organization allocates resources to realize the innovation and put it into actual use. Finally, in the confirmation stage, the organization focuses on whether to continue or discontinue the innovation. This innovation adoption process was appreciated in the technology adoption process in the study by Frambach (1993) that aims to propose an integrated organizational model of technology adoption models. Also, Roger's decision framework was utilized by Ko et al. (2008) where they studied the adoption of Customer Relationship Management (CRM) systems using three main stages: perception of CRM, adoption of CRM, and implementation of CRM.

A similar model for the adoption decision process that consists of three main stages, initiation, adoption, and routinization, was used in studying the adoption of knowledge management systems by organizations (Lee et al. 2009). Initiation acts as the first stage to evaluate the proposed technology. Then the adoption stage is widely defined as the decision to use the technology or not. Finally, for technology to be widely successful, it should be accepted and routinized into institutional practices of day to day work

Based on the above discussion, the adoption decision process could be summarized into three main stages: pre-adoption, adoption, and post-adoption (Ko et al. 2008). Organizations need to consider the factors that affect the multiple stages of the adoption separately. That is, the factors that affect the pre-adoption phase are different than the factors that affect the adoption stage, and are ultimately different than the factors that affect the post-adoption stage. Therefore, it is important to study these phases separately.

In a more practical context, organizations typically take any huge endeavor such as the adoption of a certain technology in the form of a project (Jonas 2010). Many organizations have been implementing projects as a standard way of doing business (Gray & Larson 2008). Therefore, it is important to discuss the adoption process for a project. The idea of having adoption stages for a project is discussed in the work of Heising (2012). Basically, he proposed a framework to manage new ideas as projects. His model is divided into three main phases: ideation portfolio management, front-end success, and project portfolio success as shown in figure 3.1. A lot of work got inspired by this research which was cited in more than 40 other studies. This shows the credibility and practicality of this combination between adoption process and projects. For BI&A projects, this research will study the factors that affect the three stages: pre-adoption, adoption, and post adoption in a comprehensive model. Therefore, this coming section is the adoption stages for a project.

Figure 3.1: Detailed conceptual research framework for the integration of ideation and project portfolio management by Heising (2012)



3.3 Adoption stages of a project

As discussed earlier, the adoption stages are classified intro three main categories: pre-adoption, adoption, and post-adoption. The pre-adoption stage is the first stage in the adoption process, and refers to the initiation of the BI&A project idea. This stage is defined as a series of activities that supports creating awareness, recognizing a need, forming attitude towards the innovation, and creating a proposal for innovation adoption (Cooper & Zmud 1990). The next step in the adoption process is the adoption stage. This stage involves the decision to accept the idea if it fits organizational needs, and committing the resources to implement it (Cooper & Edgett 2003). The last stage in the adoption process is the post-adoption stage which means the actual success of the project (Fowler & Walsh 1999).

As motivated earlier in the introduction chapter, these stages are discussed for a project and renamed into: front-end management, project portfolio management, and project success.

3.3.1 Front End Management-Pre-Adoption Stage

According to Cooper & Zmud (1990), the front end phase consists of idea generation, assessment, and concept definition. It is important that every organization should adopt its own front-end process (Nobelius & Trygg 2002). A proper front end management would positively impact the overall project experience ,and would eventually impact its success (Verworn et al. 2008).

Some of the factors that result in a well-managed front end are: company size, decision making style, operating culture, and frequency of new product introductions (Khurana & Rosenthal 1997). In addition, business strategy, project estimates, political biases, and organizational process complexity have an impact on the project concept (Williams & Samset 2010). Also, managerial flexibility in resource allocation is an important element to the success of front end of projects (Nobelius & Trygg 2002).

3.3.2 Project Portfolio Management Related Literature-Adoption Stage

IT project portfolio Management (ITPPM) is a set of projects that organizations may select and fund. Therefore, and as proposed by Cooper & Edgett (2003), ITPPM is guided through the following criteria (1) Maximization of returns and minimization of risk, (2) balance of projects between what the company is capable of doing and what the company needs, and (3) strategic alignment with the corporate strategy (Bonham 2005). Recently, authors have also included (4) preparing for the future as a fourth construct for PPM success (Heising 2012, Meskendahl 2010). All of these guidelines need to be restricted by the resources in the organization. A proper ITPPM would positively impact the overall project experience and eventually its success (Heising 2012, Meskendahl 2010).

Objective One: Maximization of Return and Minimization of Risk

The return of projects is based on quantitative variables such as Net Present Value (NPV) and qualitative variables such as increased productivity. The four generic techniques used for estimation are: (1) Mathematical Programming such as linear and integer programming (Dickinson et al. 2001), (2) Economic Models such as Return on Investment (ROI) and NPV, (3) decision analysis such as decision trees, risk analysis, Analytic Hierarchy Process (AHP), and (4) interactive comparative models such as Delphi and behavioral decision aids (Bonham 2005). Estimates are better done using a range such as best, average, and worst estimates (Archer & Ghasemzadeh 1999). This is because a single point forecasting could be beyond peoples' ability to estimate and eventually misleads the decision. Despite the general techniques listed above, every organization needs to develop its own criteria based on its strategy and culture (Archer & Ghasemzadeh 1999). For example, a large chemical company in the U.S. evaluates projects on five main criteria: probability of technical success, probability of commercial success, strategic leverage, business strategic fit, and reward (Dickinson et al. 2001).

Objective Two: Creating a balanced project portfolio

The project portfolio should have a homogeneous mix of projects. This is important as there are inter-dependencies between projects; both current and new. A portfolio of projects needs to be balanced based on multiple dimensions such as risk, size, complexity, and strategic intent (Bonham 2005). These dimensions vary as there are no agreed-upon list that can be followed by all organizations. For example, Archer & Ghasemzadeh (1999) considers project size and duration dimensions while Hunt et al. (2008) consider the project type, resource adequacy, and risk level dimensions as important factors for a balanced project portfolio. A successful balanced portfolio should ensure constant inflow of resources to execute the projects while maintaining constant outflow generation (Hunt et al. 2008).

Objective Three: Business Strategy

A business strategy is basically its objective/purpose. Business Strategy is based mainly on two main pillars; growth and productivity (Kaplan & Norton 2001). PPM should be used as a tool to implement the business strategy (Archer & Ghasemzadeh 1999). The projects' objectives need to be aligned with the business strategy in order to achieve business success (Meskendahl 2010). It is proven that a balanced strategy between market and technology orientation is the best in terms of helping the firm to become a top performer (Cooper 1984).

Objective Four: Preparing for the future

This dimension explores how the project prepares the organization for the future (Heising 2012, Meskendahl 2010). That is, it realizes long term benefits of the project portfolio. Some of the long term benefits as proposed by Shenhar et al.

(2001) are: exploring new technological opportunities, entering into new markets, and developing new skills and competencies.

It is important to include all project, even minor ones, in the project portfolio management (Blichfeldt & Eskerod 2008). Moreover, during the PPM phase, both new and current projects need to be evaluated (Archer & Ghasemzadeh 1999).

3.3.3 Project Success- Post adoption stage

This section will explain what project success is ,and how different authors define it. Also, this section will list all the Critical Success Factors (CSFs) that impact project success.

3.3.3.1 Project success

The Information Systems/Information Technology (IS/IT) project success literature does not agree on a common set of project success measures (Bannerman & Thorogood 2012, Müller & Turner 2007). Also, project success could have different definitions from different perspectives (Fowler & Walsh 1999). Traditionally, a project is successful if it meets time, budget, and performance goals. However, Shenhar et al. (2001) extended this project success definition and included the following dimensions: project efficiency, impact on customer, organizational and business success, and preparing for the future. Specifically, information systems success included several other factors. DeLone & McLean (1992) introduced six major dimensions to measure success: system quality, use, user satisfaction, information quality, individual impact, and organizational impact. DeLone & McLean (1992) updated their IS success model by introducing service quality construct to the model. The authors also combined organizational benefits and individual benefits into a single construct. Finally, the authors changed the use construct to intention to use construct (Delone & McLean 2003). Another study by Morris & Hough (1987) considers a project to be successful if it is: functional, implemented to budget, scheduled, and has technical specification, commercially profitable for the contractor, and terminated successfully if the need for cancellation arises. On the other hand, Ward et al. (1996) considers a project successful if it: achieves its stated business purpose, provides satisfactory benefit to the owner, satisfies the need of the owner, user and stakeholders, meets its objectives to produce the facility, aligns with the specification, meets budget and time requirements, and satisfies the need of the project team and supporters. Wateridge (1998) extends those two lists and defines a project successful if it: provides profitable returns to the owner and contractors, achieves its business purpose in a strategic, operational, and tactical way, meets its objectives, meets quality thresholds, meets specification, meets budget and time constraints, and satisfies all parties requirements. Also, some authors measured IS/IT project success using reliability which indicates the probability of successfully meeting business objectives under certain conditions (Zahedi 1987). Zahedi (1987) defines reliability as a measurable variable that indicates the success of IS. It can also support management in comparing several IS. Some authors claim that customer satisfaction is considered the most important measure of IS project success (Basten et al. 2011). Other authors typically measure success in simpler terms through four main components: time, budget, quality, and stakeholder opinion (de Bakker et al. 2012). Recently, authors focus more on stakeholder approach (Fowler & Walsh 1999). Stakeholders could be analyzed through three main groups: senior management, project core team members, and project recipient (Davis 2014).

Interestingly, Lyytinen & Hirschheim (1988) look at technology project success through failure. They define failure using three main dimensions: process failure which constitutes time and cost, interaction failure which happens when the user does not use the system, and correspondence failure when the system does not meet original goals.

As shown above, there are different definitions for project success. This means that different authors conclude a different set of criteria that defines project success based on the research methodology and context they study. Based on this assumption, it can be safely concluded that different projects in different contexts have their own definition of success. This assumption is also confirmed by Wateridge (1998).

3.3.3.2 Critical success factors (CSFs)

Project success is typically achieved through Critical Success Factors (CSFs). CSFs were first introduced in the 1970s by Rockart who defines CSFs as those factors that, if available in any project, ensure its success. These are the factors that must go right for the business to succeed. This method helps managers focus on what has to be done right to ensure success in achieving goals and objectives (Rockart et al. 1982).

Different papers have tackled CSFs for IT/IS projects as these projects are complex and have a high failure rate (Rodriguez-Repiso et al. 2007). These factors are summarized below:

Business planning

Business planning means that the organization needs to properly estimate the time line of the project and not to overestimate or underestimate the process (Yeo 2002). Moreover, business processes need to be adjusted to account for the changes that will occur after the implementation of the project (Lu et al. 2006).

Project planning

The organization needs to properly define the requirements and the scope of the project in order to visualize a clear picture of the project needs (Yeo 2002). The organization also needs a clear vision of the project (Zahedi 1987).

Project management and control

Project management practices, such as risk management and analysis, are important to ensure a successful project (Yeo 2002). These practices should also incorporate correct and realistic assumptions regarding risk analysis. There should also be consistent standards in use by all the involved stakeholders in the organization to ease the implementation process (Lu et al. 2006).

Corporate culture

The organization needs to be reactive in dealing with any problem that might arise during the implementation of the process (Yeo 2002).There should also be a constant communication and transparency between the involved parties who are implementing the project (Zahedi 1987).

Corporate and top management

Rather than a top-down management style, the organization needs to adopt a bottom-up style as change mainly happen from the employees rather than the managers (Yeo 2002). Top management also needs to manage the resources effectively (Zahedi 1987, Sabherwal et al. 2006).

Users

The organization needs to support the users by involving them and incorporating their inputs throughout the project management process (Yeo 2002). This means that the internal communication system needs to be strong and comprehensive (Zahedi 1987, Sabherwal et al. 2006).

Politics and motivation from all supporting parties

Also, in order to facilitate the process of project implementation, the organization needs to allocate an influential champion (Yeo 2002). Also, there should be strong motivation from all the stakeholders involved to keep the project going (Lu et al. 2006, Jiwat Ram 2014).

Information technology

The organization needs to properly choose an appropriate and advanced software to execute and implement the project (Yeo 2002). In addition, the project needs to have high integration with internal information system to ensure compatibility (Lu et al. 2006).

IT/IS professional and knowledge sources

The employees and the consultants need to appropriately estimate the project scope and complexity (Yeo 2002). Also, there should be synergies between the team members performing and implementing the projects (Lai 1997). Some of the important qualities in a team are: co-ordination, commitment, and integration. Also, the team needs to be cross-functional and aware of all the involved departments in the implementation of the project (Lu et al. 2006). The team should also have certain qualities such as technical knowledge, good communication skills, analytic skills, business knowledge, initiative and flexibility, good organization skills, experience, creative skills, good team process, effective leadership, user involvement, tact, dependability, calm under stress, and broad perspective (White & Leifer 1986, Zahedi 1987).

There is a different work that examined the critical success factors that impact the success of certain IT projects. For example, knowledge management projects need supportive Information Systems and cultures, the users to be motivated and to have familiarity and authority in the system, and to ensure communication among different departments to increase the likelihood of project success (Ajmal et al. 2010). Specifically, during the implementation of knowledge management projects, cultural factors strongly influence the project success (Lindner & Wald 2011). Also, in Knowledge Management Projects, leadership and policy, performance measurement, knowledge sharing and acquisitions, IS Infrastructure, bench marking and training, team working and empowerment, are considered important factors for the project success (Choy Chong 2006). Similarly, for risk management systems, business type, communication system, consultants, documentation, education, environment, general management skills, leadership, organizational structure and culture, performance reporting, process design, project management skills, resources, responsibility, reward and recognition system, strategy, team-building, and top management are important factors for the success of the system (Yaraghi & Langhe 2011). Another study by Lu et al. (2006) examining CSFs in inter-organizational IS indicates seven main ones which are: intensive simulation, shared vision, cross-organizational implementation team, high interaction with internal information systems, inter-organizational business process re-engineering, advanced legacy information system, and infrastructure and shared industry standards.

Other papers study the factor that result in IS projects failure. Some of those factors are: weak definitions of scope, inappropriate planning, lack of project management skills, unclear vision, poor communication, inappropriate choice of software, the use of high degree of customization in the chosen software ,incorrect assumptions, top down management style, absence of a champion, and lack of user involvement (Yeo 2002). These factors give rise to the notion of critical failure factors that decrease the likelihood of a successful IS/IT project.

The studies in the field of IS project success mention some CSFs that are frequent and significant. For example, project management practices or careful handling of the implementation process is a major indicator to the success of IS projects (Fowler & Walsh 1999, Purna Sudhakar 2012). Also, a skilled team would ease the implementation process of the project and thus increase the likelihood of its' success (Purna Sudhakar 2012, White & Leifer 1986). Therefore, incentives to the team is also considered an important success factor (Ajmal et al. 2010). Particularly, Mahaney & Lederer (2006) prove the value of intrinsic and extrinsic rewards for the team as an indicator on IS project success. Similarly,communication is a very important factor in determining project success (Purna Sudhakar 2012). Clear communication would ensure that all involved stakeholders are on the same page. In addition, it ensures that implementation of the project is aligned with the goals. Communication also involves knowledge management and knowledge sharing. In addition, a supportive culture is very important in the determination of project success. Moreover, organizational champions are important as they posses creativity, planning and decision making skills, and utilize their political skills to gain organizational resources. These traits increase the likelihood of IT projects success (Heng et al. 1999). Also, strong management support is a significant factor in influencing the success of any project (Fowler & Walsh 1999). In addition to that, early end user consultation is a significant influence in the success of IS projects (Fowler & Walsh 1999). Eventually, users are the ones who will be using the system and therefore their contribution is valuable.

Despite the studies that show the significance of the above factors, it is not always the case. Many times, the relationships among CSFs and IS project success constructs are inconsistent (Sabherwal et al. 2006). surprisingly, White & Leifer (1986) interview project team members and conclude that their perceptions of top management support and user involvement are not critical to the success of IS projects. Similarly, Jiwat Ram (2014) used a previously validated set of CSFs in Enterprise Resource Planning (ERP) systems and only indicated the significance in some of them. These results highly doubt the generalization and replication of the results.

Also, not all projects share a common set of CSFs Wateridge (1998). Therefore, it is important to study the different success factors for the different types of projects.

3.3.3.3 The link between Project Success and Critical Success Factors

The link between project success and critical success factors was attempted by Ngai et al. (2009) where they grouped CSFs into four main categories: communication, planning, monitoring and control, and project organization. They concluded that planning contributes the most to budget and schedule performance, while monitoring and control contributes the most to quality performance. Successful project management techniques are important to achieve project success (Munns & Bjeirmi 1996). Schedule, Budget, and Quality performance are also supported through monitoring and control. Also, other authors studied the impact of intrinsic rewards which impacted client satisfaction and perceived quality while extrinsic rewards positively impacted implementation success (Mahaney & Lederer 2010). Sabherwal et al. (2006) introduce a general model where they measure the success of a particular IS using the following constructs: user satisfaction, system use, perceived usefulness, and system quality. The study then measures the strength and relationship between those success constructs and the following CSFs: user experience with the IS, user training in the IS, user attitude toward the IS, user participation in the development of the specific IS, top management support, and facilitating conditions for the IS. Sabherwal et al. (2006) provide excellent support for the support model using a meta-analysis based on 612 findings from 121 different publications.

3.4 Factors impacting adoption models

The previous section reviewed the three main adoption stages: front-end management, project portfolio management, and project success. These stages are impacted by several factors. Frambach (1993) emphasizes the importance of identifying the factors that impact the adoption of a certain technology in an organization. According to the Technology, Organization, Environment (TOE) framework, these stages are impacted by three main categories of factors: technology, organization, and environment. The TOE framework was first introduced in 1990 by Tornatzky and Fleischer in their famous book The Process of Technological Innovation Tornatzky & Klein (1982). There are different determinants under technology, organization, and environment categories. Some of these determinants are drivers as they have a positive influence on the adoption of technology while others are barriers as they have a negative influence on the adoption of technology. Every category has a separate definition and a set of different factors that compromise it. For example, the technology component means the current or potential technologies an organization could use. The organization dimension means the characteristics and resources of an organization. The environment component means the external factors in which the organization operates such as industry, competitors, customers, and government (Borgman et al. 2013). The TOE framework was highly supported in the literature (Lin 2014, Pan & Jang 2008, Kuan & Chau 2001).

3.4.1 Technology factors

Technological context encompasses the technological characteristics of BI&A projects. Specifically, the technological characteristics of BI&A projects are studied to determine how and whether they influence the adoption and implementation decision (Tornatzky et al. 1990).

Perceived benefit or advantage

Perceived benefit is a set of expected benefits from implementing the technology (Hollenstein 2004). It refers to the degree to which information systems are perceived to bring benefits to the organization (Lin 2014). Advantage happens when the new technology gives superior benefits to the technology it replaces (Hameed et al. 2012). Perceived benefits or advantage could be divided into two main categories: direct and indirect advantages (Lee 2009). Direct advantages are tangible and measurable such as faster speed of transactions or more financial benefits. Indirect benefits are intangible and hard to measure such as better customer service or improved reputation. This factor is very similar to the technology expectations factor. According to Geroski (2000), technology expectations factor is likely to impact the adoption of a certain technology by organizations. Expectations of the new technology are usually relative to the old technology; that is, if the old technology becomes more attractive or lowers the benefits of the new technology, the new technology will take more time to be adopted. This factor was measured using the profitability of the system. This construct measures how profitable the adoption of an innovation is (Tornatzky & Klein 1982). This construct is quite vague and in fact very similar to the definition of advantage.

Costs

It is obvious that the higher the cost, the less likely an organization would adopt a certain technology. Costs include learning and search cost. Costs also indicate the set-up, training, and maintenance costs by organizations (Lin 2014). If organizations perceive that information systems are expensive, they will be reluctant to adopt and implement them in their organizations (Lin 2014). The longer the organization waits to adopt a certain technology, the lower these costs would be because information would be readily available (Geroski 2000). It is another characteristic that impacts the adoption of innovation negatively. That is, the higher the cost of innovation, the slower the innovation will be adopted. However, in most studies, cost was not a significant construct in explaining the adoption of an innovation (Tornatzky & Klein 1982).

Compatibility

This construct is defined as the degree in which the technology fits with the attitudes, behaviors, and beliefs of the organization (Cao et al. 2014). For example, if the organization does not need to go through a radical change to use the system, then it is more likely to adopt the technology. Compatibility was found to be a significant factor to explain the adoption of technologies in organizations. For instance, Cao et al. (2014) found that compatibility has a significant positive relationship to the adoption of RFID in health care organizations. Also, Bradford et al. (2014) found that compatibility has a significant positive relationship to the adoption and implementation to identity systems in organizations.

Security and privacy

Organizations care about the privacy of the data they analyze and that it does not get misused. For some organizations, such as banks and health care, privacy of customer's information is a top priority. If customer's privacy would be invaded by the use of the technology, the organization would be less likely to adopt it. In a study by Cao et al. (2014), hospital managers identified that patient's information is a privacy concern in the implementation of technology.

Perceived risk

Perceived risk is defined as the subjective expected loss if the results of the action are not desired. This factor was studied as a uni-dimensional construct or as a multidimensional construct dividing it into six main components: financial, performance, social, physical, privacy, and time-loss. This factor is particularly important in the adoption of applications such as internet banking due to its high relevance (Lee 2009).

Switching costs

Switching costs include the learning that an organization has to go through in order to use the new technology. In other words, the more radical the change from the existing technology, the higher the switching costs are(Geroski 2000). Needless to say, the higher the switching cost, the more unlikely an organization will adopt a certain technology.

Maturity of the technology

If the system is well-developed, it will have less bugs and be ready to go live. Ko et al. (2008) identified that the maturity of Information Systems (IS) is an important indicator to the adoption of a certain technology in an organization. An organization would be reluctant in adopting a certain technology that is still not fully ready to be used.

Observability

It "is the degree to which the results of an innovation are visible to others" (Rogers & Shoemaker 1971). This factor focuses on the tangible benefits from adopting and using the technology. Surprisingly, there is no enough evidence to explain the relationship between observability and the adoption of an innovation (Tornatzky & Klein 1982). However, similar to this definition, this factor is similar to the result demonstrability factor. Result demonstrability refers to the ability of the technology to show actual and tangible results of its use (Riemenschneider et al. 2002). Venkatesh & Davis (2000) provided enough to prove that result demonstrability is strongly positively related to the perceived usefulness construct; thus, it should be studied as an independent construct. Some papers also referred to this factor as visibility. Visibility is defined as the degree to which the results of the innovation are visible to others (Riemenschneider et al. 2002).

Job fit

It corresponds to the perceived usefulness construct in TAM (Thompson et al. 1991). This construct was also utilized in the literature as *Job Relevance* where it measures how useful the technology is to someone's set of tasks and responsibilities (Venkatesh & Davis 2000). Therefore, not only should a new technology be perceived as useful, it should also relate to the task and be relevant to the individual's responsibility. Venkatesh & Davis (2000) proved significant results in explaining the relationship between job fit and perceived usefulness which will eventually impact the intention to adopt a technology.

Complexity

It is ”the degree to which an innovation is perceived as relatively difficult to understand and use” (Rogers & Shoemaker 1971). That is, complexity is the degree in which the innovation is perceived to be difficult to use. Obviously, if the individual finds that the system is complex and not easy to use and learn, he/she would be more less likely to adopt the technology. This item has been referred to as *effort expectancy* (Venkatesh et al. 2003). This is because the more complex the system is, the more effort the individual needs to spend to use that system. The complexity factor is the opposite of *ease of use* factor (Davis 1989). In their meta-analysis study, Tornatzky & Klein (1982) found that complexity was found to be significantly negatively related to the adoption of an innovation.

Communicability

It is defined as the degree where the features of an innovation can be easily communicated (Tornatzky & Klein 1982). This construct refers to how an individual gets information related to the technology, or how he/she can convey information about it. It is important that a certain technology is communicate-able as its information can spread easier and faster among individuals. Despite the fact that communicability received attention from researchers, it was not found to be of a significant impact when it comes to the adoption of an innovation (Tornatzky & Klein 1982).

Divisibility

It is the ability of a non-adopter to try a prototype of an innovation before actually adopting it (Rogers & Shoemaker 1971). If the individual can have some hands-on experience using the system, he/she would be able to build a more informed decision about the technology. However, according to Tornatzky & Klein (1982), the literature reported inconsistent results of how divisibility would impact the adoption of an innovation.

Triability

It is ”the degree to which an innovation may be experimented with on a limited basis” (Rogers & Shoemaker 1971). This construct is very similar to divisibility where it frees the non-adopter from a full commitment in adopting the innovation. One would expect that triability would increase the likelihood of adopting a specific technology. However, and similar to divisibility, there were no enough evidence to explain the relationship between triability and the adoption of an innovation (Tornatzky & Klein 1982). This could be explained as the experience of trying technology might not always be pleasant for the adopter.

3.4.2 Organization factors

Organizations characteristics encompass the organizational factors that impact the adoption of BI&A project. Organizations need to be well-prepared to enable the adoption of BI&A project (Tornatzky et al. 1990).

Firm size

Firm size has been well studied in the literature and is known to impact the adoption of technologies by organizations. Large organizations have more capabilities, skilled labor, financial resources, and complementary activities that support the adoption of a particular technology faster than smaller organizations (Geroski 2000). A lot of empirical results indicate firm size as a significant factor in explaining adoption of technology (Hollenstein 2004, Lin 2014, Subramanian & Nilakanta 1996). However, different authors have different definitions of what firm size might mean; thus, it is ambiguous to interpret their empirical results. Also, some authors found that size has a positive relationship to the adoption of technology only up to a certain point, then the effect becomes reversed (Corrocher 2006).

Absorptive capacity and experience

This factor indicates the ability of the firm to assess the new technology. In other words, absorptive capacity encompasses the processes and routines by which organizations acquire knowledge to exploit further opportunities and create change (Lin 2014). Through absorptive capacity, firms expand their knowledge and improve their capacity (Lin 2014, Hollenstein 2004). If the organization has enough experience and adequate capacity to absorb knowledge, it would be easier to implement technology and they would be more likely to adopt the system. A lot of studies have proved the significance of this factor in explaining the adoption and implementation of a certain technology (Ko et al. 2008, Subramanian & Nilakanta 1996, Teo et al. 2009). This factor was also named as IT experience. Subramanian & Nilakanta (1996) prove that a high level of specialization, knowledge, and experience can positively impact the informativeness of an organization and enable its adoption to technology.

Top management

Lin (2014) proves that top management needs to create the right environment for the adoption and implementation of a certain technology. Top management also needs to motivate employees and give them incentives to ease the adoption and implementation process. In addition, top management needs to commit and provide the right resources. Also, Teo et al. (2009) found that top management is a significant factor in explaining the adoption of a certain technology in organizations.

Organizational strategy

An innovative organization needs to be flexible and to adopt decentralized decision making processes (Subramanian & Nilakanta 1996). In addition, organizational goals need to align with BI&A goals (Işık et al. 2013). Ko et al. (2008) identified that organizational strategy influences the adoption of a certain technology in an organization. Therefore, the organization needs to be flexible and to promote idea generation by employees in order to become innovative. A similar conclusion was also achieved by Subramanian & Nilakanta (1996) in studying the factors that affect the adoption of technologies in organizations.

Resources

Porter (1980) and other authors identified that a lack of resources would actually result in new technology adoption and eventually a successful organization (Akan et al. 2006). This is not completely true. There are multiple theories that look at how and why organizations become successful and can accordingly grow. For instance, the Resource Based View Theory (RBV) states that the strategy of any organization needs to be driven based on its resources and assets such as skills, technology,capabilities, etc. (Erzurumlu & Erzurumlu 2013). This theory has several applications. For instance, organizational capability is the utilization of technological and organizational capabilities to perform a task and improve performance (O'Regan et al. 2006). Similarly, the configuration theory looks at the optimum configuration of resources for an organization to get superior performance (Acur et al. 2012). It seems that the configuration theory looks at the relationship between the resources while the RBV theory looks at the aggregated view of the resources. Recent studies focus on knowledge as one of the most important assets. Knowledge as a broad term can be referred to as organizational learning. This requires managers to question their current techniques and share knowledge between different entities (O'Regan et al. 2006). The more and better the resources are, such as human capital, money, good will, and time, the more likely an organization would adopt a certain technology (Corrocher 2006). The more slack resources an organization has, the more opportunities it can invest (Subramanian & Nilakanta 1996). Also, Mahler & Rogers (1999) measured resources in terms of equipment an organization has. The resource factor was found significant in determining the adoption of a certain technology (Mahler & Rogers 1999, Subramanian & Nilakanta 1996). The organization needs to have both appropriate technical and organizational capabilities to implement a BI&A project (Işık et al. 2013). Technical capabilities include the appropriate databases and IT infrastructure to implement the system while organizational capabilities include the appropriate assets and rules such as flexibility and shared responsibilities. For instance, financial commitment was found to be a strong significant in explaining the adoption of RFID in health care organizations. Also, a higher level of slack resource would significantly increase the likelihood of adopting a certain technology in organizations (Subramanian & Nilakanta 1996).

Institutional environment and culture

Another important factor that impacts the adoption of a certain technology is the institutional environment in which an organization operates. This is emphasized in the local norms and regulations, availability of complementary factors, and geographic distance from the source (Cool et al. 1997). Cao et al. (2014) argue that an open and flexible organization would better enhance the innovation of its employees and thus increase the organizational absorptive capacity of a new technology. Firstly, a loose organization will create conflicts between its employees due to lack of specifications. Conflicts will then force an innovative climate as employees will have to solve the problems. An unstructured and loose organization will help employees reform themselves into teams to solve the problems that come at hand. A supportive culture that enables employees and empowers them with decision making authorities is more likely to be innovative and adopt and implement a certain technology (Cao et al. 2014).

Voluntariness of use

It is defined as the extent in which individuals perceive adopting a certain technology as non-mandatory (Venkatesh & Davis 2000). This was also found to be a significant moderator in explaining the relation between subjective norm and intention to use (Riemenschneider et al. 2002, Hardgrave et al. 2003). Organizational mandate is the opposite of voluntariness of use construct. It is defined as the degree to which an individual believes that his or her organization is mandating the use of the technology (Hardgrave et al. 2003).

Image

It is defined as the degree at which people care about the opinions of other significant people in their social circle. Some authors such as Rogers (1983) included image as an aspect of advantage. However, from their meta-analysis study, Tornatzky & Klein (1982) found enough evidence to separate image from advantage and treated them as two separate factors which is similar to the work of Venkatesh & Davis (2000). Similar to the image construct, *social pressure* was utilized in the literature by Hardgrave et al. (2003) who indicated the extent where an individual gets influenced by important others in his or her social circle. This factor is also referred to and is very similar to social approval factor. Social approval is defined as the intrinsic reward an individual receives from the social environment by adopting a certain technology. This means that if the individual gets appreciated by his environment whether it is the work environment, friends, or family for using a certain technology, he/she would be more likely to adopt the technology. The literature reported inconsistent results that explain the relation between social approval and the adoption of a certain technology (Tornatzky & Klein 1982). This construct was found to be a significant construct impacting the decision to adopt a certain technology or not (Riemenschneider et al. 2002). Another study by Venkatesh & Davis (2000) found that image is strongly directly related to perceived usefulness which will then impact the intention to adopt a certain technology.

3.4.3 Environment factors

According to the contingency theory, the external environment is uncontrollable (Lawrence et al. 1967). There are different events that happen in the external environment such as the introduction of new technology, the increase notion of competition, or the growth or shrink in the industry. Organizations typically react to these changes by adopting a technology (Subramanian & Nilakanta 1996). Typically, not all organizations would adopt a certain technology. There is a lot of research that identifies the characteristics of innovative organizations compared to their counterparts. Environmental factor encompasses the external factors that surround the organizations. These external factors can increase the likelihood of adopting and implementing BI&A projects in organizations (Tornatzky et al. 1990).

Trading partners

Inter-organizational applications that are not stand-alone, such as supply chain management applications, will result in better benefits if all collaborative partners use them. Lin (2014) suggests that the more trading partners use inter-organizational systems, the higher the benefits would be because processes will be more consistent and standardized.

Competition

A market with intense competition would force its players (firms) to innovate and rapidly adopt technologies to stay ahead of the competition (Bocquet et al. 2007). Sometimes, organizations might act irrationally and adopt ineffective technologies rather than effective ones because of the fear of falling behind competitors. This is known as the bandwagon effect (Cool et al. 1997). Therefore, competitive pressure forces organizations to seek opportunities to gain competitive advantage and perform better in the market (Lin 2014).

Barriers to adoption

Barriers to adoption are the expected variables that would slow down the adoption process. Hollenstein (2004) categorized them into five main categories: financial barriers that might not enable firms to financially commit to the implementation of the technology, skilled labor who might not be ready to implement and use the system, lack of information which results in uncertainty, top management who might not be aware of the technology, and finally is the extra cost the organization needs to invest to replace the old system with the new system. These barriers would impose complications to organizations when they decide to adopt a certain technology.

Information spillovers

The information spillovers factor is directly related to how a large population of adoption would impact the technology adoption process in a positive way (Hollenstein 2004). The information needs to be in a high quantity and quality. Frambach (1993) proves that the availability of high quality information increases the likelihood of adopting a certain technology by organizations.

Critical mass

Another important factor that impacts technology adoption in organizations is critical mass, which indicates the number of adopters. That is, the more the number of adopters are, the more likely an organization would adopt a certain technology (Cool et al. 1997). This factor stems from the S-shaped theory. Eventually, this factor acts similar to the network effect theory. Network effects theory was firstly introduced by Metcalf states that the higher the number of entities using a certain technology, the higher its' value would become (Cool et al. 1997). This means that, in the long run, adopters and non-adopters would start impacting each other on how they would use the technology. Although this factor has been heavily studied in the research by Mahler & Rogers (1999), Allen (1988) believes that this factor is only significant for adopting new technologies. However, the adoption of mature technologies will not be impacted by critical mass.

Customers

This factor is found to be key in determining the likelihood of adopting a certain technology. For instance,Mahler & Rogers (1999) found that if a bank has many customers, large customers, and foreign customers, a bank in Germany is more likely to adopt telecommunication services.

Market conditions

Market conditions include technology opportunities and market prospects. This is considered an important factor in determining innovative activities (Hollenstein 2004). If the industry is growing with so many opportunities being introduced, an organization would be more likely to adopt a technology to survive in the market.

New workplace organization

This factor is introduced by Hollenstein (2004) who indicates that new work practices positively impact the adoption of technology and vice versa. For instance, innovative techniques and business processes might require the use of a technology to further improve. An organization going through business process re-engineering with innovation in its practices would be more likely to adopt a technology to improve its processes.

Suppliers

Suppliers or vendors factor has been well-studied in the literature. Suppliers spread word of mouth and facilitate their knowledge about the technology. In addition, their pricing, offers, services, and support to the customer can be a deciding factor for organization to adopt a certain technology (Geroski 2000, Cool et al. 1997, Corrocher 2006). Vendor support is also very important as it is usually responsible for providing training to the employees. A study by Venkatesh (1999) proves that training acts as a motivation to employees; thus, increasing the probability of adopting a certain technology.

Government regulations

Government is also a decisive factor for technology adoption. For instance, Gruber & Verboven (2001) have shown that countries that were able to establish easy licensing procedures of mobile carriers seem to have higher rates of adoption than other countries. However, Oster & Quigley (1977), Hannan & McDowell (1984), Rose & Joskow (1988) show that government rarely speeds up technology adoption. This factor varies from country to country as different organizations take different measures to manipulate their economy.

Facilitating conditions

Those are the external conditions in the environment that make the adoption of a certain technology easy (Thompson et al. 1991). An example of facilitating conditions are social factors. It refers to the internal agreements an individual has made with others (Thompson et al. 1991). Another example is the availability of complementary assets that will support the implementation and adoption of a certain technology. Complementary assets are defined as extra investments needed to derive value from primary investments (Laudon & Laudon 2011). For example, the availability of internet would enable and ease the implementation and adoption of a laptop.

In an attempt to summarize the factors under each category and the significance of each one, Basole et al. (2013) utilized text analytics to summarize the determinants and their significance for each category. The results of their work show that more emphasis was spent on organizational characteristics at the beginning. However, more recently, researchers started focusing on technology, organization, and environment determinants. From the technology perspective, previously, cost and complexity used to represent the technology component. Recently, not only do researchers consider cost and complexity, but they also look at Compatibility, advantage, perceived usefulness, and ease of use. From the organization perspective, previously, the most famous determinants were organizational strategy, structure, and experience. However, recently, researchers focus more on experience, resources, strategy, and top management support. From the environment perspective, previously, government, power, and uncertainty factors were used. Recently, and in addition to the previous items, authors look at dependency, competitive pressure, external pressure, vendor support, and social network.

3.5 Models of technology adoption

The previous section discusses the different factors that impact the adoption technology during its multiple stages. These factors originate mainly from technology, organization, and environment characteristics (Tornatzky & Klein 1982). In addition to that, some authors consider the characteristics of the CEO Thong & Yap (1995) as important determinants to the adoption process. One of the important frameworks proposed to determine the factors that impact the adoption of technology is the Technology-Organization-Environment (TOE) framework.

There are also different models that have been proposed and validated to explain the reasons behind the adoption of IT such as personal computers, spreadsheets, electronic mail, etc. These models represent a simple abstraction of reality where a certain technology is adopted. These models are highly inspired by two main theories from the social and behavioral sciences literature: Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) (Hameed et al. 2012). The TRA theory shows that the actual behavior is based on the individual's intention to perform that specific behavior. Intentions indicate how much effort an individual is willing to spend to perform a particular behavior. Obviously, the stronger the intention, the more likely an individual would perform the behavior. It has been proven that intentions are reliable predictors of system usage (Venkatesh & Davis 1996). Intentions and perceptions were adopted by authors to determine the adoption of a certain technology as it is shown in the work of Kuan & Chau (2001) who measured perceived direct benefits, perceived indirect benefits, perceived financial cost, perceived technical competence, perceived industry pressure, and perceived government pressure in relation to the adoption of electronic data interchange systems in small companies. Despite these strong models, there are authors who directly relate the constructs to the adoption of information technology without using the intention to adopt as a mediating construct (Venkatesh et al. 2003). For example, there are several studies that did not use the intention factor as a mediator between the determinants and the actual behavior. For instance, the study by Malhotra & Singh (2007) studies the relationship between key determinants such as firm size and age in relation to the adoption of the technology.

The TPB is an extension of the TRA theory where it accounts for attitude toward the behavior, subjective norm, and perceived behavioral control as significant constructs in explaining the intention and behavior of an individual. There are models that, in addition to utilizing intention of use as a determinant to actual system use, utilized attitude towards use as a determinant to intention of use of the technology (Schepers & Wetzels 2007).

These social and behavioral theories resulted in the introduction of technology related models that explain the adoption of certain technologies such as TAM, TAM2, PCI, MPCU, UTAUT, and Socio-technical theory. These theories are mainly studied from the individual point of view as explained below.

Technology Acceptance Model (TAM)

Davies (1979) introduced this model to explain and predict an individual's adoption of an IT tool in the organization. TAM has two main constructs: usefulness and ease of use. Usefulness is defined as ”the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989). Ease of use is defined as the extent where an individual thinks a certain technology will be simple and could be used without effort. This model was highly inspired from Rogers (1983) work where usefulness corresponds to advantage and ease of use corresponds to complexity. TAM is one of the most widely used model in the field of technology adoption. According to Venkatesh et al. (2003), it is found that the TAM model explains around 40% of the variance in the intention to adopt and use a technology.

Technology Acceptance Model 2 (TAM2)

Davies (1979) then extended the TAM model to include two more key constructs in explaining the intention to adopt a technology: subjective norm and voluntariness (Venkatesh & Davis 2000). In addition to the new constructs and the perceived ease of use construct, the model divides the usefulness construct into the following independent constructs: subjective norms, voluntariness, image, job relevance, output quality, and result demonstrability.

Model of Personal Computer Utilization (MPCU)

The frameworks discussed above focused on all beliefs an individual has that would impact his intention to use the technology. This model, proposed by Thompson et al. (1991), is based on the distinction of beliefs into those that link emotions to current consequences and those that link emotions to future consequences. Therefore, and in addition to the complexity construct, this model proposes five other constructs: social factors, affect, job fit, long-term consequences, and facilitating conditions.

Unified Theory of Acceptance and Use of Technology (UTAUT)

In an attempt to unify all the various theories proposed in the literature and discussed above, Venkatesh et al. (2003) proposed a unified theory of technology adoption that explains around 70% of the variance in the adoption of technology. This model includes four main constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions, and four main moderators: gender, age, experience, and voluntariness of use.

Socio-Technical theory

This theory states that any Information System is composed of two main related subsystems: social which includes all user and organizational characteristics and technical which includes all technical aspects of the system (Bostrom & Heinen 1977). Therefore, the system designer needs to identify how these subsystems would impact each other and how optimally they could work together (Neil Foshay 2014).

3.6 Previous work in technology adoption

Different authors have utilized different theories and constructs in their attempt to model the adoption of a certain technology. For example, Riemenschneider et al. (2002) have analyzed five different adoption models, TAM, TAM2, PCI, TPB, and MPCU, to explain how software developers adopt methodologies in developing applications. Another study by Lee (2009) combined TAM and TPB theories and utilized 11 factors to explain the adoption of internet banking: perceived benefit, attitude, subjective norms, perceived behavioral control, perceived usefulness, perceived ease of use, performance risk, social risk, time risk, financial rick, and security risk. Another study by Malhotra & Singh (2007) discusses the adoption of internet banking in banks in India. The authors realized that the following factors increase the likelihood of adoption of internet banking: younger age, private ownership, large-sized banks, higher expenses for fixed assets, higher deposits, banks with lower market share, lower branch intensity, and high intensity of other bank adopters. A similar research studying the adoption of internet banking in banks in Italy found that banks with few branches and few customers speed up the adoption of the technology (Corrocher 2006).

Different authors have tried to conclude the main characteristics of technology that would impact its adoption. As shown below, the literature did not report consistent results about the constructs and their relationship to the adoption of a technology. This was also confirmed in a study by Schepers & Wetzels (2007). This is because of the different definitions and measures adopted by authors in their studies (Moore & Benbasat 1991*a*). For instance, Moore & Benbasat (1991*a*) found it appropriate to divide Rogers & Shoemaker (1971) observability construct into those two different constructs: result demonstrability and visibility while other authors have used observability as one construct (Rogers & Shoemaker 1971). Unlike the research by Malhotra & Singh (2007) studying the adoption of internet banking in banks that proves that large sized banks adopt faster than small sized banks, Corrocher (2006) found that size is an important determinant in explaining the adoption of internet banking up to a certain point, and then the relationship becomes reversed. Also, the model in Venkatesh & Davis (2000) divides the perceived usefulness construct of Davis (1989) into the following constructs and studies them independently: subjective norms, voluntariness, image, job relevance, output quality, and result demonstrability. Gopalakrishnan et al. (2003) studied the adoption of internet banking by focusing on three main factor levels: the external context of the industry, the industry, and the firm. The external level includes the favorable external conditions that facilitate the adoption of technology such as the existence of critical mass of users and providers. The industry level includes favorable industry condition that facilitates the adoption of technology such as the role of new entrants. The firm level includes the specific characteristics of the firm that facilitate the adoption of the technology such as the organizational strategy and processes design. Most of the studies lacked strong theoretical justification which resulted in mixed results (Thompson et al. 1991). This left researchers with a variety of constructs and models to choose from to use in their study (Venkatesh et al. 2003).

3.7 Previous work in TOE framework

The TOE framework was highly studied in the literature from the past. Cooper & Zmud (1990) studied the adoption of Material Resource Planning (MRP) in Supply Chain Management (SCM) systems using the following factors: technology complexity, task compatibility, user characteristics, organization characteristics, and environment. Orlikowski (1993) studied the adoption of CASE tools where role of IS in firm, IS structure and operations, IS policies and practices, IS staff, corporate strategies, corporate structure, organizational culture, customers, competitors, and available technology were found to be significant factors in the adoption decision. Another study by Iacovou et al. (1995) studied the adoption of Electronic Data Interchange (EDI) in SMEs using the following factors: perceived benefits, organizational readiness, and external pressure. Premkumar & Ramamurthy (1995) examined the adoption of inter organizational systems using the following factors: internal need, top management support, competitive pressure, and exercised power. Another research by Chau & Tam (1997) studied the adoption of open systems using the TOE framework where they examined the following factors: perceived barriers, perceived importance, satisfaction with existing systems, and external environment. Thong (1999) studied the adoption of information systems in SMEs using the TOE framework where the authors studied the following factors: advantage, compatibility, complexity, business size, and external environment. Another study by Tan & Teo (2000) assessed the adoption of internet banking using the TOE framework where they studied the influence of the following factors: advantage, compatibility, complexity, triability, and risk. Also, Zhu et al. (2003, 2004), Zhu & Kraemer (2005) studied the adoption of e-business using the TOE in three different papers and contexts. The authors utilized the following factors: technology readiness, technology competence, firm size, scope, resources commitment, competitive pressure, regulatory support, consumer readiness, and lack of partner support. Another study by Zhu et al. (2006) used the TOE framework to study the adoption of e-business assimilation in international setting. The authors studied the influence of the following factors: technology readiness, technology integration, firm size, global scope, managerial obstacles, competition intensity, and regulatory environment. The TOE model was also utilized in health care industry to study the adoption of Enterprise Application Integration (EAI) by Khoumbati et al. (2006). The authors specifically studied the following factors: IT infrastructure, IT Support, IT sophistication, benefits, barriers, compatibility, costs, international pressure, organizational size, administration relationships, external pressures, and patient's satisfaction. Venkatesh & Bala (2012) also utilized the TOE framework to study the adoption of inter-organizational process standards. The technological factors are expected benefits, process compatibility, standards uncertainty, and technology readiness. Organizational factors included organizational innovation. Environmental factors included relational trust. Lin (2014) utilized the model to study the determinants of electronic supply chain management (e-SCM) across 156 adopters and 127 non-adopters IS managers. Specifically, technological factors (perceived benefits, perceived costs), organizational factors (firm size, absorptive capacity), and environmental factors (trading partners, competition) were examined to study their influence in the adoption of e-SCM systems and the extent of their use in organizations. Another study by Bradford et al. (2014) studied the adoption of identity and access management through the technology, organization, environment (TOE) framework. The authors adopted a case study approach where they examined the different challenges organizations faced while implementing the systems. The authors, using the TOE framework, categorized the challenges into technological, organizational, and environmental factors. Technological challenges included the following: specific systems that worked in silos and did not integrate together, no centralized database that stored all the data, weak data management, non-standard processes across the organization, and lack of agreement on rules across the organization. Organizational challenges included the following: lack of agreement on user roles, lack of strong top management leadership, lack of committed resources to adopt and implement the system, and isolation between technology and business strategies. Environment challenges included the following: vendor changes and reliability, government regulations, and technological advancements. Cao et al. (2014) adopted the TOE framework to study the adoption and implementation of RFID applications in hospitals where he studied the impact of the following factors: advantage, RFID characteristics such as battery life, management support, organizational culture and structure, financial commitment, compatibility, security, patient's privacy expectations, compliance with external rules, and external pressure. Pan & Jang (2008) utilized the TOE framework to study the determinants of Enterprise Resource Planning (ERP) systems in Taiwan's communication industry. Kuan & Chau (2001) also utilized the TOE framework to study the adoption of Electronic Data Interchange (EDI) in small business. Similarly, Wang et al. (2010) utilized the TOE framework in an attempt to study the determinants of RFID adoption in the manufacturing industry. Specifically, the authors utilized nine variables (advantage, compatibility, complexity, top management support, firm size, technology competence, information intensity, competitive pressure, and trading partner pressure).

3.8 Chapter summary

This chapter provides an overview of the technology adoption literature. The adoption process is divided into three main stages: front-end management, project portfolio management, and project success. Front end management is the first stage in project management where ideas are generated and preliminary documentation is created. If the idea passes, it goes through the project management phase where it gets evaluated against other projects and eventually implemented. The last stage is when a successful implementation would result in project success. These three stages could be defined in so many ways. The ideal definitions for our research context will be discussed in the next chapter.

Based on the TOE framework, these stages are impacted by three main categories of factors: technology, organization, and environment. These factors are listed and explained. After that, the main adoption models and their previous work are explained. These models lead the discussion for the next chapter that proposes the research model.

The next chapter will discuss the proposed framework along with its three main phases: front-end, project portfolio management, and project success, along with the factors that impact each of those phases in the context of a BI&A project. This will eventually lead to a successful BI&A project journey, from the beginning till the end.

4-PROPOSED RESEARCH MODEL

4.1 Introduction

Some organizations adopt and implement Business Intelligence and Analytics projects in their organizations while others do not. The three main phases of technology adoption are summarized into three main groups: pre-adoption, adoption, and post-adoption (Lee et al. 2009). This research models the adoption process of a BI&A project in an organization in the context of a project using these three main phases: front-end management, then project portfolio management, and finally project success. This is important since most organizations take huge endeavors in the form of a project (Jonas 2010). The research then aims at explaining and validating the factors that impact each of the three adoption stages of a BI&A project in an organization. Based on the technology, organization, environment framework (TOE), these factors can be grouped to three main categories: technology, organization, and environment. The technology category means the technology characteristics an organization could use. The organization dimension means the characteristics and resources of an organization. The environment component means the external factors in which the organization operates such as industry, competitors, customers, government, etc.(Borgman et al. 2013). The environment component is supported by the Dynamic Capability View Theory (DCV). DCV looks at internal and external competencies to address the dynamic nature of the environment (Yue et al. 2007).

In an attempt to summarize the factors under each category and the significance of each one, Basole et al. (2013) utilized text analytics to summarize the factors and their significance in the adoption process of technologies. The results of their work show that more emphasis was spent on organizational characteristics at the beginning. However, more recently, researchers started focusing on technology, organization, and environment determinants (Borgman et al. 2013, Rosli et al. 2012, Bosch-Rekveldt et al. 2011). For the technology perspective, previously, cost and complexity used to represent the technology component. Recently, not only do researchers consider cost and complexity, but they also look at Compatibility, advantage, perceived usefulness, and ease of use (Basole et al. 2013). For the organization perspective, previously, the most famous determinants were: organizational strategy, structure, and experience (Basole et al. 2013). However, recently, researchers focus more on experience, resources, strategy, and top management support. For the environment perspective, previously, government, power, and uncertainty factors were used (Basole et al. 2013). Recently, and in addition to the previous items, authors look at dependency, competitive pressure, external pressure, vendor support, and social network (Basole et al. 2013).

This research follows the cycle approach introduced by Meskendahl (2010) where projects are initiated through ideas. These ideas get evaluated and implemented in the project portfolio management phase which will eventually lead to project success. Heising (2012) proposes a similar research model that links front end management, front end success and project portfolio success. At the front end of projects, ideas are generated and the more successful the ideas are, the more successful the project portfolio is (Heising 2012). This work is very important as it contributes to the project portfolio management body of knowledge with the concept of incorporating the ideation theory into the portfolio management theory. However, it is a very general model that doesn't fit all types of projects specially IS/IT projects that are very uncertain. Moreover, the model ignores several important factors such as top management, leadership style, and resources. Also, the author accounts for stakeholder management only at the front end management process where it actually has a direct impact during the different life cycle stages of the project (Martinsuo 2013). Therefore, this research aims at integrating front end management, project portfolio management, and project success in the context of BI&A projects.

This chapter will explain the proposed model in this research: its phases and the factors that impact these phases.

4.2 Proposed model

This section will explain the proposed model. The section will start by explaining the three main stages involved in the adoption of a BI&A project. These three stages are: front-end management which happens at the beginning of the adoption process. In this phase, the ideas are generated. After that, the idea is evaluated in the project portfolio management along other ideas. Once successful, it gets implemented. After that, and after the implementation phase, the project is evaluated whether it is successful or not. Therefore, the three phases involved in the adoption of a BI&A project in an organization are: front-end management, project portfolio management, and project success.

4.2.1 front end

Ideas in organizations are important. It is what makes organizations innovative and better than competitors (Schulze & Hoegl 2008). The idea generation and evaluation happens in what is known as front end management. Front end management is typically the first stage in developing new products or projects (Verworn et al. 2008). In other words, authors consider front end management to include the idea development phase (Montoya-Weiss & O'Driscoll 2000). Front end management is very exploratory in nature where employees, top management, and the organization explore, research, and study new ideas. Therefore, front end management is driven by the identification of underlying technologies, identification of customer needs, and assessment of market opportunities (Montoya-Weiss & O'Driscoll 2000). This research defines front-end management as the phase where the idea of a BI&A project is initiated.

This variable is a dependent variable. Specifically, this variable measures whether the BI&A project idea went through the preliminary stage of adoption. This variable is measured using one item. The item examines if the organization has performed some preliminary evaluation of the BI&A project idea (Carbone 2011).

Table 4.1: Front End Management Variable

Variable	Items	References
Front end management 1	Our firm has performed pre evaluation for a BI&A project	Carbone (2011)

4.2.2 Project Portfolio Management (PPM)

Project portfolio management is the second phase that a project, specifically the BI&A project, passes through. After the idea of implementing a BI&A project gets initially approved and developed into a concept, it gets thoroughly evaluated, prioritized, and selected among other projects. PPM is the process of managing multiple projects in an organizations by evaluating, prioritizing, and selecting them in the portfolio in order to achieve four main organizational objectives: balancing the types of projects in the portfolio, maximizing the return, preparing for the future, and structuring the portfolio in order to serve the organizational strategy (Cooper 1980). This process is very challenging (Ajjan et al. 2013). Therefore, it is important that organizations understand this process and consider the factors that lead to its success. Project Portfolio Management (PPM) is defined as the coordinated management of several projects that are competing for the same resources and managed under the same organizational entity (Martinsuo 2013, Meskendahl 2010). The management of PPM involves negotiating and bargaining for the evaluation, prioritization, and selection of projects to be executed in the portfolio. It is a very vague process where top management uses different structural configurations to assess projects depending on the context (Martinsuo 2013). PPM is highly emerging to the extent that some authors such as Levine (2007) consider it as an independent discipline by itself. PPM is very important because this is where organizations make their strategy work (Meskendahl 2010).

Despite the fact that not all organizations perform a formal PPM, they have to choose which projects to implement according to the resources they have and the goals they want to achieve. Therefore, in this research, the project portfolio management phase is the phase where the BI&A project gets evaluated against other projects and, if successful, gets implemented.

This variable examines whether the organization perceives that a BI&A system helps it achieve its PPM objectives. Specifically, this variable is measured by examining whether a BI&A system would maximize the return of the protfolio (Bonham 2005).

Table 4.2: Project portfolio management

Variable	Items	References
Project protfolio management 1	BI&A system will maximize our returns and minimize our costs	Bonham (2005)

4.2.3 Project success

After the BI&A idea gets initially approved and developed into a concept, it gets evaluated and implemented in the PPM phase. After that, organizations need to examine whether the project is successful or not. Generally, a project gets evaluated using the iron triangle paradigm which indicates whether the project is completed within budget, cost, and quality constraints (Atkinson 1999). The iron triangle approach was introduced by Atkinson (1999). The area of project success has received considerable attention in the literature. In the project success literature, authors strive to provide appropriate definitions for what project success is and what the critical factors that contribute to this success are. In this research, it is important to distinguish between these two terms. In general, project success provides definitions of what determines the success of the project or not. On the other hand, critical success factors (CSFs) provide definitions of the factors that contribute to the success of the project.

In this research, project success is the last phase of a BI&A project adoption process where the project gets evaluated of whether it is implemented successfully or not in terms of the iron triangle.

This variable examines whether the implementation of the BI&A project in the organization is successful or not. Success, in this research, is specifically measured using the iron triangle that examines if the project was completed within budget, time, and scope constraints (Carbone 2011).

Table 4.3: Project Success Variable

Variable	Items	References
Project success 1	The project has met (or expected to meet) project schedule	Carbone (2011)
Project success 2	The project has met (or expected to meet) project budget	Carbone (2011)
Project success 3	The project has met (or expected to meet) project scope	Carbone (2011)

4.3 Research model and hypothesis

Based on the discussion above, this study develops a research model for the adoption of a BI&A project. Grounded on the theory discussed above, this study proposes that the adoption of a BI&A project happens over three main stages: front-end management, project portfolio management, and project success. In addition, this study also incorporates the TOE research model to study the determinants that influence each of the stages of the adoption process. The main components of the TOE research model are technology, organization, and environment. These variables are examined against the three project management phases that include front-end management, project portfolio management, and project success.

In summary, this research studies the adoption process of an innovation such as a BI&A project using three main phases: pre-adoption, adoption, and post-adoption. In the context of a project, these adoption phases correspond to front-end management, project portfolio management, and project success, respectively. This process is a function of several factors grouped into three main categories: technology (cost, advantage, complexity, compatibility), organization (top management, resources, strategy, experience, culture, project management), and environment (vendor, competition, government). These variables and the hypothesis are detailed below.

4.3.1 Technological context

The technology component means the characteristics that would influence the adoption of a BI&A system (Basole et al. 2013). An organization would be specifically interested in the cost of setting up and running the BI&A system (Kuan & Chau 2001). Other technological factors include but are not limited to: Perceived benefits of a BI&A system such as better communication, increased profitability, and higher productivity, complexity of using a BI&A system, and the compatibility of the BI&A system with the organizational values and practices (Basole et al. 2013).

Cost

Cost refers to how much the BI&A system would cost to be adopted. Cost is a significant factor on the adoption stage when organizations decide whether to implement the BI&A system or not (Li et al. 2010, Rosli et al. 2012, Lin 2014, Kuan & Chau 2001). Similarly, in a meta-analysis study of the TOE research model, it is found that cost was a significant determinant of adoption 62% of the time (Basole et al. 2013). In general, when organizations feel that the cost of adopting a BI&A system is high, they will be less likely to adopt it.

This variable is part of the technology component that impacts the implementation and adoption journey of BI&A projects in organizations. Specifically, this variable measures the perception of BI&A projects cost in the organization. Cost, in this research, is measured in terms of set-up costs, running costs, and training costs (Kuan & Chau 2001).

Table 4.4: Cost Variable

Variable	Items	References
cost1	BI&A system has high set up costs	Kuan & Chau (2001)
cost2	BI&A system endures high running costs	Kuan & Chau (2001)
cost3	BI&A system endures high training costs	Kuan & Chau (2001)

Advantage

Advantage is defined as the degree to which an innovation is perceived as being more useful and better than the idea it supersedes (Rogers & Shoemaker 1971). That is, advantage refers to how much more benefits would an organization expect to get by implementing the BI&A system (Li et al. 2010). Several studies prove the significance of advantage on the decision process to adopt a specific technology. In fact, advantage is proven significant 26% of the time in research (Basole et al. 2013). In general, when BI&A systems have more benefits, the employees will be more likely to generate the idea and the organization will be more likely to adopt the system. Wu & Chuang (2010) prove that advantage has a significant positive relationship in the pre-adoption phase of a specific technology. Also, Lee et al. (2009), Lin (2014), Pan & Jang (2008), Ramamurthy et al. (2008*a*) prove that advantage is a significant indicator in explaining the adoption decision of a certain technology.

This variable is part of the technology component that impacts the implementation and adoption journey of BI&A projects in organizations. Specifically, this variable measures the organizational perception of how BI&A projects could be beneficial. Advantage, in this research, is measured using the following items: increasing profitability, improving timely information, and improving employees job performance (Premkumar & Roberts 1999, Moore & Benbasat 1991*b*).

Table 4.5: Advantage variable

Variable	Items	References
Advantage1	implementing the technology will increase the profitability of our business	Premkumar & Roberts (1999)
Advantage2	adoption of the technology will provide timely information for decision makers	Premkumar & Roberts (1999)
Advantage3	Using BI&A system improves employees job performance	Moore & Benbasat (1991*b*)

Complexity

Complexity is defined as the degree to which an innovation is perceived as not easy to understand and use (Rogers & Shoemaker 1971). In their meta-analysis study, Tornatzky & Klein (1982) found that complexity is a significant negative factor in relation to the adoption of an innovation. In another meta analysis study by Basole et al. (2013), complexity is found to be a significant indicator of technology adoption 57% of the time. This construct is the opposite of *ease of use* which is utilized by (Davis 1989) and others. In general, complexity will have a negative impact on the adoption decision of a BI&A system by organizations since they will perceive it as not easy to use (Lee et al. 2009). Similarly, if the BI&A system is perceived as complex, it will not be completed successfully; thus, negatively impacting the post-adoption phase (Lee et al. 2009).

This variable is part of the technology component that measures the perception of BI&A project complexity in organizations. Specifically, complexity, in this research, is measured if the BI&A project requires high skills (Premkumar & Roberts 1999, Moore & Benbasat 1991*b*).

Table 4.6: Complexity variable

Variable	Items	References
Complexity1	The skills required to use these technologies are too complex for our employees	Premkumar & Roberts (1999), Moore & Benbasat (1991*b*)

Compatibility

Compatibility is defined as the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of receivers (Rogers & Shoemaker 1971). That is, this construct means how compatible the BI&A system is with the current practices of the organization (Li et al. 2010). Borgman et al. (2013), Li et al. (2010), Rosli et al. (2012), Lee et al. (2009) conclude that compatibility is a significant indicator in the adoption of a certain technology. In their meta analysis study, Basole et al. (2013) finds that compatibility is a significant indicator in the adoption decision 41% of the time. In general, if the BI&A system is compatible with the current practices of the organization, it will be more likely to adopt it.

This variable is the last one in the technology component. It specifically measures if the organization perceives the BI&A system to be compatible with their culture, work practices, and current business values (Hernández-Ortega 2011).

Table 4.7: Compatibility variable

Variable	Items	References
Compatibility1	The system is compatible with our culture	Hernández-Ortega (2011)
Compatibility2	The system is compatible with our work practices	Hernández-Ortega (2011)
Compatibility3	The system is compatible with our business values	Hernández-Ortega (2011)

A list of hypotheses related to the technology variables are shown in table 4.8. The hypothesis aims to examine whether there is correlation and influence between the technology variables an the three phases of the BI&A adoption process.

Table 4.8: Summary hypothesis results for the technology variables

Hypothesis
H1a: technology variables are significantly correlated to the front-end management of a BI\&A project in an organization
H1b: technology variables are significantly correlated to the PPM of a BI\&A project in an organization
H1c: technology variables are significantly correlated to the success of a BI\&A project in an organization
H2a: technology variables significantly impact the front-end management of a BI&A project in an organization
H2b: technology variables significantly impact the PPM of a BI&A project in an organization
H2c: technology variables significantly impact the success of a BI&A project in an organization
H3a: technology variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3b: technology variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3c: technology variables significantly impact the success of a BI&A project in an organization relative to other variables

4.3.2 Organizational context

Second, the organizational component refers to the characteristics and resources of an organization (Borgman et al. 2013). In general, an organization would examine whether it is ready in terms of resources, IT infrastructure, experience, and culture to implement a BI&A project (Lin & Lin 2008, Chang et al. 2007, Grover 1993, Tsou & Hsu 2015). This must be also accompanied with strong and enthusiastic top management support (Teo et al. 2009) and appropriate project management practices (Ofori 2013).

Infrastructure

Infrastructure is a set of interrelated components that builds the IT of the company (Laudon & Laudon 2011). That is, infrastructure is the technological base where the BI&A system will be implemented (Lin & Lin 2008). In general, an organization will be more likely to adopt a BI&A system if it has an appropriate and a compatible IT infrastructure.

This component belongs to the organization component as it measures specific IT infrastructure aspects in the organization. Specifically, this component examines how well the IT infrastructure of the organization is ready to run the BI&A system in it. IT infrastructure is measured using the following items: having clean and accurate data (Laudon & Laudon 2011).

Table 4.9: IT Infrastructure variable

Variable	Items	References
IT infrastructure1	Our organization maintains clean data	Laudon & Laudon (2011)
IT infrastructure2	Our organizations maintains the integrity of data	Laudon & Laudon (2011)

Top management

Top management is another important factor that impacts the adoption and diffusion process of technology (Blichfeldt & Eskerod 2008). Thompson (1965) points out that management consists of procedures and functions to organize resources such as human workforce in order to achieve the organization's objective. Research shows that top management leadership style affects the innovative ability of the staff (Amabile et al. 1996, Jung et al. 2003). Top Management can also support a creative environment (Amabile et al. 2004). A creative environment is one such that there is encouragement of creativity by the organization. In a meta-analysis study to examine the most significant factors impacting the adoption of a certain technology, top management is found to be significant 24% of the time (Basole et al. 2013).

Top management variable is an organizational factor that measures how top management influences the adoption and implementation of BI&A projects in their organizations. Specifically, top management can positively influence the adoption process if they are interested or aware of the benefits of BI&A systems (Teo et al. 2009, Lin & Lin 2008, Premkumar & Roberts 1999).

Table 4.10: Top management variable

Variable	Items	References
Top management1	Top Management is interested in BI&A system	Teo et al. (2009)
Top management2	top management is aware of the benefits of a BI&A system to the firm	Lin & Lin (2008), Premkumar & Roberts (1999)

Resources

The more and better the resources, such as human capital, and time, the more likely an organization would adopt a certain technology (Corrocher 2006). Some authors identify that a lack of resources would actually result in innovation and eventually a successful organization (Akan et al. 2006, Blichfeldt & Eskerod 2008, Smith 1997). This is not completely true. There are multiple theories that look at how and why organizations become successful and can accordingly grow. For instance, the Resource Based View Theory (RBV) states that the strategy of any organization needs to be driven based on its resources and assets such as skills, technology, capabilities (Erzurumlu & Erzurumlu 2013, Penrose 1995). This theory has several applications. For instance, organizational capability is the utilization of technological and organizational capabilities to perform a task and improve performance (O'Regan et al. 2006). In addition, Thompson (1965) argues that human capital is one of the most important resources that management should focus on in order to be an innovative organization. This means that employees should be given freedom in their work, without forcefully expecting them to innovate.

Resources is an organizational factor that indicates how much resources an organization should have in order to execute the phases in the adoption process of BI&A projects. Specifically, resources are measured in terms of time, funding, IT human resources, and data (Lee et al. 2009, Chang et al. 2007).

Table 4.11: Resources variable

Variable	Items	References
Resources1	The organization have enough time resources to execute BI&A projects	Chang et al. (2007)
Resources2	The firm had enough funding resources to execute a BI&A project	Chang et al. (2007)
Resources3	We have good IT human resources	Lee et al. (2009)

Strategy

Business strategy decides how a business wants to compete (Meskendahl 2010). A business strategy is basically its objective/purpose (Laudon & Laudon 2011). Strategy is a significant statistical indicator in explaining the adoption of a certain technology (Basole et al. 2013). An innovative strategy will positively impact the adoption phase of the adoption of a BI&A system since it motivates and enables employees to innovate (Acur et al. 2012). In addition, the strategy of the business can highly impact its success and influence the way its project portfolio is structured (Meskendahl 2010).

Strategy is an organizational factor that highly impacts the adoption process of BI&A projects in organizations. If BI&A project is aligned with the company's strategy or goal, then it is more likely to be adopted (Grover 1993, Carbone 2011).

Table 4.12: Strategy Variable

Variable	Items	References
Strategy1	There is continuous assessment of IT in IS planning	Grover (1993)
Strategy2	IS management is constantly involved in business planning	Grover (1993)
Strategy3	Our BI&A projects are aligned with company goals	Carbone (2011)

Experience

Experience indicates the learning effect that the firm has acquired from previous experiences with previous technology implementation (Hollenstein 2004).It also includes the IT expertise of business users. In general, the more experience and knowledge an organization and its employees have, the more likely they will adopt a BI&A system (Borgman et al. 2013, Kuan & Chau 2001, Lee et al. 2009). Moreover, if the organization is familiar with the implementation of similar analytical systems, they are more likely to succeed in adopting a BI&A project (Ajmal et al. 2010).

Experience is an organizational factor that measures how prepared an organization is to implement and adopt a BI&A project. An organization is said to be experienced if it: has implemented new technologies in the last three years, typically invests a lot in technology, has necessary knowledge and relevant experience to implement a BI&A project (Lin & Lin 2008, Paul Jones et al. 2013, Grover 1993).

Culture

Table 4.13: Experience Variable

Variable	Items	References
Experience1	Number of new technologies implemented in the last three years	Lin & Lin (2008), Paul Jones et al. (2013)
Experience2	Level of investment in technology	Lin & Lin (2008)
Experience3	Our firm has necessary knowledge to learn and implement a BI&A system	Lin (2014)
Experience4	A BI&A system is compatible with our experience with similar systems	Grover (1993)

Culture is an important factor that positively contributes to the adoption process (Laforet 2013). It is defined as a set of shared assumptions by the members of the organization (Laudon & Laudon 2011). An innovative culture is used as a determinant to the adoption stage of a certain technology (Acur et al. 2012, Lee et al. 2009). In general, an innovative culture will motivate employees to submit new ideas and become more likely to generate the idea of a BI&A project.

Culture is an organizational factor that examines if the organizational culture would influence the adoption process of BI&A projects in organizations (Tsou & Hsu 2015). A culture is supportive if it enables easy and fast access to data (Thong & Yap 1995).

Table 4.14: Culture variable

Variable	Items	References
Culture1	It is important to have access to reliable, relevant, and accurate information	Thong & Yap (1995)
Culture2	It is important to access information fast	Thong & Yap (1995)

Project management

Project Management Practices include estimation, risk management, knowledge management, monitoring and control, and project champion (Ofori 2013). This factor is positively related to the adoption of a BI&A project. For instance, meeting time constraints could be achieved using adequacy of project management practices (Cooke-Davies 2002). This is also supported by the work of Müller & Turner (2007) showing the influence of project managers on project success.

This factor explains how the organization performs project management practices while implementing and adopting a BI&A project. The organization has good project management practices if it performs adequate scope and plan for the project. Also, the project manager and his practices need to be suitable for the implementation of BI&A projects (Yap et al. 1994).

Table 4.15: Project management practices variable

Variable	Items	References
Project management1	The project manager has an understanding of a BI&A system in comparison to other PMs	Yap et al. (1994)
Project management2	Our BI&A project is well managed	developed by researcher

A list of hypotheses related to the organization variables are shown in table 4.16. The hypothesis aims to examine whether there is correlation and influence between the organization variables an the three phases of the BI&A adoption process.

Table 4.16: Summary hypothesis results for the organization variables

Hypothesis
H1d: organization variables are significantly correlated to the front-end management of a BI\&A project in an organization
H1e: organization variables are significantly correlated to the PPM of a BI\&A project in an organization
H1f: organization variables are significantly correlated to the success of a BI\&A project in an organization
H2d: organization variables significantly impact the front-end management of a BI&A project in an organization
H2e: organization variables significantly impact the PPM of a BI&A project in an organization
H2f: organization variables significantly impact the success of a BI&A project in an organization
H3d: organization variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3e: organization variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3f: organization variables significantly impact the success of a BI&A project in an organization relative to other variables

4.3.3 Environmental context

Third, the environmental component refers to the external context in which the organization operates such as industry, competitors, customers, government...etc

(Borgman et al. 2013). This component is supported by the Dynamic Capability View Theory (DCV). DCV looks at internal and external competencies to address the dynamic nature of the environment (Yue et al. 2007). A knowledgeable vendor will support and help the organization adopt the BI&A system successfully (Bosch-Rekveldt et al. 2011). In addition, if the industry is going through a fierce competition, an organization would be threatened and thus adopt the BI&A system to stay in the market (Laudon & Laudon 2011, Grandon & Pearson 2004). Lastly, if the organization is operating in a country where government supports and motivates innovation, it is likely that the organization would adopt a BI&A system (Kuan & Chau 2001).

Vendor support

Vendor support factor is well-studied in the literature. Suppliers spread word of mouth and facilitate their knowledge about the technology. In addition, their pricing, offers, services, and support to the customer can be a deciding factor for organization to adopt a certain technology (Geroski 2000, Cool et al. 1997, Corrocher 2006). Vendor support is also very important as they are usually responsible for providing training to the employees. A study by Venkatesh (1999) proves that training acts as a motivation to employees; thus, increasing the probability of adopting a certain technology.

Vendor support is an important external factor to the organization. Vendor support would typically positively influence the implementation and adoption of BI&A projects in organizations if they are knowledgeable in the domain, provides adequate training and support, and establishes trust with organization (Lin & Lin 2008, Chang et al. 2007, Bosch-Rekveldt et al. 2011).

Table 4.17: Vendor support variable

Variable	Items	References
Vendor1	Our vendor is very knowledgeable in BI&A	Lin & Lin (2008)
Vendor2	The vendor provides adequate training	Chang et al. (2007)
Vendor3	The vendor provides adequate support	Chang et al. (2007)
Vendor4	Do you trust the vendor	Bosch-Rekveldt et al. (2011)

Competition

Competition is defined as the degree to which an organization is affected by other competitors (Borgman et al. 2013) That is, the more organizations in the network use a BI&A project, the more pressured the organization would be to adopt it (Kuan & Chau 2001). In general, a market with intense competition would force its players (other organization) to innovate and rapidly adopt technologies to stay ahead (Bocquet et al. 2007).

Competition is an environmental factor as it measures an external condition to the organization. Competition might actually force organizations to implement and adopt BI&A projects specially if they experience a competitive disadvantage from this competition (Grandon & Pearson 2004, Lin & Lin 2008, Lin 2014).

Table 4.18: Competition variable

Variable	Items	References
Competition1	Our firm would have experienced a competitive disadvantage if we didn't implement data analytics	Lin & Lin (2008), Lin (2014)
Competition2	Competition is a factor in our decision to adopt a BI&A system	Grandon & Pearson (2004)
Competition3	Our industry is pressuring us to adopt a BI&A system	Grandon & Pearson (2004)

Government

The government component indicates how the government could force or motivate organizations to adopt specific technologies. This indicates that the government may actually force organizations to use more advanced systems such as BI&A (Kuan & Chau 2001).

Government is another external factor to the organization that may influence its decision to implement and adopt a BI&A project (Grandon & Pearson 2004). This factor is specifically important due to the EXPO 2020 initiative in UAE. These governmental initiatives might actually influence and motivate organization to implement and adopt BI&A projects (Kuan & Chau 2001, Grandon & Pearson 2004).

Table 4.19: Government variable

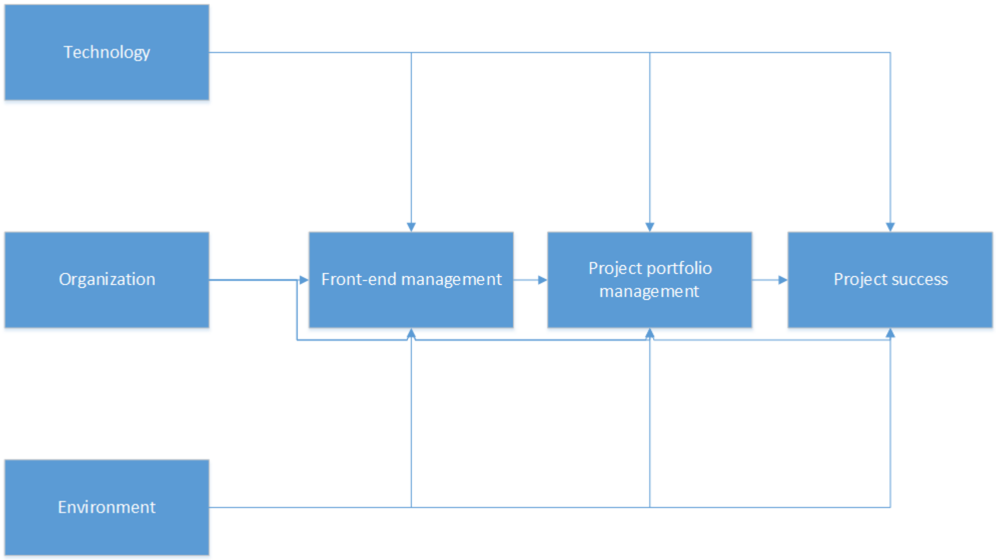
Variable	Items	References
Government1	There are progressive government measures to implement BI&A systems	Kuan & Chau (2001)
Government2	our organization is pressured by the government to adopt a BI&A system	Grandon & Pearson (2004)

A list of hypotheses related to the environment variables are shown in table 4.20. The hypothesis aims to examine whether there is correlation and influence between the environment variables an the three phases of the BI&A adoption process.

Table 4.20: Summary hypothesis results for the environment variables

Hypothesis
H1g: environment variables are significantly correlated to the front-end management of a BI\&A project in an organization
H1h: environment variables are significantly correlated to the PPM of a BI\&A project in an organization
H1i: environment variables are significantly correlated to the success of a BI\&A project in an organization
H2g: environment variables significantly impact the front-end management of a BI&A project in an organization
H2h: environment variables significantly impact the PPM of a BI&A project in an organization
H2i: environment variables significantly impact the success of a BI&A project in an organization
H3g: environment variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3h: environment variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3i: environment variables significantly impact the success of a BI&A project in an organization relative to other variables

Figure 4.1: Proposed research model



4.4 Proposed research model

Based on the above discussion, a figure depicting the proposed model is shown in figure 4.1.

4.5 Chapter summary

BI&A projects are very important as they help organizations analyze data and make better decisions. Surprisingly, not all organizations adopt these projects. In other words, some organizations adopt BI&A projects while others do not. Therefore, it is important to study the factors that impact the decision of adopting a BI&A project in organizations.

Most organizations are becoming project based organizations where they implement systems in the form of a project (Jonas 2010). Therefore, this research will study the adoption phases of a BI&A project. These phases are guided through the technology adoption phases which are pre-adoption, adoption, and post-adoption. In the context of a project, it seems that these three phases correspond to front-end management, project portfolio management, and project success, respectively.

Using the technology-organization, environment (TOE) model, this research will study the different technological, organizational, and environmental factors that impact each of the three project phases.

This chapter started by providing a summary of the three main project phases (front-end management, project portfolio management, and project success) in the context of a BI&A project. After that, using an extensive literature review, the chapter links the factors from the TOE model to those three phases. That is, this research provides a set of hypotheses, supported by the literature, to build the proposed research model. This research model aims to explain the factors that impact the front-end management, project portfolio management, and project success of BI&A projects in organizations.

To the best of my knowledge, this research fills the literature gap that explains the adoption process for a project by introducing three main project adoption phases: front-end management, project portfolio management, and project success. Also, the research model proposes a set of factors, using the TOE framework, that impact each of these phases. In addition, this study focuses on BI&A projects that are relatively new and different than other IT adoption studies.

5-RESEARCH METHODOLOGY

5.1 Introduction

This research aims at studying the factors that impact the adoption of BI&A projects in organizations. Our proposed model uses knowledge from the technology adoption literature. That is, the proposed model divides the adoption process for a BI&A project in organizations into three main phases: front-end management, project portfolio management, and project success. The model also examines the impact of several technology, organization, and environment factors on these three adoption phases.

This chapter explains the research approach and methodology used in this research. First, a brief description of the two main research approaches will be explained: positivist and interpretative. The research utilizes the positivist approach due to the aims of this research. This means that the proposed research model will be verified empirically through questionnaires. The questionnaire structure, design, and validity, sampling and distribution are also explained. Finally, the main analysis techniques used in this research are discussed.

5.2 Research philosophy

A researcher could either be a realist or an interpretive. These two notions are different in their research philosophy in the way they perceive reality, knowledge, language used, focus, and also approach. These two types of researchers correspond to two different research philosophies: positivist and phenomenological. The positivist philosophy is objective and quantitative in nature.The phenomenological philosophy is subjective and qualitative in nature (Saunders et al. 2011).

The positivist approach or a realist believes that reality is known. That is, everything in this world is measurable and knowable. This means that the researcher would mainly depend on objective measures. That is, most of his sources would be reliable and published work. In addition, he would describe reality as it is without biasing it with his own interpretations. So, the language would be clear and objective. A realist would also use a deductive approach. The deductive approach is when you move from general ideas and theories into particular situations. That is, the proposed theory shall be validated through empirical results and tests. Therefore, most of his work will be about empirically testing hypothesis deduced from the literature. A realist would use research methods such as questionnaires and statistical analysis (Lee & Lings 2008).

However, the phenomenological approach or an interpretive believes that reality is mysterious. That is, this world is unknown and could be interpreted differently from different researchers. This means that he would mainly depend on subjective measures. An interpretive would also use different bodies of research in different contexts to actively construct reality. He would typically generate theories by using an inductive approach. Inductive research is when you move from particular situations to general ideas. That is, research data results and analysis are used to create general theories. Therefore, most of his work will be about creating theories from data collected. An interpretive would use research methods such as interviews, field work, observations, and ethnography (Lee & Lings 2008).

The philosophy is really determined by the nature of the research and the researcher as well. It is also important as it has a direct impact on the research methodology that will be deployed in this research. Specifically, the philosophy will guide the methodology in how, why, what, and where data will be collected and analyzed. This research will adopt a realist nature and use a positivist research approach. This research aims at identifying, measuring, and modeling the factors that influence the implementation and adoption of BI&A projects in organizations. Unlike a research question that aims at subjectively exploring the experience of adopting a BI&A project in organizations, our research question is objective in nature which indicates a positivist research approach. In addition, a positivist approach has several advantages such as: suitability for structured research, ease of data collection, ability to reproduce results and test conclusions. Although a positivist research approach cannot help explain why things happen in a certain way, it will fulfill the needs of this research due to the irrelevance of that disadvantage (Hameed et al. 2012).

Also, a positivist approach is highly used by researchers in the technology adoption literature. Lin (2014), Hardgrave et al. (2003), Thong & Yap (1995), Jiang (2009), Hameed et al. (2012), Ko et al. (2008) utilized a positivist approach through the use of questionnaires to test their developed theoretical models.

In line with the positivist view, this research is deductive in nature as it starts from theories about IS/IT adoption, the Technology, Organization, Environment (TOE) framework, and the project management literature to propose a theoretical model to explain the factors that impact the implementation and adoption process of BI&A projects in organizations. The research will use questionnaire data to verify and validate the model.

5.3 Type of research

There are two main types of research: qualitative and quantitative. Qualitative data analyzes data from sources such as observations, open-ended interviews, and observations. This method usually generates rich data that corresponds to a lot of different themes (Patton 2005). On the other hand, quantitative research analyzes data from sources such as questionnaires and experimental results. This method usually generated structured data that are analyzed using statistical methods (Lee & Lings 2008). This research utilizes mixed methods using qualitative and quantitative techniques.

Questionnaires, the data collection source in this research, are considered both qualitative and quantitative. They are qualitative as it converts people's opinions into numbers. They are also quantitative as statistical analysis could be applied on this data. Therefore, questionnaires are considered to be a mixed method technique

(Bryman 1992).

5.4 Purpose of the research

Generally, just like any study, this research aims at increasing the knowledge base in the community (Clark-Carter 2004). Specifically, a research study could either be exploratory, descriptive, and predictive or experimental depending on its nature. These purposes are briefly explained.

Exploratory research is when few studies have been undertaken before (Grabski 2010). The main objective of this type of research is to create the initial base/hypothesis for other research opportunities to take off. Exploratory research mainly utilizes qualitative methods such as case studies and observations to gain as much insights as possible.

Descriptive research is used to identify the characteristics of a topic. This type of research assumes previous knowledge about the topic. It only needs to deduce certain characteristics about a specific topic. This is mainly conducted using quantitative methods (Lee & Lings 2008).

Predictive research aims to study the causes of a phenomenon based on analyzing data from observations. This type of research is usually based on existing studies. It can also be referred to as experimental research which aims to conduct computer simulations or experiments in labs to test a specific a hypothesis or claim (Saunders et al. 2011).

In general, this research aims to explain the adoption process of a BI&A project in an organization. To the best of my knowledge, this was not tackled before in the literature. Specifically, this research aims to:

- describe the stages in the adoption process for a BI&A project in an organization
- list and explain the technological factors that impact the adoption of a BI&A project in an organization
- list and explain the organizational factors that impact the adoption of a BI&A project in an organization
- list and explain the environmental factors that impact the adoption of a BI&A project in an organization
- examine the differences in the perceptions of respondents of how they view the adoption of a BI&A project in an organization

The first aim of this research is exploratory in nature due to the newness of the topic. This phase results in building a research model that explains the factors that impact the adoption of BI&A projects in organizations. This model is explained thoroughly in the research model chapter. The second, third, and fourth aims are descriptive in nature as the impact of the technology, organization, and environment factors are empirically analyzed against the adoption phases from phase 1. The last aim is also descriptive in nature to examine whether there are differences in the respondents perceptions or not.

5.5 Questionnaire structure

A web-based questionnaire is designed and distributed electronically to respondents. A web-based questionnaire is better than a paper and pencil based questionnaire (Wang et al. 2005). First, it allows respondents enough time to respond. It also enables the collection of large volumes of data. This method also saves time, money, and effort. The tool selected for the web-based questionnaire is Google Forms. Google forms provides a robust platform to create, distribute, and collect questionnaires. It also provides preliminary descriptive statistics of the results such as frequency diagrams. In addition, google forms enables the export of data to different advanced statistical programs such as SPSS which is used in this research. This tool is also free of charge unlike other tools in the market such as survey monkey.

The questionnaire starts by an introduction that explains the purpose of the study and defines what BI&A systems are. The questionnaire then requests respondents to take few minutes to answer the questionnaire in return of a preliminary copy of the aggregate results. The introduction of the questionnaire also assures respondents of confidentiality issues and states that no individual responses will be published. That is, only aggregate results will be published. Finally, the introduction part of the questionnaire provides the email and phone number of the researcher in case of any questions or clarifications.

The questionnaire itself consists of five main parts. Part 1 includes demographics; questions about the respondents and about the organization he/or she is working is as the level of analysis in this study is organization.

Part 2 asks respondents to indicate whether they adopt any BI&A applications or not. If the respondents say no, the questionnaire will terminate because this indicates that his/her organization is a non-adopter. Therefore, he/she will not be able to answer the rest of the questions concerning BI&A systems as his/or her organization did not experience working with such systems. If the respondent answers yes, this means that his organization is aware of such systems and that the respondent would be able to answer the rest of the questions. This part continues by asking detailed questions about the average BI&A project such as the applications used, the duration of use, etc. This part concludes by asking the participant about the BI&A project adoption experience using the three main phases, indicated previously, front end management, project portfolio management, and project success. Part 2 is mainly concerned with the dependent variables: front-end management, project portfolio management, and project success.

Parts 3, 4, and 5 ask questions about the technology, organization, and environment factors, respectively. These three parts are mainly concerned with independent variables: technology, organization, and environment factors that impact the dependent variables.

A copy of the questionnaire is available in Appendix A.

5.6 Questionnaire design

All questions were structured and closed ended. All questions were grouped together to the respective variable and clearly worded. Simple vocabulary and short sentences are used. The questionnaire had questions with three different variations for responses: multiple choice (single answer), multiple choice (multiple answer), and seven point likert scale.

5.6.1 Likert scale considerations

The seven-point likert scale questions are coded as follows: 1 strongly disagree, 2 is disagree, 3 is disagree somewhat, 4 is neutral, 5 is agree somewhat, 6 is agree, and 7 is strongly agree. Other multiple choice questions (single answer) were coded numerically in an ascending order. Multiple choice question (multiple answer) were coded numerically in an ascending order including coding that corresponds to all different combinations of answers. Another consideration was the negatively coded words that are reversed before conducting any analysis.

There has been a lot of debate whether a five point likert scale is better than a 7 point likert scale. A 5 point likert scale could be better as it gives respondents few responses which means it will be less confusing. However, it might not give them enough freedom to clearly express their answer and this would eventually result in a measurement error (Colman et al. 1997). Therefore, a 7 point likert scale will be used in this study to give respondents enough freedom to choose the appropriate answer. It is important to mention that both the 5 and 7 likert scales are comparable and would eventually result in the same analysis (Dawes 2008).

Different cultures also respond differently to the likert scale. In fact, individuals answers vary according to their culture. For example, a 170 cm East Asian is considered tall compared to similar East Asians. However, a 170 cm American is considered short compared to similar Americans. Therefore, every questionnaire should clearly guide respondents to answer in comparison to the average in their culture (Heine et al. 2002). In this research, the questionnaire targets individuals in the UAE and GCC as they all have common culture and business rules.

5.7 Questionnaire validity

Validity of the questionnaire is confirmed using a pilot study. The questionnaire is first distributed to five applicable respondents. These five respondents are not considered in the actual sample to avoid bias (Lee & Lings 2008). The respondents were observed and timed. Common comments were: the questionnaire is too long, some questions are vague, and some words are not clear. Also, preliminary reliability analysis using Cronbach alpha was conducted. The questionnaire was then shortened by eliminating unnecessary items. Also, all unclear questions and words were modified and/or eliminated.

After the pilot study, the questionnaire was passed on to three academic experts who approved the questionnaire and gave it the green light to start distributing it.

Also, one of the common problems of questionnaire data is that it incorporates people's opinions which might not always reflect reality (Lee & Lings 2008). This is avoided by implementing a pilot study that eliminates wrong questions. Also, the questionnaire is sent to knowledgeable employees who work in the BI&A field and whose organizations currently adopt the system. Also, questionnaire results go through multiple tests such as reliability analysis, factor analysis, and assumptions validity to ensure the quality of the data before conducting the actual tests (Choi & Pak 2005).

5.8 Sampling and questionnaire distribution

This research will focus on a specific domain which is the United Arab Emirates (UAE) and Gulf region. This is important as it enables the generalization of the results to that specific domain. Also, every market is different in nature and therefore it is important to study each one separately. The UAE and Gulf region is assumed to be similar due to the Gulf Cooperation Council (GCC) which assumes common political rules for the following countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE) (Sikimic 2014). Convenience sampling and simple random sampling are used in this research. Convenience sampling is useful as it is very hard to collect data in this region otherwise. However, the sample might not be representative of the population. Therefore, simple random sampling is used as it is considered a fair way of selecting a sample from the population of BI&A adopting organizations in the UAE and GCC (Lee & Lings 2008).

The questionnaire is distributed to mail lists that contained email addresses of organizations. This method did not have a high response rate as most organizations did not update their email addresses. In addition, these lists contained the organization's public email, not email addresses of individual employees. The person checking these organization emails is typically not qualified to respond or even escalate it to the right person.

Therefore, appropriate individuals, typically IT and Business professionals, are targeted by performing a filtered search on LinkedIn that showed only those individuals in the BI&A field in the Gulf region. 500 individuals working in organizations in different industries such as health care, education, etc. are contacted individually via LinkedIn messages where the researcher and the research objectives are introduced. In addition, respondents were promised the anonymity of their responses. Also, to prove the authenticity of this research and the identity of the researcher, a letter from the university was attached. Most of the responses were collected using this method.

5.9 Analysis techniques

Questionnaire results were exported from Google forms to an Excel sheet where it were then imported into SPSS. SPSS is the tool selected for analysis as it is powerful for statistical analysis. Also, SPSS helps in creating visualizations and in conducting sensitivity analysis (Lee & Lings 2008). The analysis used in this research is: (1) descriptive statistics to explain the nature of the data, (2) reliability analysis to confirm that the items measure what they intend to measure, (3) factor analysis for dimension reduction, (4) correlation to understand the correlations between variables, (5) regression to understand the impact between independent variables on dependent variables, and (6) differences between samples to examine whether different groups of respondents have different perceptions about the adoption of a BI&A project in organizations.

5.10 Chapter summary

This chapter started by explaining the research approach used in this study. It first outlines and briefly explains the two main research approaches: positivist and phenomenological. The positivist approach will be used in this study as the world is measurable and can be examined regardless of the bias from the researcher.

After that, the chapter explained that questionnaires will be used to collect data. The questionnaire design of questions and answer responses is explained and justified. After that, the questionnaire is passed to five individuals for pilot study. These individuals highlighted some confusing aspects of the questionnaire and suggested a lot of wording changes and questions elimination. After the pilot study phase, the questionnaire was then examined by a panel of 5 academics who approved the quality of the questionnaire.

The questionnaire targets IT or business individuals in the UAE or GCC who are aware of the adoption and implementation process of BI&A projects in their organizations. If the employee is not aware, the questionnaire will terminate and his response will not be counted.

Questionnaires are distributed electronically using Google Forms and then exported to SPSS for analysis. Descriptive and inferential statistics will be explained in the next chapter.

6-DESCRIPTIVE ANALYSIS

6.1 Introduction

This chapter discusses the descriptive statistics of the results. The chapter starts by giving an overview of the questionnaire development and distribution. The data is then grouped and analyzed based on the three clusters of independent factors (Technology, Organization, Environment) and the three dependent factors (front-end management, project portfolio management, project success). First, data is cleaned by eliminating irrelevant responses and outliers from the data. Also, unreliable items are eliminated from the questionnaire using cronbach alpha analysis. Then the descriptive findings of the results are explained. Variable ranking is also conducted as it might provide the researcher with obvious trends necessary for further analysis. Also, normality test is conducted to prepare for further analysis. Further inferential statistics and results are presented in further chapters.

6.2 Questionnaire development and distribution

The questionnaire includes five main parts. Part 1 asks the respondent about his demographics and the characteristics of the organization he works in. Part 1 includes the following: location of the organization to eliminate organizations from outside the UAE and the Gulf scope, ethnicity of the respondent, position of respondent in the organization, and experience of respondent in current organization.

Part 2 asks about the characteristics of the average BI&A project in the organization. Part 2 includes the following: the type of BI&A system used, the average number of members typically included in a BI&A project, the data storage duration, and the data analysis duration. This part also includes the three main dependent variables that explain the adoption process of a BI&A project in an organization: front-end management, project portfolio management, and project success. Front-end management is measured using 1 item, project portfolio management is measured using 1 item, and project success is measured using 3 items. The items that measure the dependent variables are shown in figure 6.1.

Parts 3, 4, and 5 ask about the three main clusters of independent variables: Technology, Organization, Environment. Technology cluster is measured using 4 variables and 10 items. Organization cluster is measured using 7 variable and 19 items. Environment cluster is measured using 3 variables and 9 items. The variables and items that measure the independent clusters are shown in figure6.2. Also, every independent cluster, Technology, Organization, and Environment, along with its variables and items is shown in figures 6.3, 6.4, and 6.5, respectively.

Figure 6.1: Dependent variables

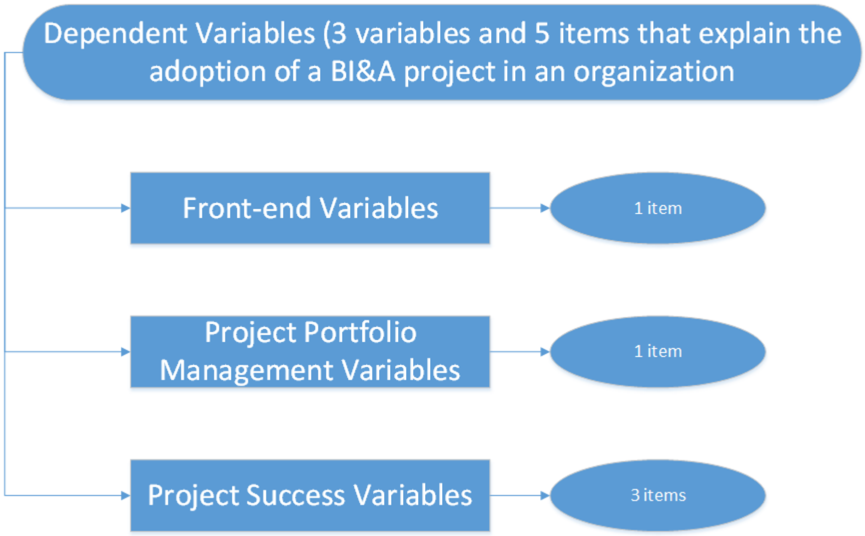


Figure 6.2: Independent variables

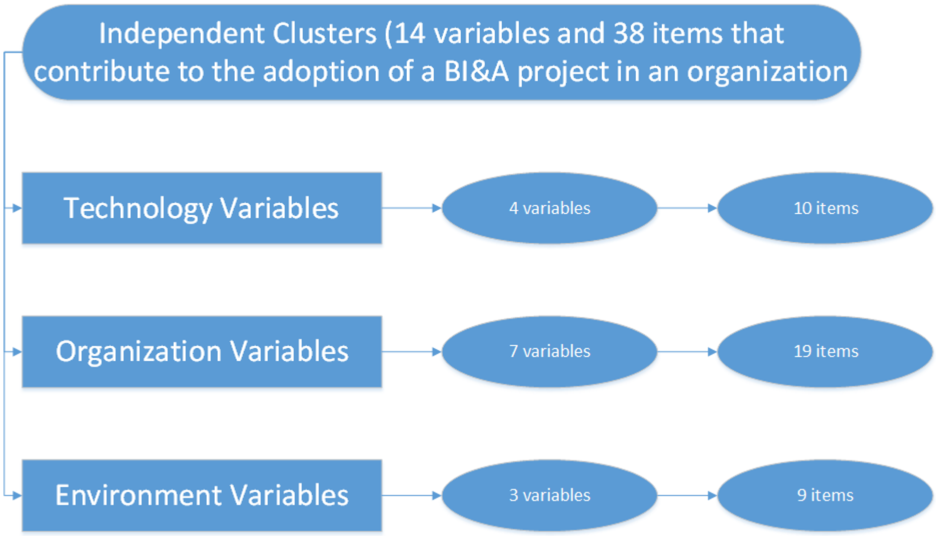


Figure 6.3: Technology cluster

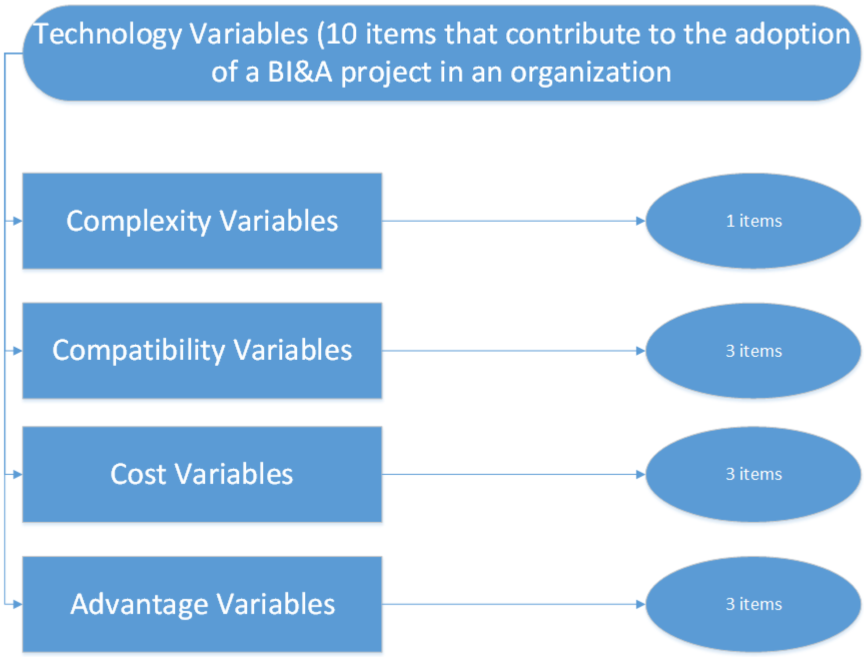
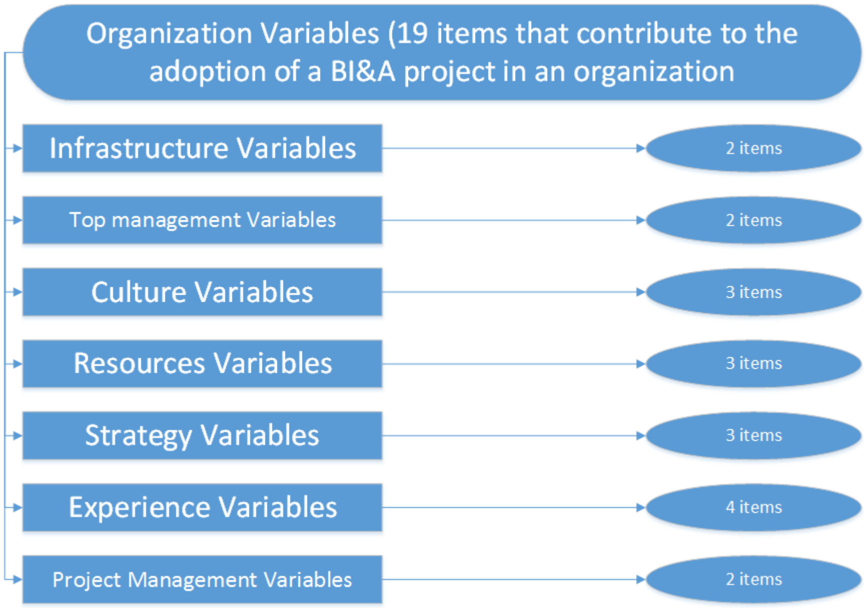


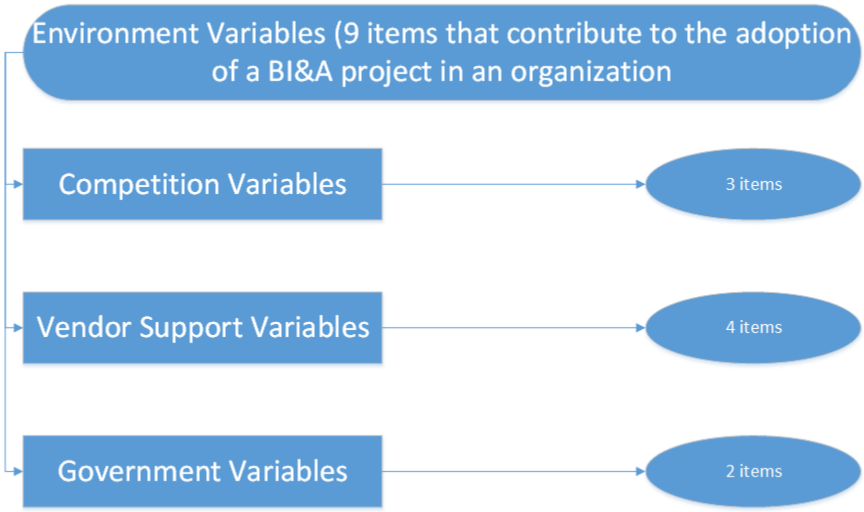
Figure 6.4: Organization cluster



Respondents are asked to rate each item using a 7-point likert scale. The 7-point likert scale questions were coded as follows: 1 strongly disagree, 2 is disagree, 3 is disagree somewhat, 4 is neutral, 5 is agree somewhat, 6 is agree, and 7 is strongly agree. 5-point or 7-point likert scale is widely used in the social science literature. According to a study conducted by (Dawes 2008), 5-point and 7-point likert scale behave similarly to each other and produce similar results. Refer to the research approach and methodology chapter for a further discussion regarding likert scale.

The questionnaire was first distributed electronically to mail lists. Unfortunately, these mail lists were outdated and did not result in a high response rate. Alternatively, the researcher contacted individuals who work in organizations that adopt BI&A projects via LinkedIn. 500 Individuals are selected based on simple random sampling. Data was collected over a period of two-months while sending bi-weekly reminders. 177 completed questionnaires were returned by respondents. The number of respondents represent 35.4% response rate. This sample size is acceptable in the context of this research due to practicality reasons in terms of time and resources. Also, this response rate is typical for web-based surveys (Işık et al. 2013). In addition, the assumptions of all the statistical tests conducted in this and the next chapter were met. Moreover, it is not practical to get an exact number of the population of BI&A adopting organizations. Therefore, it will never be clear whether a sample of 177 or a sample of 1777 is representative of the population. Also, IT adoption studies with a small number of respondents were conducted and acceptable such as the study by Işık et al. (2013) which included 116 usable responses.

Figure 6.5: Environment cluster



6.3 Data cleaning

The 177 completed collected questionnaires are then cleaned. 55 responses are removed as they were completed from organizations that do not adopt a BI&A project and out of scope for this research as this research is only interested in adopting organizations of a BI&A project. Using the location question in the questionnaire, 13 other responses are removed as they were completed from organizations outside the UAE and the Gulf region which is also out of scope for this research. Items are then examined for outliers using the z-score method where any item that is 3 standard deviations away from the mean were eliminated. A table that shows the z-scores for the variables and the responses eliminated is shown in table 6.1. The following responses are eliminated: 1, 12, 25, 69, 80, 90, 105, 106, and 109. The removal of outliers is important as it might impact further analysis (Osborne & Overbay 2004). After all eliminations, there were 100 usable responses to be used for analysis.

Table 6.1: Z-score for variables with eliminated responses

Response	PPM_1	Success_2	Success_3	Advantage_2	Advantage_3	Compat_1	topMngmnt_2	Resources_2
109	-4.632	-3.110						
12		-3.110	-3.481					
1			-3.481					
80				-3.765				
90					-3.455			
105						-3.225		
25							-3.686	
106								-3.119
69								-3.119

6.4 Reliability analysis

Cronbach alpha cleans the data before feeding it into factor analysis. Cronbach alpha is used to assess how consistent the items measuring the same variable are (Cronbach & Meehl 1955). Cronbach alpha values range from 0 to 1 with values more than or equal to 0.7 considered strongly reliable (Feldmann 2007). Only item 1 of the culture variable had to be eliminated to increase the reliability from 0.583 to 0.750. The reliability for the different variables is shown in table 6.2.

Main findings of reliability analysis

The results show that Chronbach alpha is between 0.734 and 0.900. The results are consistent with the literature that studies IT adoption in organizations. For instance, Lin (2014) used Cronbach alpha to measure construct reliability of their measurement model. Lin (2014) finds Cronbach alpha from his measurement model to be ranging from 0.724 to 0.928, while Pan & Jang (2008) find Cronbach alpha to be ranging from 0.725 to 0.891, and Kuan & Chau (2001) find Cronbach alpha to be ranging between 0.7132 and 0.9609.

Table 6.2: Reliability Analysis

Independent Variables	
Front-end management	univariante
Project portfolio management	univariante
Project success	0.867
Dependent Variables	
Technology	
Complexity	univariante
Compatibility	0.790
Cost	0.799
Advantage	0.734
Organization	
Infrastructure	0.840
Top management	0.843
Culture	0.750
Resources	0.767
Strategy	0.885
Experience	0.880
Project Management	0.850
Environment	
Competition	0.792
Vendor Support	0.900
Government	0.782

6.5 Descriptive analysis

This section starts by providing an overview of the respondents, their organizations, and the characteristics of an average BI&A project in their organizations.

Ethnicity

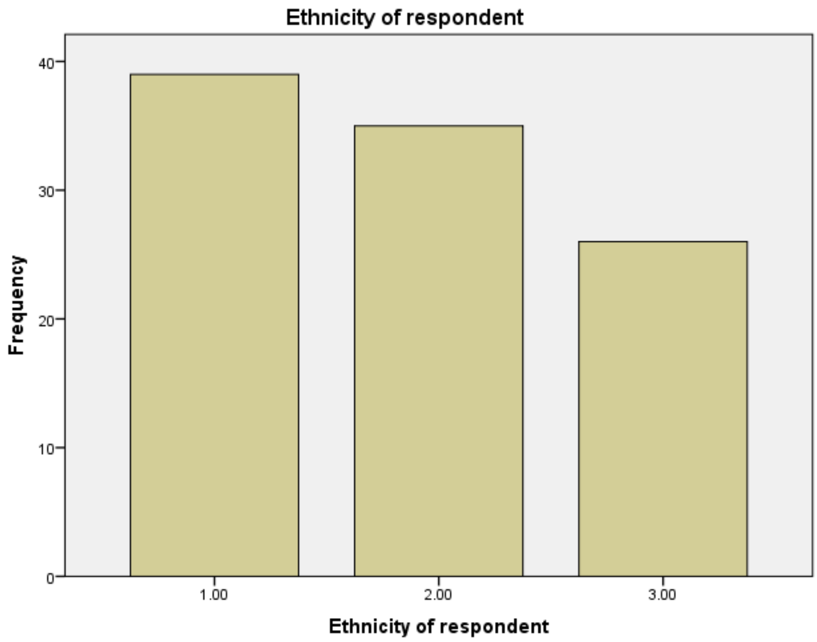
It is important to identify the ethnicity of the respondents to ensure that the culture of the respondents does not result on any response bias (Lee et al. 2009). Technology adoption is not the same across different cultures. For example, the impact of effort expectancy on behavioral intention and the effects of behavioral intention on use behavior is greater in the U.S. more than Korea (Im et al. 2011).

Ethnicity is divided into three groups: Middle Eastern or Arabs, South Asians or Indians, and others. The results show that 39 respondents are Middle Eastern or Arabs, 35 respondents are South Asians or Indians, and the rest 26 are from other ethnic backgrounds. Using independent samples test, it shows that all ethnic groups agree on all variables except the compatibility variable with a 0.18 significance. As the majority of the variables have a similar distribution across categories of ethnic background of respondents, it is safe to assume that the there is no response bias resulting from the difference ethnic backgrounds. The results are shown in figure 6.6. In the graph, 1 refers to Middle Easters or Arabs, 2 refers to South Asians or Indians, and 3 refers to others.

Experience in organization

Experience in organization is divided into three groups: 0-3 years of experience,

Figure 6.6: Ethnicity

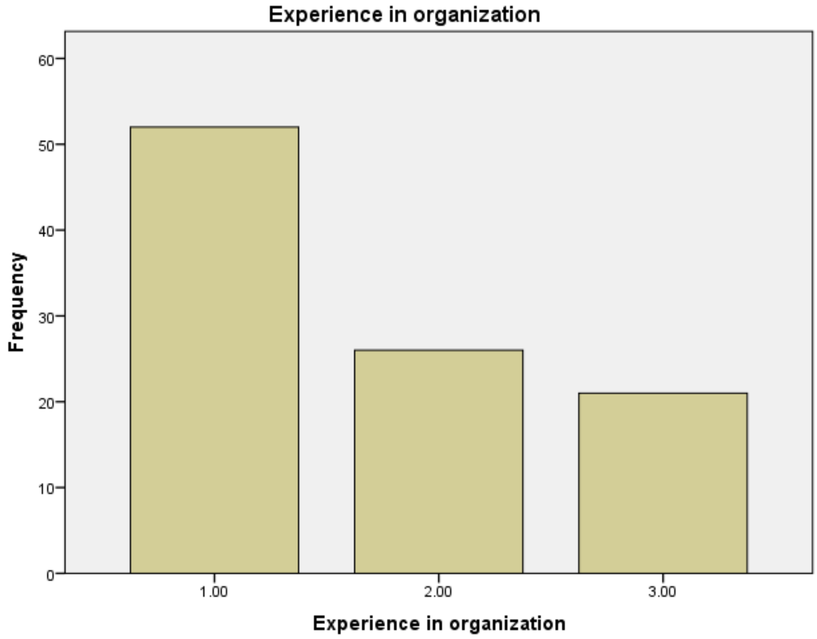


3-8 years of experience, and more than 8 years of experience. The results show that 52 respondents have 0 to 3 years of experience, 26 respondent have 3-8 years of experience, and 21 respondents have more than 8 years of experience. This gives an overall view of the organization experience of the respondents who completed the questionnaire. The results are shown in figure 6.7. In the graph, 1 refers to 0-3 years of experience, 2 refers to 3-8 years of experience, and 3 refers to more than 8 years of experience.

Position in organization

Position in organization is divided into three groups: IT positions, business positions, and other positions. The results show that 30 respondents are in IT positions, 36 respondents are in business positions, and the rest 34 are from other positions. This gives an overall view of the positions of the respondents who completed the questionnaire. The results are shown in figure 6.8. In the graph, 1 refers to IT

Figure 6.7: Experience in organization

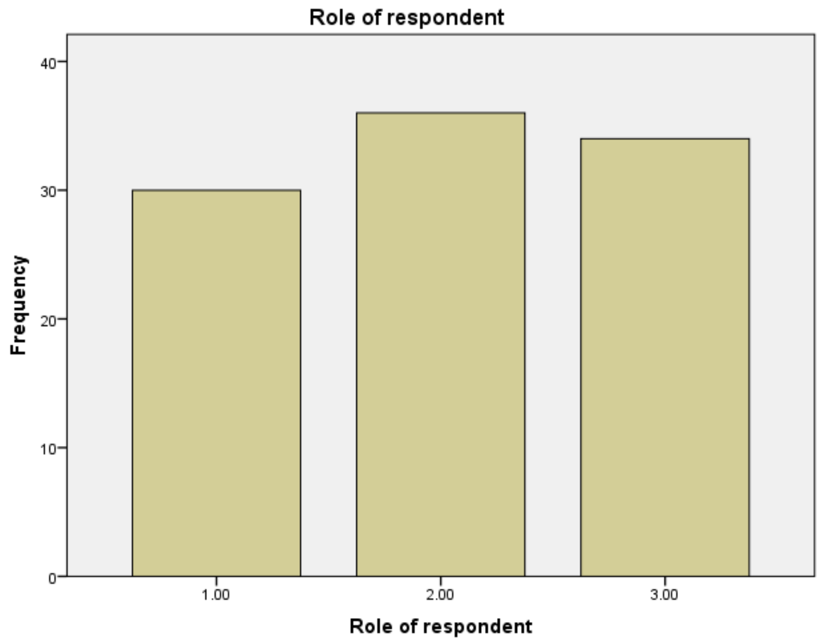


positions, 2 refers to business positions, and 3 refers to others.

Characteristics of the average BI&A project in an organization

Table 6.3 provides an overview of the average BI&A project in an organization. Most respondents state that their BI&A projects are performed as part of their Enterprise Resource Planning (ERP) system. 72 respondents state that organizations perform BI&A projects using their ERP system while the other 18 conduct simple analysis. Most respondents state that their BI&A project involve a large number of people. 40 respondents state that projects consist of 9 or more members, 31 respondents state that projects consist of less than 5 members, and 29 respondents state that projects consist of 6 to 9 members. Most respondents state that their organizations have been matured in storing their data. 55 respondents state that their organizations have been storing data for 8 or more years, 24 respondents state that their organizations have been storing data for 0 to 3 years, and 21 respondents state that their organizations have been storing data for 3 to 8 years. The analysis duration is approximately equally distributed among the 100 respondents. 35 respondents state that their organizations have been analyzing data for 3 to 8 years, 33 respondents state that their organizations have been analyzing data for more than 8 years, and 22 respondents state that their organizations have been analyzing data for 0 to 3 years.

Figure 6.8: Position in organization



6.6 Ranking

This section presents the descriptive stats of the variables. For ease of interpretation, items have been averaged out to measure the variable. This method is a non-refined method to construct components. This method is easy to calculate and interpret and preserves the variation in the data (DiStefano et al. 2009). The components are ranked using the mean likert rating scale. The mean over a 7-point likert scale is used to provide the average response for the variable by the respondents. This method is widely used in the literature such as in Bing et al. (2005), Ismail (2013) to rank the variables. The ranking is presented in five main ways: (1) cluster ranking which presents the ranking of the component against other components in the cluster, (2) overall ranking which presents the ranking of the component against all other components, (3) ranking by experience which presents how different ethnic

Table 6.3: BI&A project characteristic

Characteristics of BI&A project	**Frequency**
Type of BI&A Project	
Simple Analysis	18
ERP	72
Members involved	
less than 5 members	31
6 to 9 members	29
more than 9 members	40
Storage duration	
0 to 3 years	24
3 to 8 years	21
more than 8 years	55
Analysis duration	
0 to 3 years	22
3 to 8 years	35
more than 8 years	33

groups ranked the components, (4) ranking by experience which presents how different experience groups ranked the components, and (5) ranking by position which presents how different position groups ranked the components. Also, the coefficient of variation (CV) is used to indicate the variability of the responses; that it, the lower the CV, the more the respondents agreed on that specific variable (Reed et al. 2002).

6.6.1 Overall descriptive analysis of dependent components

From table 6.4, the mean of the dependent components ranges from 5.280 to 6.250 with overall mean of 5.853. The project portfolio management phase has the highest mean with a value of 6.250. This indicates that most respondents agree that in the project portfolio management phase a BI&A project will maximize their returns and minimize their costs. The coefficient of variation (CV) range within 12.9% and 19.8%.

Table 6.4: Descriptive statistics for dependent components

Variable	Mean	CV	Ethnicity			Experience			Role			Overall Rank
Dependent variables			Middle East	Asians	Others	0-3 years	3-8 years	more than 8 years	IT	Business	Others	
Front-end management	6.03	0.18	2	2	2	2	1	2	2	2	2	2
Project portfolio management	6.25	0.13	1	1	1	1	2	1	1	1	1	1
Project success	5.28	0.20	3	3	3	3	3	3	3	3	3	3

Front-end management

The mean of front-end management of BI&A projects is 6.030. This indicates that respondents, on average, agree that their organizations have performed front-end activities such as: initial evaluation for BI&A projects. The CV is 18% which is relatively low compared to the CVs of other variables. This means that most of the respondents had similar perceptions regarding front-end management of a BI&A project. Based on the mean, front-end management is ranked second by all ethnic groups. Respondents with 0-3 years of experience or more than 8 years of experience ranked front-end management as second while respondents with 3-8 years of experience ranked it as first. All groups of positions ranked front-end management as second. Overall, front-end management is ranked second against other dependent variables.

Project portfolio management

The mean of project portfolio management (PPM) where a BI&A project is compared to other projects is 6.250. This indicates that respondents, on average, agree that a BI&A project will help maximize the organizationś returns and minimize the costs. The CV of PPM is 13% which is relatively low compared to CVs of other factors. This means that respondents had consensus about their opinions regarding PPM of BI&A projects. Based on the mean, project portfolio management is ranked first by all ethnic groups. Respondents with 0-3 years of experience or more than 8 years of experience ranked project portfolio management as first while respondents with 3-8 years of experience ranked it as second. All groups of positions ranked project portfolio management as first. Overall, project portfolio management is ranked first against other dependent variables.

Project Success

The mean of project success is 5.280. This indicates that respondents, on average, agree somewhat that their organizations have successful BI&A project in terms of schedule, budget, and scope. The CV of project success is 20.% which is relatively high compared to the CVs of other factors. This means that respondents did not agree in their perceptions about a BI&A project success. Based on the mean, project success is ranked third by all ethnic groups, all experience groups, and all position groups. Overall, project success is ranked third against other dependent variables.

6.6.2 Overall descriptive analysis of independent components

The independent variables consist of three main clusters: Technology, Organization, Environment. The three clusters are explained below.

6.6.2.1 Overall descriptive analysis of Technology components

From table 6.5, the mean of the technology variables ranges from 3.800 to 6.053 with overall mean of 5.024. The advantage of a BI&A project has the highest mean with a value of 6.053. This indicates that most respondents agree that a BI&A project is advantageous to their organization.

Table 6.5: Descriptive statistics for technology cluster components

Variable	Mean	CV	Ethnicity			Experience			Role			Cluster rank	Overall Rank
Independent variables			Middle East	Asians	Others	0-3 years	3-8 years	more than 8 years	IT	Business	Others		
Complexity	3.80	0.45	13	14	14	14	14	13	14	13	14	4	14
Compatibility	5.63	0.16	9	4	4	4	7	6	8	5	5	2	6
Cost	4.61	0.26	12	12	12	12	12	12	12	11	12	3	11
Advantage	6.05	0.12	3	3	3	3	3	3	3	3	1	1	3

Complexity

The mean of complexity of BI&A projects is 3.800. This indicates that respondents, on average, disagree somewhat that a BI&A project is complex to their organization in terms of: being too complex for their employees to use. The CV is 45% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the complexity of a BI&A project. Based on the mean, complexity is ranked 13 out of 14 independent variables by Middle Eastern ethnic group, 14/14 by Asian ethnic group, and 14/14 by other ethnic groups. Respondents with 0-3 years of experience and 3-8 years of experience ranked complexity as 14/14 while respondents with more than 8 years of experience ranked it as 13/14. IT and other positions ranked complexity as 14/14 while business positions ranked it as 13/14. In the technology cluster, complexity is ranked last as 4/4. Overall, complexity is ranked 14 against other 14 independent variables.

Compatibility

The mean of compatibility of BI&A projects is 5.630. This indicates that respondents, on average, agree somewhat that a BI&A project is compatible with their organization in terms of: culture, work practices, and business values. The CV is 16% which is relatively low compared to the CVs of other variables. This means that most of the respondents had similar perceptions regarding the compatibility of a BI&A project. Based on the mean, compatibility is ranked 9 out of 14 independent variables by Middle Eastern ethnic group, and 4/14 by Asians and other ethnic groups. Respondents with 0-3 years of experience ranked compatibility as 4/14, respondents with 3-8 years of experience ranked it as 7/14, and respondents with more than 8 years of experience ranked it as 6/14. IT positions ranked compatibility as 8/14, and business and other positions ranked it as 4/14. In the technology cluster, compatibility is ranked second as 2/4. Overall, compatibility is ranked 6 against other 14 independent variables.

Cost

The mean of cost of BI&A projects is 4.613. This indicates that respondents, on average, are neutral about a BI&A project being costly to their organization in terms of: set up costs, running costs, and training costs. The CV is 26% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the cost of a BI&A project. Based on the mean, cost is ranked 12 out of 14 independent variables by all ethnic groups. Cost is also ranked 12/14 by all experience groups. IT and other positions ranked cost as 12/14 while business positions ranked it as 11/14. In the technology cluster, cost is ranked third as 3/4. Overall, cost is ranked 11 against other 14 independent variables.

Advantage

The mean of advantage of BI&A projects is 6.053. This indicates that respondents, on average, agree that a BI&A project is advantageous to their organization in terms of: increasing profitability, providing timely information, and improving the employees job performance. The CV is 12% which is relatively low compared to the CVs of other variables. This means that most of the respondents had similar perceptions regarding the advantage of a BI&A project. Based on the mean, advantage is ranked 3 out of 14 independent variables by all ethnic groups and all experience groups. IT and business positions ranked advantage as 3/14 while other positions ranked it as 1/4. In the technology cluster, advantage is ranked first as 1/4. Overall, advantage is ranked 3 against other 14 independent variables.

6.6.2.2 Overall descriptive analysis of Organization components

From table 6.6, the mean of the organization variables ranges from 5.213 to 6.315 with overall mean of 5.740. The culture of the organization has the highest mean with a value of 6.315. This indicates that most respondents agree that the culture of the organization is very important to the adoption a BI&A project.

Table 6.6: Descriptive statistics for organization cluster components

Variable	Mean	CV	Ethnicity			Experience			Role			Cluster rank	Overall Rank
Independent variables			Middle East	Asians	Others	0-3 years	3-8 years	more than 8 years	IT	Business	Others		
Infrastructure	5.52	0.21	7	6	9	7	8	7	7	10	6	6	8
Top management	6.22	0.13	2	2	1	1	2	2	2	2	2	2	2
Culture	6.32	0.11	1	1	2	2	1	1	1	1	2	1	1
Resources	5.21	0.21	11	11	10	11	11	11	9	12	11	7	10
Strategy	5.71	0.21	4	5	7	6	4	4	5	8	4	3	4
Experience	5.64	0.18	6	7	5	5	6	5	4	6	7	4	5
Project Management	5.57	0.20	5	8	8	8	5	8	6	7	8	5	7

Infrastructure

The mean of infrastructure of an organization is 5.520. This indicates that respondents, on average, agree somewhat that infrastructure of the organization is important to the adoption of a BI&A project in an organization in terms of: a good database, clean, and integrated data. The CV is 21% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the infrastructure of their organization. Based on the mean, infrastructure is ranked 7 out of 14 independent variables by Middle Eastern ethnic group, and 6/14 by Asian ethnic group, and 9/14 by other ethnic groups. Respondents with 0-3 years of experience and more than 8 years of experience ranked infrastructure as 7/14, and respondents with 3-8 years of experience ranked it as 8/14. IT positions ranked infrastructure as 7/14, business positions ranked it as 10/14, and other positions ranked it as 6/14. In the organization cluster, infrastructure is ranked sixth as 6/7. Overall, infrastructure is ranked 8 against other 14 independent variables.

Top management

The mean of top management of an organization is 6.215. This indicates that respondents, on average, agree that top management of the organization is important to the adoption of a BI&A project in an organization in terms of: interest and awareness in a BI&A project. The CV is 13% which is relatively low compared to the CVs of other variables. This means that most of the respondents had similar perceptions regarding the infrastructure of their organization. Based on the mean, top management is ranked 2 out of 14 independent variables by Middle Eastern and Asian ethnic groups while other ethnic groups rank top management 1/14. Respondents with 0-3 years of experience rank top management as 1/14 while other experience groups rank it as 2/14. All position groups rank top management as 2/14. In the organization cluster, top management is ranked second as 2/7. Overall, top management is ranked 2 against other 14 independent variables.

Culture

The mean of culture of an organization is 6.315. This indicates that respondents, on average, agree that culture of the organization is important to the adoption of a BI&A project in an organization in terms of access to good, reliable, relevant, and accurate data fast. The CV is 11% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the culture of their organization. Based on the mean, culture is ranked 1 out of 14 independent variables by Middle Eastern and Asian ethnic groups while other ethnic groups rank culture as 2/14. Respondents with 0-3 years of experience rank culture as 2/14 while respondents with 3-8 years of experience and more than 8 years of experience ranked culture as 1/14. IT and business positions ranked culture as 1/14 while other positions ranked it as 2/14. In the organization cluster, culture is ranked first as 1/7. Overall, culture is ranked 1 against other 14 independent variables.

Resources

The mean of resources of an organization is 5.213. This indicates that respondents, on average, agree somewhat that having resources in the organization is important to the adoption of a BI&A project in terms of: time, funding, and human resources. The CV is 21% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the resources of their organization. Based on the mean, resources is ranked 11 out of 14 independent variables by Middle Eastern and Asian ethnic groups while other ethnic groups rank it as 10/14. All groups of experience rank resources as 11/14. IT positions rank resources 9/14, business positions rank resources as 12/14, while other positions rank it as 11/14. In the organization cluster, resources is ranked last as 7/7. Overall, resources is ranked 10 against other 14 independent variables.

Strategy

The mean of strategy of an organization is 5.707. This indicates that respondents, on average, agree somewhat that strategy of the organization is important to the adoption of a BI&A project in an organization in terms of: continuous assessment of technologies in information systems planning, constantly involving information systems management in business planning, and aligning a BI&A project with the company goals. The CV is 21% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the strategy of their organization. Based on the mean, strategy is ranked 4 out of 14 independent variables by Middle Eastern ethnic group, and 5/14 by Asian ethnic group, and 6/14 by other ethnic groups. Respondents with 0-3 years of experience rank strategy as 6/14 while respondents with 3-8 years of experience and more than 8 years of experience ranked strategy as 4/14. IT positions ranked strategy as 5/14, business positions ranked it as 8/14, and other positions ranked it as 4/14. In the organization cluster, strategy is ranked third as 3/7. Overall, strategy is ranked 4 against other 14 independent variables.

Experience

The mean of experience of an organization is 5.638. This indicates that respondents, on average, agree somewhat that experience of the organization is important to the adoption of a BI&A project in an organization in terms of: implementing a lot of new technologies in the last three years, having a high level of investment in technology, having necessary knowledge to learn and build a BI&A project, and having a previous experience compatible with a BI&A project. The CV is 18% which is relatively low compared to the CVs of other variables. This means that most of the respondents had similar perceptions regarding the experience of their organization. Based on the mean, experience is ranked 6 out of 14 independent variables by Middle Eastern ethnic group, and 7/14 by Asian ethnic group, and 5/14 by other ethnic groups. Respondents with 0-3 years of experience and more than 8 years of experience rank experience as 5/14 while respondents with 3-8 years of experience ranked it as 6/14. IT positions ranked strategy as 4/14, business positions ranked it as 6/14, and other positions ranked it as 7/14. In the organization cluster, strategy is ranked fourth as 4/7. Overall, strategy is ranked 5 against other 14 independent variables.

Project management

The mean of project management of an organization is 5.570. This indicates that respondents, on average, agree somewhat that project management of the organization is important to the adoption of a BI&A project in an organization in terms of: having a good project manager and managing a BI&A project well. The CV is 20% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the project management of their organization. Based on the mean, project management is ranked 5 out of 14 independent variables by Middle Eastern ethnic group, and 8/14 by Asian ethnic group and other ethnic groups. Respondents with 0-3 years of experience and more than 8 years of experience rank project management as 8/14 while respondents with 3-8 years of experience ranked it as 5/14. IT positions ranked project management as 6/14, business positions ranked it as 7/14, and other positions ranked it as 8/14. In the organization cluster, project management is ranked fifth as 5/7. Overall, project management is ranked 7 against other 14 independent variables.

6.6.2.3 Overall descriptive analysis of Environment components

From table 6.7, the mean of the environment variables ranges from 3.935 to 5.367 with overall mean of 4.514. The competition in the environment has the highest mean with a value of 5.367. This indicates that most respondents agree that the competition in the environment has a high impact on the adoption of a BI&A project in the organization.

Table 6.7: Descriptive statistics for environment cluster components

Variable	Mean	CV	Ethnicity			Experience			Role			Cluster rank	Overall Rank
Independent variables			Middle East	Asians	Others	0-3 years	3-8 years	more than 8 years	IT	Business	Others		
Competition	5.37	0.22	10	9	6	9	10	9	11	4	9	1	9
Vendor Support	4.24	0.26	8	10	11	10	9	10	10	9	10	2	12
Government	3.94	0.36	14	13	13	13	13	14	13	14	13	3	13

Competition

The mean of competition in the environment is 5.367. This indicates that respondents, on average, agree somewhat that competition in the environment impacts the adoption of a BI&A project in an organization in terms of: having a competitive disadvantage if the organization does not adopt a BI&A project, being a factor in deciding to adopt a BI&A project in the organization, being pressured by the industry to adopt a BI&A project in the organization. The CV is 22% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the competition in the environment. Based on the mean, competition is ranked 10 out of 14 independent variables by Middle Eastern ethnic group, and 9/14 by Asian ethnic group,and 6/14 by other ethnic groups. Respondents with 0-3 years of experience and more than 8 years of experience rank competition as 9/14 while respondents with 3-8 years of experience ranked it as 10/14. IT positions ranked competition as 11/14, business positions ranked it as 4/14, and other positions ranked it as 9/14. In the environment cluster, competition is ranked first as 1/3. Overall, competition is ranked 9 against other 14 independent variables.

Vendor support

The mean of vendor support in the environment is 4.240. This indicates that respondents, on average, are neutral that vendor support in the environment impacts the adoption of a BI&A project in an organization in terms of: the vendor being knowledgeable in BI&A projects, providing adequate training and support, and establishing trust with the organization. The CV is 26% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding vendor support. Based on the mean, vendor support is ranked 8 out of 14 independent variables by Middle Eastern ethnic group, 10/14 by Asian ethnic group,and 11/14 by other ethnic groups. Respondents with 0-3 years of experience and more than 8 years of experience rank competition as 10/14 while respondents with 3-8 years of experience ranked it as 9/14. IT and other positions ranked vendor support as 10/14 while business positions ranked it as 9/14. In the environment cluster, vendor support is ranked second as 2/3. Overall, vendor support is ranked 12 against other 14 independent variables.

Government

The mean of government in the environment is 3.935. This indicates that respondents, on average, disagree somewhat that government in the environment impacts the adoption of a BI&A project in an organization in terms of: the government providing progressive measures for organizations to adopt a BI&A project or pressuring organization to adopt a BI&A project. The CV is 36% which is relatively high compared to the CVs of other variables. This means that most of the respondents had different perceptions regarding the complexity of a BI&A project. Based on the mean, government is ranked 14 out of 14 independent variables by Middle Eastern ethnic group, and 13/14 by Asian and other ethnic groups. Respondents with 0-3 years of experience and 3-8 years of experience rank government as 13/14 while respondents with more than 8 years of experience ranked it as 14/14. IT and other positions ranked government as 13/14 while business positions ranked it as 14/14. In the environment cluster, government is ranked last as 3/3. Overall, government is ranked 13 against other 14 independent variables.

6.6.2.4 Overall ranking of all independent variables

Looking at the overall ranking of all independent variables, culture is the most important variable in impacting the adoption of a BI&A project. This means that organizations with a culture that seeks access to good, reliable, relevant, and accurate data fast drive the adoption of a BI&A project in an organization. The following variables follow: top management of the organization, advantage of a BI&A project, strategy of the organization, experience of the organization, compatibility of a BI&A project, project management of the organization, infrastructure of the organization, competition of the environment, resources of the organization, cost of a BI&A project, vendor support of the environment, government, complexity of a

BI&A project. Complexity is the least important variable in impacting the adoption of a BI&A project. This means that the complexity of a BI&A project does not really impact the adoption of a BI&A project in an organization.

6.7 Normality tests

In order to prepare for further analysis, the data is tested for normality tests. It is important to conduct other tests to confirm normality. Shapiro-Wilk test is chosen as it is the most powerful normality test (Razali et al. 2011). Shapiro-Wilk test utilizes the null hypothesis that states that: the population is normally distributed. If the p-value is less than the 5% significance, the null hypothesis is rejected and the data is not from a normally distributed population (Field 2013). The results of the Shapiro-Wilk test are shown in table 6.8. Based on the significance, none of the variables follow a normal distribution. Therefore, all tests requiring a normal distribution assumption such as one-way ANOVA will be substituted with non-parametric tests (Razali et al. 2011).

6.8 Summary

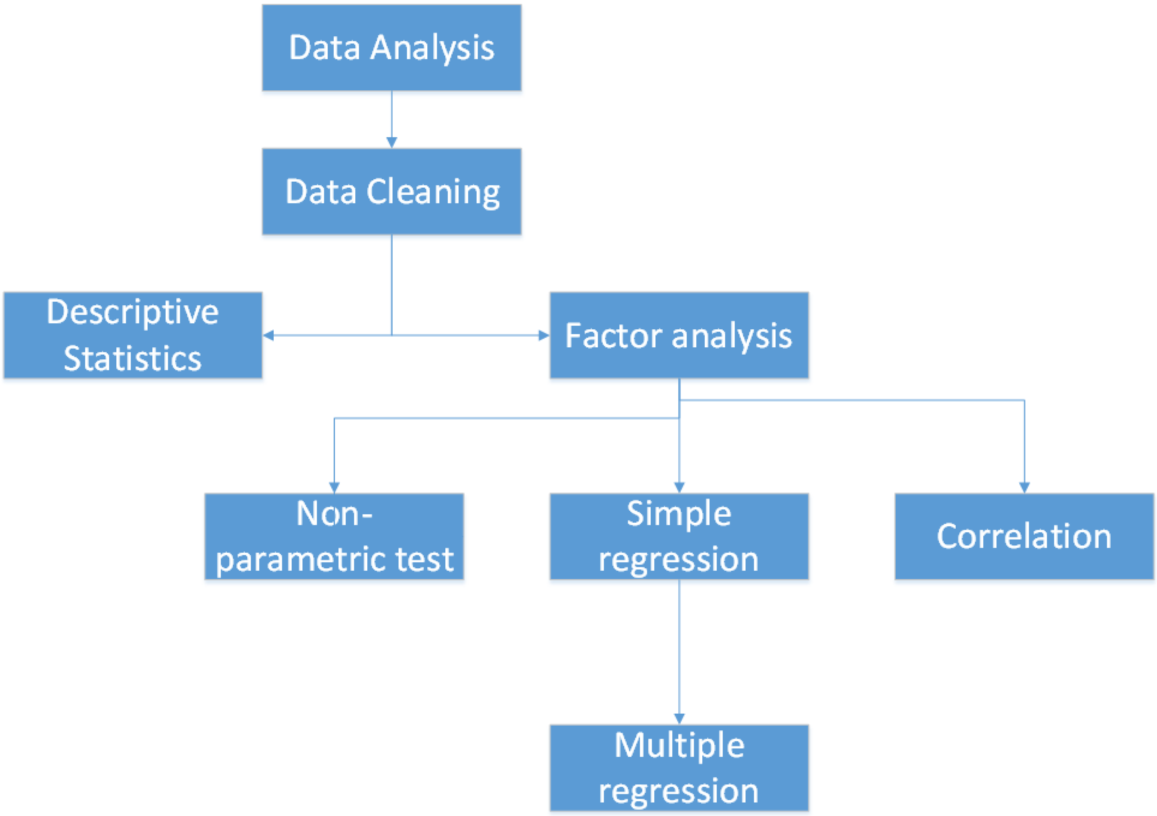
This chapter provided the process to conduct and present descriptive statistics for the data. In preparation for further tests, normality test is conducted. As depicted in figure 6.9, the next chapters will discuss: (1) factor analysis to reduce the number of variables, (2) non-parametric tests to examine if there are differences in perceptions

Table 6.8: Normality test results

Variable	Shapiro-Wilk Significance
Independent Variables	
Front-end management	0.000
Project portfolio management	0.000
Project success	0.000
Dependent Variables	
Technology	
Complexity	0.000
Compatibility	0.000
Cost	0.008
Advantage	0.000
Organization	
Infrastructure	0.000
Top management	0.000
Culture	0.000
Resources	0.000
Strategy	0.000
Experience	0.000
Project Management	0.000
Environment	
Competition	0.000
Vendor Support	0.001
Government	0.004

between respondents in different positions and respondents with different experiences, (3) correlation to examine if there are relations between the independent and dependent variables, and (4) regression to examine if there is are impacts between the independent and dependent variables.

Figure 6.9: Data analysis process



7-FACTOR ANALYSIS

7.1 Introduction

This research is interested in studying the adoption of BI&A projects in organizations in the UAE and Gulf region. Therefore, it is important to identify the factors that increase the likelihood of adopting a BI&A project in an organization.

The process of factor analysis is highly used in the literature of technology adoption. Lin (2014), Pan & Jang (2008), and Kuan & Chau (2001) used similar techniques to what is discussed in this chapter such as principal component analysis, varimax rotation, and rotation convergent matrix. Many studies have identified the factors that impact the adoption of technology projects in organizations (Lin 2014). Identifying the factors that impact the adoption of a BI&A project in an organization is important to improve the likelihood of adopting a BI&A project in an organization. Failure to identify these factors contributes to the non-adoption of a BI&A project in an organization.

The purpose if this chapter is to explain factor analysis as a data reduction technique used to reduce a large number of variables into a smaller set that accounts for most of the variance in the original variables. That is, factor analysis is used to extract appropriate number of components that explain the variance among the items (Feldmann 2007).

This chapter explains factor analysis in relation to this data. As discussed earlier, there are three dependent variables: Front-end, PPM, Project success, and three main clusters of independent variables: Technology, Organization, Environment. The three clusters of independent variables consist of four, seven, and three variables, respectively. Factor analysis attempts to reduce those 14 variables into fewer ones that explain most of the variance.

After describing the main methods that will be used in factor analysis, the rest of the section will apply those methods to independent variables. As independent variables consist of three main clusters: technology, organization, and environment, with a total of 14 variables and 38 items, factor analysis is applicable to reduce the number of variables. Dependent variables are only three variables with 5 items. This eliminates the need for factor analysis as there is no large number of variables to be reduced.

It is also important to conduct factor analysis to reduce the problem of multicollinearity as it combines variables that correlate with each other (Lee & Lings 2008). Multicollinearity is a a problem in multiple regression which is conducted in a later chapter in this research (Field 2013).

Therefore, in order to ease analysis by reducing the number of variables and eliminating the problem of multicollinearity, factor analysis is important and is explained in this chapter.

7.2 Factor analysis process

Factor analysis is conducted using SPSS software. First, the appropriateness of factor analysis is examined using Bartlettś test of sphericity and KMO. Next, the methods of eigen values and scree plots are used to indicate the number of components. After that, the techniques used in factor analysis, such as principal component analysis and rotated convergence matrix using varimax algorithm, are explained.

Analysis is conducted using SPSS software package by computing the correlations and categorizing the factors according to their relationships with each other. Data reduction resulted in reducing the three independent clusters into a few components. After conducting factor analysis, the 10 items of the technology cluster are reduced to four components (complexity, compatibility, cost, and advantage), the 19 items of the organization cluster are reduced to six components (infrastructure, top management, culture, resources, experience, and project management), and the 9 items of the environment cluster are reduced to three components (competition, vendor support, and government).

The main result from factor analysis is the elimination of the strategy variable from the organization cluster as it did not load highly on any of the components. Further details are discussed later in this chapter.

7.2.1 Appropriateness of factor analysis

The first step in factor analysis is to check the correlation matrix. This step is important to examine if every variable is strongly correlated with other variables. That is, every variable should correlate with at least one other variable where $r \geq 0.3$.

Kaiser-Meyer-Olkin (KMO) index examines the correlation between variables. A high KMO index (approximately close to 1) indicates that there is correlation between the variables and that the data is fit for factor analysis (Kaiser 1974). If however the KMO index is low (approximately close to 0), this indicates that there is no correlation between the variables and that the data is NOT fit for factor analysis (Field 2013). Kaiser recommends the following, KMO index between 0.5 and 0.7 are good, between 0.7 and 0.8 are great, and above 0.8 are superb (Hair et al. 2006).

Bartletts̈ test of sphericity is used to check the appropriateness of factor analysis with our data. This test examines the hypothesis that there are no correlations between any of the variables (Bartlett 1937). If the significance reported is $p < 0.005$, the null hypothesis is rejected. This means that there are correlations between the variables and the data is fit for factor analysis.

7.2.2 Number of components

Principal component analysis (PCA) is used for extraction of components (Gelman et al. 2014). Basically, PCA is a statistical method that transforms a set of possible correlated variables into a set of uncorrelated variables. The new variables are called principle components. PCA assumes linear relationship between the variables which is established through KMO index.

The number of components is determined by examining eigenvalues of the components. Eigenvalues explain the variance accounted for by a certain variable and should typically be greater than or equal to 1 (Yuan & Bentler 1998).

The number of components can be visually confirmed by examining the inflection point in the scree plot. The scree plot has the number of dimensions on the x-axis and the eigenvalues on the y-axis (Cattell 1966).

7.2.3 Rotation of components

Rotated convergence matrix is typically used to create a simple structure where an item loads highly on one component. Some of the famous rotation algorithms are varimax, promax, and oblimin (Thurstone 1947). Varimax algorithm does not always meet the simple structure, which means a lot of subjective analysis would be required (Osborne & Costello 2009). However, many authors prefer varimax algorithm because it is simple to interpret (Reise et al. 2000) such as in the work of Ramamurthy et al. (2008*b*).

After describing the main methods that will be used in factor analysis, the rest of the section will apply those methods to independent variables.

7.3 Analysis and findings:Independent variables

This section explains the process of factor analysis in application to independent variables that consist of three main clusters: technology, organization, and environment. Technology cluster is measured using four variables and 10 items, organization cluster is measured using seven variables and 19 items, and environment cluster is measured using three variables and nine items.

By examining the correlation matrix, all items correlate with other items at $r \geq 0.3$. The overall KMO measure is 0.717 and Bartlett test of sphericity is significant $(p < .000)$. This indicates that factor analysis is appropriate for independent variables.

7.3.1 Analysis and findings: technology cluster

First, the technology cluster is composed of four variables: complexity, compatibility, cost, and advantage. Complexity variable is measured using one item, compatibility variable is measured using three items, cost variable is measured using three items, and advantage variable is measured using 3 items.

7.3.1.1 Appropriateness of factor analysis

By examining the correlation matrix, all items correlate with other items at $r \geq 0.3$. The overall KMO measure is 0.692 and Bartlett test of sphericity is significant ($p < .000$). This indicates that the factor analysis is appropriate for the technology cluster variables.

7.3.1.2 Number of components

Table 7.1 shows that the components are extracted using principle component analysis. The first column in the table shows the components. The next three columns show the initial eigenvalues for the components. The components with eigen values greater than 1 are to be remained and the components with eigen values less than 1 are to be eliminated. Based on the table, the eigen values indicate three components to be included that explain 65.8% of the variance as shown in the cumulative % column.

Table 7.1: Total variance explained-Technology cluster

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.235	32.350	32.350	3.235	32.350	32.350	2.262	22.624	22.624
2	2.196	21.955	54.305	2.196	21.955	54.305	2.258	22.576	45.200
3	1.147	11.469	65.774	1.147	11.469	65.774	2.057	20.574	65.774
4	.943	9.433	75.208						
5	.642	6.418	81.626						
6	.518	5.180	86.806						
7	.485	4.851	91.657						
8	.342	3.424	95.081						
9	.270	2.702	97.783						
10	.222	2.217	100.000						

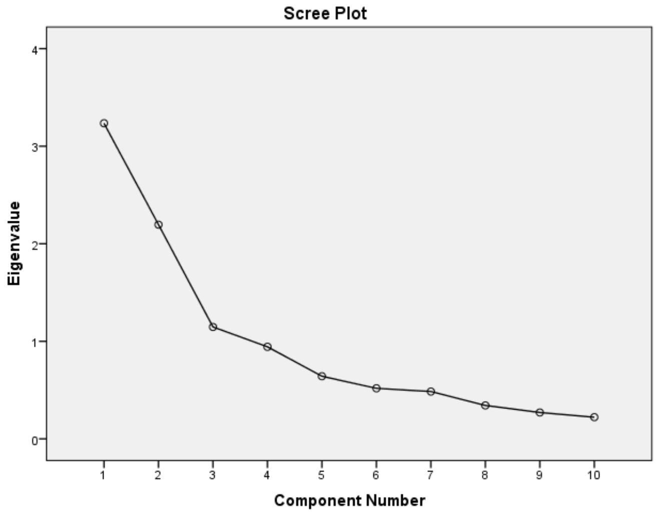
Extraction Method: Principal Component Analysis.

The three components are confirmed through visual inspection of the scree plot. Graphically, it can be seen that the inflection point happens at three components as shown in figure 7.1.

7.3.1.3 Rotation of components

By examining the rotated matrix in table 7.2, items with high loading (above 0.5) and common information are grouped together. The component is then titled with a name that represents the characteristics of the grouped items (Hair et al. 2006). The rotated matrix suggests the following: (1) component 1 to be named as cost and includes the following items: cost_1, cost_2, and cost_3, (2) component 2 to be named as advantage and includes the following items: advantage_1, advantage_2, advantage_3, and (3) component 3 to be named as compatibility and includes the following items: compatibility_1, compatibility_2, and compatibility_3.

Figure 7.1: Scree plot for the technology cluster



Despite the fact that the eigen value for the fourth component is less than 1, including it will increase the % of variance explained from 65.8% to 75.2%. Therefore, complexity_1 is considered as a separate component.

7.3.1.4 Main findings of factor analysis: technology cluster

Applying factor analysis to the technology cluster reduced the questionnaire 10 items to to 4 components which are shown in table 7.12. The table also shows the eigen values, percentage of variance for each component, loading score, and the description of the item.

Table 7.2: Rotated component matrix-technology cluster

Rotated Component Matrixa

	Component		
	1	2	3
complexity_2	.367	-.414	-.002
advantage_1	-.041	.700	.306
advantage_2	.129	.859	.166
advantage_3	.021	.732	.105
compatibility_1	-.040	.005	.908
compatibility_2	-.051	.314	.817
compatibility_3	-.155	.455	.642
cost_1	.826	.117	-.129
cost_2	.865	-.033	-.062
cost_3	.806	-.041	-.007

Table 7.3: Factor analysis - technology cluster

Item	Eigenvalue	Extraction sum of squared loadings: variance	Rotation sum of squared loadings: variance	Item loading score	Item code	Item description
1	3.235	32.35	22.624	0.826	cost_1	high setup costs
				0.865	cost_2	high running costs
				0.806	cost_3	high training costs
2	2.196	21.955	22.576	0.700	advantage_1	increase profitability
				0.859	advantage_2	provide timely information
				0.732	advantage_3	improve employee job performance
3	1.147	11.469	20.574	0.908	compatibility_1	compatibility with culture
				0.817	compatibility_2	compatibility with work practices
				0.642	compatibility_3	compatibility with business values
4	0.943	9.433	N/A	N/A	complexity_1	Skills are too complex

7.3.2 Analysis and findings: organization cluster

The organization cluster is composed of seven variables: infrastructure, top management, culture, resources, strategy, experience, and project management. Infrastructure variable is measured using two items, top management variable is measured using two items, culture variable is measured using three items, resources variable is measured using three items, strategy variable is measured using three items, experience variable is measured using four items, and project management variable is measured using two items.

7.3.2.1 Appropriateness of factor analysis

By examining the correlation matrix, all items correlate with other items at $r \geq 0.3$. The overall KMO measure is 0.809 and Bartlett test of sphericity is significant $(p < .000)$. This indicates the factor analysis is appropriate for the organization cluster variables.

7.3.2.2 Number of components

Table 7.4 shows the components are extracted using principle component analysis. The first column in the table shows the components. The next three columns show the initial eigenvalues for the components. The components with eigen values greater than 1 are to be remained and the components with eigen values less than 1 are to be eliminated. Based on the table, the eigen values indicate six components to be included that explain 78.5% of the variance as shown in the cumulative % column.

The six components are confirmed through visual inspection of the scree plot. Graphically, it can be seen that the inflection point happens at three components as shown in figure 7.2.

Table 7.4: Total variance explained-organization cluster

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.764	40.863	40.863	7.764	40.863	40.863	3.390	17.842	17.842
2	1.957	10.299	51.162	1.957	10.299	51.162	3.079	16.206	34.048
3	1.483	7.806	58.968	1.483	7.806	58.968	2.531	13.319	47.366
4	1.361	7.161	66.129	1.361	7.161	66.129	2.322	12.221	59.588
5	1.270	6.685	72.815	1.270	6.685	72.815	1.916	10.086	69.674
6	1.082	5.694	78.509	1.082	5.694	78.509	1.679	8.836	78.509
7	.711	3.741	82.250						
8	.684	3.599	85.849						
9	.563	2.961	88.810						
10	.381	2.005	90.815						
11	.334	1.756	92.571						
12	.292	1.538	94.110						
13	.237	1.247	95.357						
14	.222	1.168	96.525						
15	.183	.963	97.488						
16	.148	.779	98.267						
17	.130	.682	98.949						
18	.114	.598	99.547						
19	.086	.453	100.000						

Extraction Method: Principal Component Analysis.

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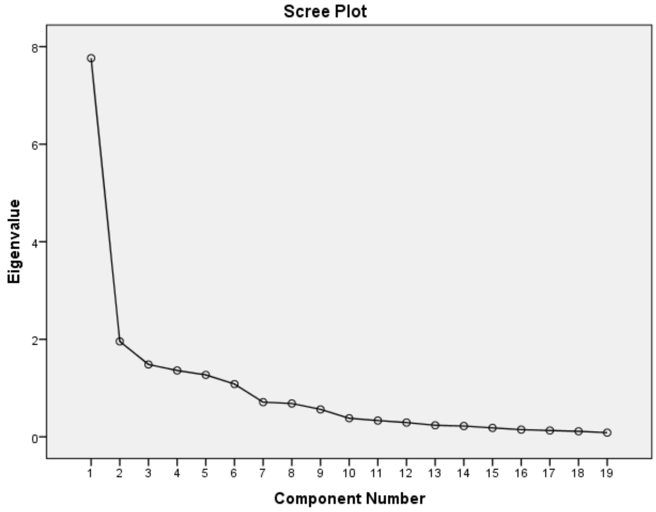
7.3.2.3 Rotation of components

By examining the rotated matrix in table 7.5, items with high loading (above 0.4) and common information are grouped together. The component is then titled with a name that represents the characteristics of the grouped items (Hair et al. 2006). The rotated matrix suggests the following: , (1) component 1 to be named as experience and includes the following items: experience_1, experience_2, experience_3, and experience_4, (2) component 2 to be named as infrastructure and includes the following items: infrastructure_1, infrastructure_2, infrastructure_3, resources_3, and strategy_1 (3) component 3 to be named as strategy & project management and includes the following items: strategy_2, projectManagement_1, and projectManagement_2, (4) component 4 to be named as top management and includes the following items: topManagement_1, topManagement_2, and strategy_3, (5) component 5 to be named as resources and includes the following items: resources_1 and resources_2, and (6) component 6 to be named as culture and includes the following items: culture_1 and culture_2.

Figure 7.2: Scree plot for the organization cluster



7.3.2.4 Main findings of factor analysis: organization cluster

Applying factor analysis to the organization cluster reduced the questionnaire 19 items to to 6 components which are shown in table 7.6. The table also shows the eigen values, percentage of variance for each component, loading score, and the description of the item.

Table 7.5: Rotated Component Matrixa-organization cluster

Rotated Component Matrixa

	Component					
	1	2	3	4	5	6
infrastructure_1	.563	.546	.057	.027	.304	.174
infrastructure_2	.093	.850	.076	.015	.131	.001
infrastructure_3	.129	.895	.084	.041	.173	.075
topManagement_1	.063	-.007	.050	.862	.178	.122
topManagement_2	.151	.073	.084	.865	.149	.142
culture_1	.235	-.108	.142	.085	.086	.851
culture_2	.003	.169	.020	.166	-.063	.876
resources_1	.136	.216	.282	.081	.787	-.061
resources_2	.254	.141	.082	.230	.802	.069
resources_3	.392	.510	.156	.114	.359	.001
strategy_1	.410	.532	.448	.348	-.201	-.104
strategy_2	.246	.519	.539	.382	-.147	-.058
strategy_3	.453	.218	.405	.586	-.041	.060
experience_1	.850	.138	.161	.199	.149	.037
experience_2	.893	.105	.164	.096	.177	.107
experience_3	.673	.265	.329	.209	.196	.204
experience_4	.482	.416	.493	.006	.046	.073
projectManagement_1	.269	.032	.753	.082	.346	.158
projectManagement_2	.126	.104	.865	.100	.207	.075

Table 7.6: Factor analysis-organization cluster

Item	Eigenvalue	Extraction sum of squared loadings: variance	Rotation sum of squared loadings: variance	Item loading score	Item code	Item description
1	7.764	40.863	17.842	0.85	experience_1	experience with technology
				0.893	experience_2	high technology investment
				0.673	experience_3	necessary knowledge
2	1.957	10.299	16.206	0.546	infrastructure_1	good database
				0.85	infrastructure_2	clean data
				0.895	infrastructure_3	data integrity
				0.51	resources_3	good IT personnel
				0.532	strategy_1	continuous assessment of technologies
3	1.483	7.806	13.319	0.539	strategy_2	involvement of IS management
				0.753	projectManagement_1	good project manager
				0.865	projectManagement_2	project is managed well
4	1.361	7.161	12.221	0.862	topManagement_1	interest in BI&A projects
				0.865	topManagement_2	awareness of BI&A projects
				0.586	strategy_3	alignment of BI&A projects with strategy
5	1.27	6.685	10.086	0.787	resources_1	time resources
				0.802	resources_2	funding resources
6	1.082	5.694	8.836	0.851	culture_1	access to reliable information
				0.876	culture_2	access to information fast

7.3.3 Analysis and findings: environment cluster

The environment cluster is composed of three variables: competition, vendor support, and government support. Competition variable is measured using three items, vendor support variable is measured using four items, and government variable is measured using two items.

7.3.3.1 Appropriateness of factor analysis

By examining the correlation matrix, all items correlate with other items at $r \geq 0.3$. The overall KMO measure is 0.720 and Bartlett test of sphericity is significant $(p < .000)$. This indicates the factor analysis is appropriate for the environment cluster variables.

7.3.3.2 Number of components

Table 7.7 shows the components are extracted using principle component analysis. The first column in the table shows the components. The next three columns show the initial eigenvalues for the components. The components with eigen values greater than 1 are to be remained and the components with eigen values less than 1 are to be eliminated. Based on the table, the eigen values indicate three components to be included that explain 77.2% of the variance as shown in the cumulative % column.

Table 7.7: Total variance explained: environment cluster

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.296	36.621	36.621	3.296	36.621	36.621	3.092	34.350	34.350
2	2.042	22.694	59.314	2.042	22.694	59.314	2.168	24.085	58.435
3	1.608	17.871	77.185	1.608	17.871	77.185	1.687	18.750	77.185
4	.575	6.392	83.578						
5	.399	4.438	88.016						
6	.374	4.153	92.169						
7	.324	3.597	95.767						
8	.253	2.811	98.577						
9	.128	1.423	100.000						

Extraction Method: Principal Component Analysis.

The three components are confirmed through visual inspection of the scree plot. Graphically, it can be seen that the inflection point happens at three components as shown in figure 7.3.

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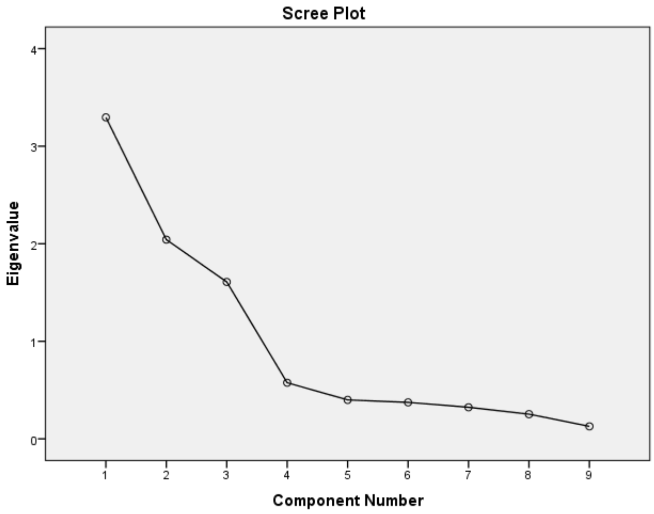
Figure 7.3: Scree plot for the environment cluster



7.3.3.3 Rotation of components

By examining the rotated matrix in table 7.10, items with high loading (above 0.4) and common information are grouped together. The component is then titled with a name that represents the characteristics of the grouped items (Hair et al. 2006). The rotated matrix suggests the following: , (1) component 1 to be named as vendor support and includes the following items: vendorSupport_1, vendorSupport_2, vendorSupport_3, and vendorSupport_4, (2) component 2 to be named as competition and includes the following items: competition_1, competition_2, and competition_3, (3) component 3 to be named as government and includes the following items: government_1 and government_2.

7.3.3.4 Main findings of factor analysis: environment cluster

Applying factor analysis to the organization cluster reduced the questionnaire 9 items to to 3 components which are shown in table 7.9. The table also shows the

Table 7.8: Rotated component matrix-environment cluster

Rotated Component Matrixa

	Component		
	1	2	3
competition_1	.083	.791	-.110
competition_2	.140	.882	.097
competition_3	.005	.836	.152
vendorSupport_1	.840	.153	-.052
vendorSupport_2	.885	.092	-.037
vendorSupport_3	.933	.142	.011
vendorSupport_4	.836	-.088	.129
government_1	.077	.037	.894
government_2	-.046	.068	.907

eigen values, percentage of variance for each component, loading score, and the description of the item.

Table 7.9: Factor analysis-environment cluster

Item	Eigenvalue	Extraction sum of squared loadings: variance	Rotation sum of squared loadings: variance	Item loading score	Item code	Item description
1	3.296	36.621	34.35	0.840	vendorSupport_1	our vendor is very knowledgeable in data analytics
				0.885	vendorSupport_2	the vendor provides adequate training
				0.933	vendorSupport_3	the vendor provides adequate support
				0.836	vendorSupport_4	our firm trusts the vendor
2	2.042	22.694	24.085	0.791	competition_1	a competitive disadvantage
				0.882	competition_2	competition is a factor
				0.836	competition_3	industry pressure
3	1.608	17.871	18.75	0.894	government_1	progressive measures
				0.907	government_2	pressure by government

7.4 Analysis and findings: realizing new components

It is interesting to examine whether new components would arise if all data is plugged in to factor analysis together rather than plugging each cluster alone: technology, organization, environment. This is an important procedure to do as perhaps some variables might be deleted or merged with other variables. As a rule of thumb, variables with a $+$ or $-$ 0.5 loading or higher is desirable to consider the component (Hair et al. 2006).

7.4.1 Appropriateness of factor analysis

By examining the correlation matrix, all items correlate with other items at $r \geq 0.3$. The overall KMO measure is 0.717 and Bartlett test of sphericity is significant ($p < .000$). This indicates the factor analysis is appropriate for the technology cluster variables.

7.4.2 Number of components

Table 7.10 shows the components are extracted using principle component analysis. The first column in the table shows the components. The next three columns show the initial eigenvalues for the components. The components with eigen values greater than 1 are to be remained and the components with eigen values less than 1 are to be eliminated. Based on the table, the eigen values indicate 11 components to be included that explain 76.1% of the variance as shown in the cumulative % column.

The eleven components are confirmed through visual inspection of the scree plot. Graphically, it can be seen that the inflection point happens at 11 components as shown in figure 7.4.

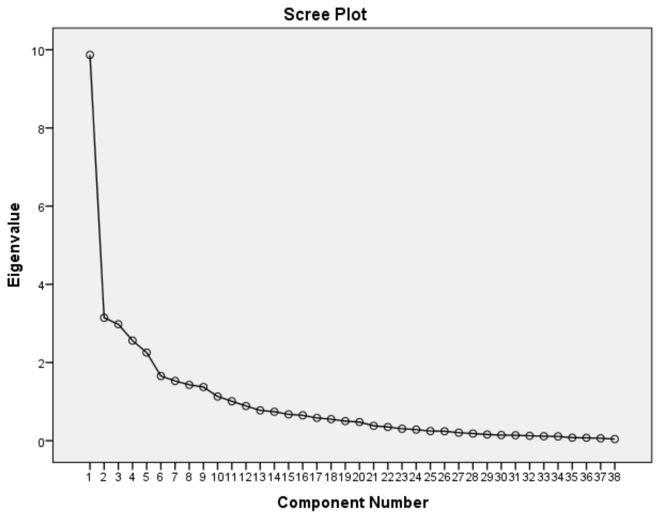
Table 7.10: Total variance explained: all variables together

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.868	25.970	25.970	9.868	25.970	25.970	4.101	10.793	10.793
2	3.145	8.276	34.245	3.145	8.276	34.245	3.270	8.605	19.397
3	2.978	7.838	42.083	2.978	7.838	42.083	3.169	8.338	27.736
4	2.561	6.739	48.822	2.561	6.739	48.822	2.918	7.678	35.413
5	2.253	5.930	54.752	2.253	5.930	54.752	2.699	7.102	42.515
6	1.654	4.353	59.104	1.654	4.353	59.104	2.413	6.350	48.865
7	1.528	4.021	63.126	1.528	4.021	63.126	2.313	6.086	54.951
8	1.428	3.758	66.884	1.428	3.758	66.884	2.211	5.818	60.770
9	1.373	3.613	70.497	1.373	3.613	70.497	2.206	5.806	66.576
10	1.131	2.975	73.472	1.131	2.975	73.472	1.864	4.905	71.481
11	1.008	2.653	76.125	1.008	2.653	76.125	1.765	4.644	76.125
12	.888	2.337	78.462						
13	.775	2.041	80.503						
14	.740	1.947	82.450						
15	.673	1.771	84.221						
16	.649	1.708	85.929						
17	.582	1.531	87.461						
18	.551	1.450	88.910						
19	.500	1.316	90.226						
20	.477	1.256	91.482						
21	.381	1.003	92.485						
22	.350	.921	93.405						
23	.304	.801	94.206						
24	.283	.745	94.952						
25	.246	.647	95.599						
26	.242	.636	96.235						
27	.205	.539	96.774						
28	.183	.481	97.255						
29	.159	.418	97.673						
30	.143	.376	98.049						
31	.139	.366	98.415						
32	.126	.331	98.746						
33	.114	.301	99.047						
34	.110	.289	99.336						
35	.077	.203	99.539						
36	.074	.194	99.733						
37	.061	.160	99.893						
38	.041	.107	100.000						

7.4.3 Rotation of components

By examining the rotated matrix in table 7.11, items with high loading (above 0.5) and common information are grouped together. The component is then titled with a name that represents the characteristics of the grouped items (Hair et al. 2006). The rotated matrix suggests the following: , (1) component 1 to be named as experience & compatibility and includes the following items: compatibility_1, experience_1, experience_2, experience_3, and experience_4, (2) component 2 to be named as vendor support and includes the following items: vendorSupport_1, vendorSupport_2, vendorSupport_3, and vendorSupport_4 (3) component 3 to be named as infrastructure& personnel and includes the following items: infrastructure_1, infrastructure_2, infrastructure_3, and resources_3, (4) component 4 to be named as advantage & compatibility and includes the following items: advantage_1, advantage_2, advantage_3, compatibility_2, and compatibility_3, (5) component 5 to be named as strategy & project management and includes the following items: strategy_1, strategy_2, projectManagement_1, and projectManagement_2, (6) component 6 to be named as cost and includes the following items: cost_1, cost_2, and cost_3, (7) component 7 to be named as competition and includes the following items: competition_1, competition_2, and competition_3, (8) component 8 to be named as top management and alignment and includes the following items: topManagement_1, topManagement_2, and strategy_3, (9) component 9 to be named as resources and includes the following items: resources_1 and resources_2, (10) component 10 to be named as government and includes the following items: government_1 and govern-

Figure 7.4: Scree plot for all variables together



ment_2, and (11) component 11 to be named as culture and includes the following items: culture_1 and culture_2.

7.4.4 Main findings of factor analysis: all variables together

Applying factor analysis to all the variables reduced the questionnaire 38 items to to 11 components which are shown in table 7.12. The table also shows the eigen values, percentage of variance for each component, loading score, and the description of the item.

Table 7.11: Rotated Component Matrixa-all variables together

Rotated Component Matrixa

	Component										
	1	2	3	4	5	6	7	8	9	10	11
complexity_2	-.342	.055	.021	-.073	-.011	.234	.177	-.071	-.453	.201	-.192
advantage_1	.172	.044	.026	.701	.002	-.013	.168	.270	.078	-.055	-.041
advantage_2	.177	-.062	-.153	.676	.088	.171	.036	.183	.251	-.135	.265
advantage_3	-.190	.079	.160	.735	.089	.019	.106	.123	.090	-.026	.142
compatibility_1	.663	.016	.074	.323	.150	-.130	.150	-.042	-.178	.121	.050
compatibility_2	.545	-.022	.270	.537	.211	-.099	.067	-.095	-.073	-.072	.058
compatibility_3	.359	-.017	.018	.684	.095	-.217	.016	.099	-.120	.029	.105
cost_1	-.025	-.069	-.108	-.061	.099	.823	.005	.007	-.025	-.100	.276
cost_2	-.058	-.101	.087	-.060	.050	.854	.042	-.048	-.094	.062	.055
cost_3	-.002	-.125	.030	.059	-.078	.785	-.034	.034	-.116	.071	-.213
infrastructure_1	.546	.181	.578	.019	.013	.070	.028	.051	.307	.022	.107
infrastructure_2	.094	.128	.829	.075	.091	-.030	.024	.002	.051	.129	-.079
infrastructure_3	.146	.084	.885	.033	.095	.115	-.029	.049	.142	.055	.025
topManagement_1	.081	.185	-.007	.220	.053	.018	.058	.791	.134	-.101	.045
topManagement_2	.121	.145	.097	.417	.069	-.015	.127	.767	.106	-.050	.054
culture_1	.250	.140	-.100	.204	.064	-.117	.018	.023	.110	-.055	.785
culture_2	.015	.230	.129	.141	-.006	.211	.036	.112	-.026	.007	.840
resources_1	.116	.055	.257	.053	.233	-.048	.252	.021	.716	.109	-.063
resources_2	.175	.105	.191	.085	.075	-.199	.149	.203	.720	.147	.064
resources_3	.303	.068	.536	.080	.246	-.182	-.074	.093	.337	-.031	.072
strategy_1	.364	.036	.472	-.022	.544	-.011	.071	.370	-.143	.159	.011
strategy_2	.228	.047	.450	.008	.643	.022	.070	.344	-.120	.135	.076
strategy_3	.396	.033	.178	.082	.484	-.074	.061	.570	.039	.095	.159
experience_1	.774	.061	.156	-.015	.148	.050	.083	.269	.253	.041	.029
experience_2	.838	.112	.110	.029	.134	.004	-.011	.153	.272	.037	.072
experience_3	.628	.198	.266	.262	.285	-.011	.038	.145	.267	-.053	.147
experience_4	.522	.061	.392	.104	.456	-.053	.054	-.035	.062	-.041	.061
projectManagement_1	.267	.195	.046	.268	.662	.030	.007	-.020	.403	-.173	.024
projectManagement_2	.172	.179	.057	.135	.773	.100	.134	.027	.250	-.019	-.029
competition_1	.044	.059	.051	.141	.021	-.019	.771	-.004	.010	-.108	.111
competition_2	.053	.137	-.024	.147	.054	-.065	.837	.145	.121	.104	-.108
competition_3	.054	.017	-.034	-.001	.081	.095	.834	.048	.073	.130	.025
vendorSupport_1	.190	.816	.034	.072	.077	-.131	.118	-.051	.191	-.063	.069
vendorSupport_2	.036	.874	.069	-.016	-.024	-.112	.093	.164	-.013	-.025	.085
vendorSupport_3	.021	.912	.189	.043	.018	-.028	.133	.140	.011	.012	.105
vendorSupport_4	.034	.774	.055	-.017	.337	-.066	-.116	.068	-.018	.129	.101
government_1	.101	.050	.058	.010	.009	-.033	.015	-.048	.111	.901	.058
government_2	-.031	-.027	.118	-.139	-.003	.079	.089	-.027	-.021	.854	-.106

Table 7.12: Factor analysis-all variables together

Item	Eigenvalue	Extraction sum of squared loadings: variance	Rotation sum of squared loadings: variance	Item loading score	Item code	Item description
1	9.868	25.97	10.793	0.663	compatability_1	compatibility with culture
				0.774	experience_1	experience with technology
				0.838	experience_2	high technology investment
				0.628	experience_3	necessary knowledge
				0.522	experience_4	compatibility with similar experience
2	3.145	8.276	8.605	0.816	vendorSupport_1	our vendor is very knowledgeable in data analytics
				0.874	vendorSupport_2	the vendor provides adequate training
				0.912	vendorSupport_3	the vendor provides adequate support
				0.774	vendorSupport_4	our firm trusts the vendor
3	2.978	7.838	8.338	0.578	infrastructure_1	good database
				0.829	infrastructure_2	clean data
				0.885	infrastructure_3	data integrity
				0.538	resources_3	good IT personnel
4	2.561	6.739	7.678	0.701	advantage_1	increase profitability
				0.676	advantage_2	provide timely information
				0.735	advantage_3	improve employee job performance
				0.537	compatibility_2	compatibility with work practices
				0.684	compatibility_3	compatibility with business values
5	2.253	5.93	7.102	0.544	strategy_1	continunous assessment of technologies
				0.643	strategy_2	involvement of IS management
				0.662	projectManagement_1	good project manager
				0.773	projectManagement_2	project is managed well
6	1.654	4.353	6.35	0.823	cost_1	high setup costs
				0.854	cost_2	high running costs
				0.785	cost_3	high training costs
7	1.528	4.021	6.086	0.771	competition_1	a competitive disadvantage
				0.837	competition_2	competition is a factor
				0.834	competition_3	industry pressure
8	1.428	3.758	5.818	0.791	topManagement_1	interest in BI&A projects
				0.767	topManagement_2	awareness of BI&A projects
				0.570	strategy_3	alignment of BI&A projects with strategy
9	1.373	3.613	5.806	0.716	resources_1	time resources
				0.720	resources_2	funding resources
10	1.131	2.975	4.905	0.901	government_1	progressive measures
				0.854	government_2	pressure by government
11	1.008	2.653	4.644	0.785	culture_1	access to reliable information
				0.840	culture_2	access to information fast

7.5 Summary

This chapter discussed factor analysis in application to the data cleaned from the descriptive analysis chapter. Factor analysis is only applied to independent variables as the dependent variables were a few with 3 variables and 5 items.

After that, correlation matrix, KMO, and bartlett's test of sphericity are conducted to ensure the appropriateness of factor analysis to the data. The components are then extracted using principle component analysis. The number of components is determined using eigen value and scree plot. After that, varimax algorithm creates the rotated convergent matrix where the loadings are examined to complete the process of factor analysis.

The results of factor analysis in application to independent variables reduced the technology cluster from 10 items to 4 components, the organization cluster from 19 items to 6 components, and the environment cluster to 3 components. Also, the main finding of factor analysis is the elimination of the strategy variable from the organization cluster as it did not load highly on the rotated convergent matrix.

8-CORRELATION AND REGRESSION ANALYSIS

8.1 Introduction

The previous chapter presents the descriptive analysis and factor analysis. The results presents a research model that includes three dependent variables: front-end management, project portfolio management, and project success, and three independent clusters: technology, organization, and environment. The technology cluster includes four variables (complexity, compatibility, cost, advantage) with 10 items. The organization cluster includes six variables (experience, project management, infrastructure, top management, culture, resources) with 15 items. The environment clusteappenr includes three variables (competition, vendor support, government) with 9 items.

It is important to revise the aims of this research before explaining these analysis techniques. The research aims are as follows:

- Describing the stages in the adoption process for a BI&A project in an organization
- Listing and explaining the technological factors that impact the adoption of a BI&A project in an organization
- Listing and explaining the organizational factors that impact the adoption of a BI&A project in an organization

- Listing and explaining the environmental factors that impact the adoption of a BI&A project in an organization
- Examining the differences between perceptions of respondents in how they view the adoption of a BI&A project in an organization

Specifically, this research aims to empirically test: (1) if there are correlations between the independent variables and the dependent variables, (2) if there is an impact between one independent variable with each of the dependent variables, and (3) if there are impacts between the independent variables with each of the dependent variables. In order to do that, a questionnaire was developed to measure the adoption of BI&A projects in organizations as explained in the methodology chapter.

In this chapter, three tests that study independent analysis and dependent analysis are conducted: correlation analysis, simple regression analysis, and multiple regression analysis. Correlation analysis examines whether there are any correlations between the independent variables and the dependent variables. Simple regression analysis examines whether any independent variable has an impact on each of the dependent variables, while multiple regression analysis examines whether independent variables (together) have an impact on each of the dependent variables.

Each test starts by explaining what it is and why it is conducted. After that, the assumptions of the tests are verified to ensure the validity of the tests. Next, the hypotheses for that test are proposed. The analysis is then conducted and the results and findings are presented.

8.2 Correlation analysis

Pearson correlation coefficient, denoted as r, was selected for studying the strength and direction of a linear relationship between independent and dependent continuous variables. r ranges between -1 and $+1$ where 0 indicates no relationship between the two continuous variables (Benesty et al. 2009).

8.2.1 Pearson Correlation assumptions

Pearson correlation coefficient is based on main assumptions which must hold: the variables should be measured at the continuous level, there needs to be linear relationship between the variables, and there are no significant outliers.

The first assumption holds because all variables are measured at the continuous level via likert scale. The second assumption of linearity is checked through visual inspections of scatter plots where there is a linear relationship between every independent variable and every dependent variable. Outliers were previously eliminated in the descriptive analysis chapter.

8.2.2 Pearson correlation hypothesis

Correlation analysis measured whether there is any correlation between independent variables and dependent variables. The hypotheses are listed below.

H1a: technology variables are significantly correlated to the front-end management of a BI&A project in an organization

H1b: technology variables are significantly correlated to the PPM of a BI&A project in an organization

H1c: technology variables are significantly correlated to the success of a BI&A project in an organization

H1d:organization variables are significantly correlated to the front-end management of a BI&A project in an organization

H1e:organization variables are significantly correlated to the PPM of a BI&A project in an organization

H1f: organization variables are significantly correlated to the success of a BI&A project in an organization

H1g: environment variables are significantly correlated to the front-end management of a BI&A project in an organization

H1h: environment variables are significantly correlated to the PPM of a BI&A project in an organization

H1i: environment variables are significantly correlated to the success of a BI&A project in an organization

8.2.3 Pearson correlation results

The result of correlation analysis is shown in table 8.1.

Table 8.1: Pearson correlation results

	Front-end	PPM	Project success
Technology			
complexity	-.216*	-.169	.034
advantage	.235*	.451**	.130
compatibility	.330**	.260**	.276**
cost	-.172	.021	.017
Organization			
infrastructure	.189	.166	.329**
top management	.343**	.344**	.235*
culture	.274**	.397**	.003
experience	.374**	.381**	.307**
strategy&project management	.368**	.328**	.365**
Resources	.183	.264**	.274**
Environment			
competition	.296**	.293**	.084
vendor support	.364**	.105	.179
government	-.036	-.021	.183

Pearson correlation is used to examine whether there is any correlation between the independent and dependent variables. $**$ indicate significance at the 1% level and $*$ indicate significance at the 5% level. The results indicate the following:

- Complexity significantly correlates with front-end management
- Advantage significantly correlates with front-end management and positively correlates with project portfolio management
- Compatibility significantly correlates with front-end management, project portfolio management, and project success
- Cost does not correlate with any dependent variable
- Infrastructure significantly correlates with project success
- Top management significantly correlates with front-end management, project portfolio management, and project success
- Culture significantly correlates with front-end management and project portfolio management
- experience significantly correlates with front-end management, project portfolio management, and project success
- Strategy and project management significantly correlates with front-end management, project portfolio management, and project success
- Resources significantly correlates with project portfolio management and project success

- Competition significantly correlates with front-end management and project portfolio management
- Vendor support significantly correlates with front-end management
- Government does not correlate with any dependent variable

8.2.4 Correlation hypothesis results

Correlation hypothesis results are presented in table 8.2 through table 8.10. Further discussion of hypothesis is presented in the discussion chapter.

Table 8.2: Correlation results between technology variables with front-end management

Hypothesis	H1a: technology variables are significantly correlated to the front-end management of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between technology variables and front-end management of a BI&A project in an organization regarding the following variables: complexity advantage compatibility
Researchers observations	Perceptions of the complexity, advantage, and compatilibility of a BI system correlate with the initial stage of adopting a BI&A system in the organization, front-end management (Hardgrave et al. 2003, Riemenschneider et al. 2002, Schepers & Wetzels 2007)
Conclusion	The null hypothesis is rejected for the cost variable The null hypothesis is retained for the complexity, advantage, and compatibility variables

Table 8.3: Correlation results between technology variables with project portfolio management management

Hypothesis	H1b: technology variables are significantly correlated to the PPM of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between technology variables and PPM of a BI&A project in an organization regarding the following variables: advantage compatibility
Researchers observations	Perceptions of the advantage and compatibility of a BI system correlate with the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the complexity and cost variables The null hypothesis is retained for the advantage and compatibility variables

Table 8.4: Correlation results between technology variables with project success

Hypothesis	H1c: technology variables are significantly correlated to the success of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between technology variables and success of a BI&A project in an organization regarding the following variables: compatibility
Researchers observations	Perceptions of the compatibility of a BI system correlate with the last stage of adopting a BI&A system in the organization, project success (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the complexity, advantage, and cost variables The null hypothesis is retained for the compatibility variable

Table 8.5: Correlation results between organization variables with front-end management

Hypothesis	H1d: organization variables are significantly correlated to the front-end management of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between organization variables and front-end management of a BI&A project in an organization regarding the following variables: top management culture experience strategy & project management
Researchers observations	Perceptions of the top management, culture, experience, strategy & project management, and resources in the organization correlate with the initial stage of adopting a BI&A system in the organization, front-end management (Zhu et al. 2006)
Conclusion	The null hypothesis is rejected for the infrastructure and resources variables The null hypothesis is retained for the top management, culture, experience, and strategy and project management variables

Table 8.6: Correlation results between organization variables with project portfolio management

Hypothesis	H1e: organization variables are significantly correlated to the PPM of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between organization variables and PPM of a BI&A project in an organization regarding the following variables: top management culture experience strategy and project management resources
Researchers observations	Perceptions of the top management, culture, experience, strategy & project management, and resources in the organization correlate with the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the infrastructure variable The null hypothesis is retained for the top management, culture, experience, strategy and project management, and resources variables

Table 8.7: Correlation results between organization variables with project success

Hypothesis	H1f: organization variables are significantly correlated to the success of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between organization variables and success of a BI&A project in an organization regarding the following variables: infrastructure top management experience strategy and project management resources
Researchers observations	Perceptions of the infrastructure, top management, experience, strategy & project management in the organization correlate with the last stage of adopting a BI&A system in the organization, project success (Wu & Chen 2014)
Conclusion	The null hypothesis is rejected for the culture variables The null hypothesis is retained for the top management, infrastructure, experience, strategy and project management, and resources variables

Table 8.8: Correlation results between environment variables with front-end management

Hypothesis	H1g: environment variables are significantly correlated to the front-end management of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant corelation between environment variables and front-end management of a BI&A project in an organization regarding the following variables: competition vendor support
Researchers observations	Perceptions of the competition and vendor support in the organization correlate with the initial stage of adopting a BI&A system in the organization, front-end management (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the government variable The null hypothesis is retained for the competition and vendor support variables

Table 8.9: Correlation results between environment variables with project portfolio management

Hypothesis	H1h: environment variables are significantly correlated to the PPM of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is a significant correlation between technology variables and front-end management of a BI&A project in an organization regarding the following variables: competition
Researchers observations	Perceptions of the competition in the organization correlate with the second stage of adopting a BI&A system in the organization, project portfolio management (Kuan & Chau 2001)
Conclusion	The null hypothesis is rejected for the vendor support and government variables The null hypothesis is retained for the competition variable

8.3 Regression analysis

Regression is selected to study the impact of the independent components on the three dependent variables which represent the phases of adopting BI&A projects in organizations. There are multiple reasons for this selection. First, regression is used to predict and explain a dependent variable based on single or multiple independent

Table 8.10: Correlation results between environment variables with project success

Hypothesis	H1i: environment variables are significantly correlated to the success of a BI&A project in an organization
Results	Pearson correlation results indicate that: There is no significant correlation between environment variables and success of a BI&A project in an organization regarding the following variables:
Researchers observations	External environment, such as competition, vendor support, or government, does not correlate with the success of a BI&A project in an organization
Conclusion	The null hypothesis is rejected for the competition, vendor support, and government variables

variables. Second, regression is easy to understand and interpret. Third, there are easy techniques that can be used to overcome violations of the assumptions of the regression model. More importantly, regression analysis will measure the overall significance of the model.

8.3.1 Regression assumptions

Regression analysis is based on six main assumptions which must hold: independence of observations (errors), a linear relationship between the dependent and independent variables, homoscedasticity of residuals, no multi-collinearity, no outliers or any significant points, and the errors to be normally distributed (Pedhazur 1997, Aiken et al. 1991, Cohen et al. 2013).

The first assumption of independence of observations is checked by examining Dubsin-Watson Statistics. This statistics ranges between zero and four with values close to two indicating no correlation between residuals.

The second assumption of linear relationships between variables is checked by examining scatter plots of residuals against predicted variables. These plots are checked for every independent variable with every dependent variable. If the residuals form a straight band, it is likely that there is a linear relationship between the dependent and independent variables.

Similarly, the third assumption of homoscedasticity is examined visually through inspecting the scatter plots of residuals against the predicted variables. If the residuals are equally spread over the values of the predicted variables, it is likely that the homoscedasticity assumption is met.

The fourth assumption of multicollinearity is when two or more of the independent variables are correlated with each other. This needs to be absent, in multiple regression, because it leads to problems concluding which independent variable affected the dependent variable. The assumption of multi-colinearity was tested by examining VIF collinearity statistics and condition index. VIF of values less than 10 indicate the absence of collinearity problems. The VIF statistics for all independent variables are summarized in table 8.11. Condition indexes of values less than 30 indicate the absence of collinearity problems (Hair et al. 2006).

The fifth assumption of outliers is tested by examining the case wise diagnostics table in SPSS where it is instructed to highlight all residuals with ± 3 standard deviations away from the mean. The results of this assumption will be explained in every regression model.

The last assumption of normality was checked by plotting the errors in prediction in histograms. The histograms need to be approximately normally distributed.

8.3.2 Simple regression analysis

Simple regression is used to examine the impact of an independent variable on a dependent variable (Zou et al. 2003). This model is used to examine the impact of each independent variable in the three main independent clusters: technology, organization, environment on each of the three dependent variables: front-end management, project portfolio management, and project success.

Table 8.11: VIFs for all variables

Variable	VIFs
Independent Variables	
Front-end management	1.594
Project portfolio management	1.734
Project success	1.327
Dependent Variables	
Technology	
Complexity	1.417
Compatibility	2.019
Cost	1.303
Advantage	1.883
Organization	
Infrastructure	1.881
Top management	1.708
Culture	1.479
Resources	2.005
Strategy	2.298
Experience	3.048
Project Management	1.841
Environment	
Competition	1.298
Vendor Support	1.550
Government	1.210

8.3.2.1 Simple regression hypothesis

H2a: technology variables significantly impact the front-end management of a BI&A project in an organization

H2b: technology variables significantly impact the PPM of a BI&A project in an organization

H2c: technology variables significantly impact the success of a BI&A project in an organization

H2d:organization variables significantly impact the front-end management of a BI&A project in an organization

H2e:organization variables significantly impact the PPM of a BI&A project in an organization

H2f: organization variables significantly impact the success of a BI&A project in an organization

H2g: environment variables significantly impact the front-end management of a BI&A project in an organization

H2h: environment variables significantly impact the PPM of a BI&A project in an organization

H2i: environment variables significantly impact the success of a BI&A project in an organization

8.3.2.2 Simple regression results

The results of simple regression analysis are shown in tables 8.12 through 8.14.

Table 8.12: Simple regression analysis: independent variables with front-end management

	Dependent variable: front-end management				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity	0.037	4.778	6.540	-0.134	0.031
Advantage	0.046	5.727	3.990	0.337	0.019
Compatibility	0.100	11.993	3.865	0.385	0.001
Cost	0.020	2.971	6.730	-0.152	**0.088**
Organization					
Infrastructure	0.026	3.631	4.980	0.190	**0.060**
Top management	0.109	13.069	3.281	0.450	0.000
Culture	0.066	7.973	3.335	0.427	0.006
Experience	0.131	15.975	3.954	0.365	0.000
Strategy&projectManagement	0.126	15.323	3.987	0.366	0.000
Resources	0.024	3.389	5.228	0.157	**0.069**
Environment					
Competition	0.079	9.435	4.626	0.262	0.003
Vendor support	0.124	14.982	4.196	0.350	0.000
Government	-0.009	0.126	6.135	-0.027	**0.724**

Table 8.13: Simple regression analysis: independent variables with project portfolio management

	Dependent variable: PPM				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity	0.019	2.882	6.556	-0.080	**0.093**
Advantage	0.195	25.056	3.257	0.494	0.000
Compatibility	0.058	7.105	4.947	0.231	0.009
Cost	-0.010	0.043	6.185	0.014	**0.837**
Organization					
Infrastructure	0.018	2.784	5.545	0.128	**0.098**
Top management	0.110	13.189	4.141	0.345	0.000
Culture	0.149	18.334	3.270	0.472	0.000
Experience	0.136	16.595	4.637	0.283	0.000
Strategy&projectManagement	0.099	11.830	4.857	0.250	0.001
Resources	0.060	7.358	5.365	0.173	0.008
Environment					
Competition	0.077	9.231	5.188	0.198	0.003
Vendor support	0.001	1.090	5.846	0.077	**0.299**
Government	-0.010	0.043	6.297	-0.012	**0.836**

Simple regression analysis is used to examine whether there is an impact between each independent variable with every dependent variable. The results indicate the following:

- Complexity significantly impacts front-end management
- Advantage significantly impacts front-end management and project portfolio management
- Compatibility significantly impacts front-end management, project portfolio management, and project success
- Cost does not impact any dependent variable
- Infrastructure significantly impacts project success
- Top management significantly impacts front-end management, project portfolio management, and project success
- Culture significantly impacts front-end management and project portfolio management
- Experience significantly impacts front-end management, project portfolio management, and project success
- Strategy and project management significantly impacts front-end management, project portfolio management, and project success
- Resources significantly impacts project portfolio management and project success

Table 8.14: Simple regression analysis: independent variables with project success

	Dependent variable: project success				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity	-0.009	0.112	5.201	0.021	**0.739**
Advantage	0.007	1.692	4.163	0.184	**0.196**
Compatibility	0.067	8.055	3.495	0.317	0.006
Cost	-0.010	0.030	5.210	0.015	**0.863**
Organization					
Infrastructure	0.099	11.910	3.475	0.327	0.001
Top management	0.045	5.707	3.423	0.304	0.019
Culture	-0.010	0.001	5.255	0.004	**0.980**
Experience	0.085	10.174	3.600	0.295	0.002
Strategy&projectManagement	0.124	15.018	3.280	0.359	0.000
Resources	0.065	7.925	4.096	0.232	0.006
Environment					
Competition	-0.003	0.693	4.888	0.073	**0.407**
Vendor support	0.022	3.258	4.388	0.170	**0.074**
Government	0.024	3.400	4.748	0.135	**0.068**

- Competition significantly impacts front-end management and project portfolio management
- Vendor support significantly impacts front-end management
- Government does not impact any dependent variable

8.3.2.3 Simple regression hypothesis results

Simple regression hypothesis results are presented in table 8.15 through table 8.23. Further discussion of hypothesis is presented in the discussion chapter.

Table 8.15: Simple regression results between technology variables with front-end management

Hypothesis	H2a: technology variables significantly impact the front-end management of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between technology variables and front-end management of a BI&A project in an organization regarding the following variables: complexity advantage compatibility
Researchers observations	Perceptions of the complexity, advantage, and compatibility of a BI system significantly impact the initial stage of adopting a BI&A system in the organization, front-end management (Hardgrave et al. 2003, Riemenschneider et al. 2002, Schepers & Wetzels 2007)
Conclusion	The null hypothesis is rejected for the cost variable The null hypothesis is retained for the complexity, advantage, and compatibility variables

Table 8.16: Simple regression results between technology variables with project portfolio management

Hypothesis	H2b: technology variables significantly impact the PPM of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between technology variables and PPM of a BI&A project in an organization regarding the following variables: advantage compatibility
Researchers observations	Perceptions of the advantage and compatibility of a BI system significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the complexity and cost variables The null hypothesis is retained for the advantage and compatibility variables

Table 8.17: Simple regression results between technology variables with project success

Hypothesis	H2c: technology variables significantly impact the success of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between technology variables and success of a BI&A project in an organization regarding the following variables: compatibility
Researchers observations	Perceptions of the compatibility of a BI system significantly impact the last stage of adopting a BI&A system in the organization, project success (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the complexity, advantage, and cost variables The null hypothesis is retained for the compatibility variable

Table 8.18: Simple regression results between organization variables with front-end management

Hypothesis	H2d: organization variables significantly impact the front-end management of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between organization variables and front-end management of a BI&A project in an organization regarding the following variables: top management culture experience strategy & project management
Researchers observations	Perceptions of the top management, culture, experience, strategy & project management, and resources in the organization significantly impact the initial stage of adopting a BI&A system in the organization, front-end management (Zhu et al. 2006)
Conclusion	The null hypothesis is rejected for the infrastructure and resources variables The null hypothesis is retained for the top management, culture, experience, and strategy and project management variables

Table 8.19: Simple regression results between organization variables with project portfolio management

Hypothesis	H2e: organization variables significantly impact the PPM of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between organization variables and PPM of a BI&A project in an organization regarding the following variables: top management culture experience strategy and project management resources
Researchers observations	Perceptions of the top management, culture, experience, strategy & project management, and resources in the organization significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the infrastructure variable The null hypothesis is retained for the top management, culture, experience, strategy and project management, and resources variables

Table 8.20: Simple regression results between organization variables with project success

Hypothesis	H2f: organization variables significantly impact the success of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between organization variables and success of a BI&A project in an organization regarding the following variables: infrastructure top management experience strategy and project management resources
Researchers observations	Perceptions of the infrastructure, top management, experience, strategy & project management in the organization significantly impact the lastl stage of adopting a BI&A system in the organization, project success (Wu & Chen 2014)
Conclusion	The null hypothesis is rejected for the culture variables The null hypothesis is retained for the top management, infrastructure, experience, strategy and project management, and resources variables

Table 8.21: Simple regression results between environment variables with front-end management

Hypothesis	H2g: environment variables significantly impact the front-end management of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between environment variables and front-end management of a BI&A project in an organization regarding the following variables: competition vendor support
Researchers observations	Perceptions of the competition and vendor support in the organization significantly impact the initial stage of adopting a BI&A system in the organization, front-end management (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the government variable The null hypothesis is retained for the competition and vendor support variables

Table 8.22: Simple regression results between environment variables with project portfolio management

Hypothesis	H2h: environment variables significantly impact the PPM of a BI&A project in an organization
Results	Simple regression results indicate that there is a significant impact between technology variables and front-end management of a BI&A project in an organization regarding the following variables: competition
Researchers observations	Perceptions of the competition in the organization significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Kuan & Chau 2001)
Conclusion	The null hypothesis is rejected for the vendor support and government variables The null hypothesis is retained for the competition variable

8.3.3 Multiple regression analysis

Multiple regression is used to examine the impact of all independent variables together with every dependent variable (Hair et al. 2006). Multiple regression is different than simple regression in that multiple regression examines the impact of all independent variables together on each dependent variable rather than the impact of each independent variable alone on each dependent variable. The method used in

Table 8.23: Simple regression results between environment variables with project success

Hypothesis	H2i: environment variables significantly impact the success of a BI&A project in an organization
Results	Simple regression results indicate that there is no significant impact between environment variables and success of a BI&A project in an organization regarding the following variables:
Researchers observations	External environment, such as competition, vendor support, or government, does not impact the success of a BI&A project in an organization
Conclusion	The null hypothesis is rejected for the competition, vendor support, and government variables

multiple regression is backward. This model starts by running all the variables and then eliminating variables until there is a robust model (Edwards 1985).

8.3.3.1 Multiple regression hypothesis

H3a: technology variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3b: technology variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3c: technology variables significantly impact the success of a BI&A project in an organization relative to other variables

H3d:organization variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3e:organization variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3f: organization variables significantly impact the success of a BI&A project in an organization relative to other variables

H3g: environment variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
H3h: environment variables significantly impact the PPM of a BI&A project in an organization relative to other variables
H3i: environment variables significantly impact the success of a BI&A project in

an organization relative to other variables

8.3.3.2 Multiple regression results

The results of multiple regression analysis are shown in tables 8.24 through 8.26.

Table 8.24: Multiple regression analysis: independent variables with front-end management

	Dependent variable: front-end management				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity					
Advantage					
Compatibility	0.100	11.993	3.865	0.385	0.001
Cost					
Organization					
Infrastructure					
Top management					
Culture				0.266	0.076
Experience				0.198	0.076
Strategy&projectManagement				0.215	0.055
Resources					
Environment					
Competition				0.212	0.011
Vendor support				0.309	0.001

Table 8.25: Multiple regression analysis: independent variables with project portfolio management

	Dependent variable: PPM				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity					
Advantage	0.195	25.056	3.257	0.494	0.000
Compatibility					
Cost					
Organization					
Infrastructure					
Top management					
Culture				0.374	0.001
Experience				0.217	0.002
Strategy&projectManagement					
Resources					
Environment					
Competition				0.198	0.003
Vendor support					
Government					

Table 8.26: Multiple regression analysis: independent variables with project success

	Dependent variable: project success				
Independent	**R squared**	**F**	**Constant**	**Beta**	**Sig**
Technology					
Complexity					
Advantage					
Compatibility	0.067	2.230	3.495	0.317	0.006
Cost					
Organization					
Infrastructure					
Top management					
Culture					
Experience					
Strategy&projectManagement				0.359	0.000
Resources					
Environment					
Competition					
Vendor support					
Government					

8.3.3.3 Multiple regression hypothesis results

Multiple regression hypothesis results are presented in table 8.27 through table 8.35. Further discussion of hypothesis is presented in the discussion chapter.

Table 8.27: Multiple regression results between technology variables with front-end management

Hypothesis	H3a: technology variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between technology variables and front-end management of a BI&A project in an organization regarding the following variables: complexity advantage compatibility
Researchers observations	Perceptions of the complexity, advantage, and compatibility of a BI system significantly impact the initial stage of adopting a BI&A system in the organization, front-end management (Hardgrave et al. 2003, Riemenschneider et al. 2002, Schepers & Wetzels 2007)
Conclusion	The null hypothesis is rejected for the cost variable The null hypothesis is retained for the complexity, advantage, and compatibility variables

Table 8.28: Multiple regression results between technology variables with project portfolio management

Hypothesis	H3b: technology variables significantly impact the PPM of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between technology variables and PPM of a BI&A project in an organization regarding the following variables: advantage
Researchers observations	Perceptions of the advantage of a BI system significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the compatibility, complexity and cost variables The null hypothesis is retained for the advantage variables

Table 8.29: Multiple regression results between technology variables with project success

Hypothesis	H3c: technology variables significantly impact the success of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between technology variables and success of a BI&A project in an organization regarding the following variables: compatibility
Researchers observations	Perceptions of the compatibility of a BI system significantly impact the last stage of adopting a BI&A system in the organization, project success (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the complexity, advantage, and cost variables The null hypothesis is retained for the compatibility variable

Table 8.30: Multiple regression results between organization variables with front-end management

Hypothesis	H3d: organization variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that: There is no significant impact between organization variables and front-end management of a BI&A project in an organization
Researchers observations	Perceptions of the infrastructure top management, culture, experience, strategy & project management, and resources in the organization do not impact the initial stage of adopting a BI&A system in the organization, front-end management
Conclusion	The null hypothesis is rejected for all organization variables

Table 8.31: Multiple regression results between organization variables with project portfolio management

Hypothesis	H3e: organization variables significantly impact the PPM of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between organization variables and PPM of a BI&A project in an organization regarding the following variables: culture experience
Researchers observations	Perceptions of the culture and experience in the organization significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Lee et al. 2009)
Conclusion	The null hypothesis is rejected for the infrastructure, top management, strategy and project management, and resources variables The null hypothesis is retained for the culture and experience variables

Table 8.32: Multiple regression results between organization variables with project success

Hypothesis	H3f: organization variables significantly impact the success of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between organization variables and success of a BI&A project in an organization regarding the following variables: strategy and project management
Researchers observations	Perceptions of the strategy & project management in the organization significantly impact the last stage of adopting a BI&A system in the organization, project success (Wu & Chen 2014)
Conclusion	The null hypothesis is rejected for the infrastructure, top management, culture, experience, and resources variables The null hypothesis is retained for the strategy and project management variable

Table 8.33: Multiple regression results between environment variables with front-end management

Hypothesis	H3g: environment variables significantly impact the front-end management of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between environment variables and front-end management of a BI&A project in an organization regarding the following variables: competition vendor support
Researchers observations	Perceptions of the competition and vendor support in the organization significantly impact the initial stage of adopting a BI&A system in the organization, front-end management (Wu & Chuang 2010)
Conclusion	The null hypothesis is rejected for the government variable The null hypothesis is retained for the competition and vendor support variables

Table 8.34: Multiple regression results between environment variables with project portfolio management

Hypothesis	H3h: environment variables significantly impact the PPM of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is a significant impact between technology variables and front-end management of a BI&A project in an organization regarding the following variables: competition
Researchers observations	Perceptions of the competition in the organization significantly impact the second stage of adopting a BI&A system in the organization, project portfolio management (Kuan & Chau 2001)
Conclusion	The null hypothesis is rejected for the vendor support and government variables The null hypothesis is retained for the competition variable

8.3.3.4 Multiple regression model discussion

The regression model that examines the impact between technology variables and front-end management with explanatory power is 10%, F is 11.993, constant is 3.865, and significance $p < 0.05$. The most influencing factor is compatibility with beta value 0.385 and $p < 0.05$.

Table 8.35: Multiple regression results between environment variables with project success

Hypothesis	H3i: environment variables significantly impact the success of a BI&A project in an organization relative to other variables
Results	Multiple regression results indicate that there is no significant impact between environment variables and success of a BI&A project in an organization regarding the following variables:
Researchers observations	External environment, such as competition, vendor support, or government, does not impact the success of a BI&A project in an organization
Conclusion	The null hypothesis is rejected for the competition, vendor support, and government variables

The regression model that examines the impact between technology variables and project portfolio management with explanatory power is 19.5%, F is 25.056, constant is 3.257, and significance $p < 0.05$. The most influencing factor is advantage with beta value 0.494 and $p < 0.05$.

The regression model that examines the impact between technology variables and project success with explanatory power is 6.7%, F is 2.230, constant is 3.495, and significance $p < 0.05$. The most influencing factor is compatibility with beta value 0.317 and $p < 0.05$.

The regression model is the one that examines that there is no impact between organization variables and front-end management.

The regression model that examines the impact between organization variables and project portfolio management with explanatory power is 23.6%, F is 14.950, constant is 2.656, and significance $p < 0.05$. The most influencing factor is culture with beta value 0.374 and $p < 0.05$. The second most influencing factor is experience with beta value 0.217 and $p < 0.05$.

The regression model that examines the impact between organization variables and project success with explanatory power is 612.4%, F is 15.018, constant is 3.280, and significance $p < 0.05$. The most influencing factor is strategy & project management with beta value 0.359 and $p < 0.05$.

The regression model that examines the impact between environment variables and front-end management with explanatory power is 17.2%, F is 11.247, constant is 3.247, and significance $p < 0.05$. The most influencing factor is vendor support with beta value 0.309 and $p < 0.05$. The second most influencing factor is competition with beta value 0.212 and $p < 0.05$.

The regression model that examines the impact between environment variables and project portfolio management with explanatory power is 7.7%, F is 9.231, constant is 5.188, and significance $p < 0.05$. The most influencing factor is competition with beta value 0.198 and $p < 0.05$.

The regression model that examines that there is no impact between environment variables and project success.

8.4 Chapter summary

This research proposed a conceptual model to study the factors that impact the adoption of BI&A projects in organizations. Quantitative data is collected from 100 usable questionnaires from organizations in the Gulf. This chapter applies correlation, simple regression, and multiple regression to examine whether the hypothesis are supported or not.

9-DIFFERENCE IN PERCEPTIONS BETWEEN GROUPS

9.1 Introduction

This section applies the necessary techniques to understand whether there are statistical differences between the perception of: (1) ethnicity of respondent, (2) experience in current organization of respondent, (3) role in organization for respondent, (4) IT project budget in the organization, (5) type of BI system, (6) storage duration, and (7) analysis duration.

Since the data is not normal as discussed in the descriptive analysis chapter, non-parametric tests are used (Cleophas & Zwinderman 2011). SPSS will automatically select an appropriate test based on the data.

9.2 Independent sample hypothesis

H4a: Participants from different ethnicities have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4b: Participants with different experience in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4c: Participants with different roles in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4d: Participants with different IT project budget in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4e: Participants with different type of BI system in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4f: Participants with different storage duration in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

H4g: Participants with different analysis duration in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI&A project in an organization

9.3 Independent sample hypothesis results

Independent sample hypothesis results are presented in table 9.1 through table 9.7. Further discussion of hypothesis is presented in the discussion chapter.

Table 9.1: Difference in perceptions between different ethnic groups

Hypothesis	H4a: Participants from different ethnicity have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different ethnicity of respondents regarding the following variable: infrastructure
Researchers observations	Different ethnic groups have a different perception of infrastructure in their organization with p=.042 significance
Conclusion	The null hypothesis is retained for the infrastructure variable

Table 9.2: Difference in perceptions between different experience groups

Hypothesis	H4b: Participants with different experience in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between between the perception of different experience of respondents regarding the following variable: advantage culture
Researchers observations	Different experience groups have a different perception of the advantage of a BI&A project with p=.031 significance and the culture in their organization with p=.043 significance
Conclusion	The null hypothesis is retained for the advantage and culture variables

Table 9.3: Difference in perceptions between different roles groups

Hypothesis	H4c: Participants with different roles in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different roles of respondents regarding the following variables: advantage infrastructure resources strategy&project management experience
Researchers observations	Groups with different roles have a different perception of the advantage of a BI&A project with p=.030 significance, the infrastructure in their organization with p=.008 significance, the resources of the organization with p=.002 significance, the strategy & project management of the organization with p=.002 significance, and the experience of the organization with similar projects with p=.033 significance
Conclusion	The null hypothesis is retained for the advantage, infrastructure, resources, strategy&project management, and experience variables

Table 9.4: Difference in perceptions between different IT project budget groups

Hypothesis	H4d: Participants with different IT project budget in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different IT project budget organizations regarding the following variables: project success infrastructure strategy & project management
Researchers observations	Different IT project budget groups have a different perception of the success of a BI&A project with p=.008 significance, the infrastructure in their organization with p=.015 significance, and the strategy & project management of the organization with p=.003 significance
Conclusion	The null hypothesis is retained for the project success, infrastructure, and strategy & project management variables

Table 9.5: Difference in perceptions between different BI system groups

Hypothesis	H4e: Participants with different type of BI system in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different organizations using different BI systems regarding the following variable: advantage
Researchers observations	Different BI systems groups have a different perception of theadvantage of a BI&A project with p=.043 significance
Conclusion	The null hypothesis is retained for the advantage variable

Table 9.6: Difference in perceptions between different storage duration groups

Hypothesis	H4f: Participants with different storage duration in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different organizations having different storage durations regarding the following variable: competition
Researchers observations	Different storage duration groups have a different perception of the competition in the environment with p=.005 significance
Conclusion	The null hypothesis is retained for the competition variable

9.4 Chapter summary

This research proposed a conceptual model to study the factors that impact the adoption of BI&A projects in organizations. Quantitative data is collected from 100 usable questionnaires from organizations in the Gulf. This chapter applied non-parametric tests to examine whether there are different perceptions between different groups regarding the adoption of a BI&A project in an organization.

Table 9.7: Difference in perceptions between different analysis duration groups

Hypothesis	H4g: Participants with different analysis duration in their current organization have different perceptions of the technology variables, organization variables, environment variables, front-end management, project portfolio management, and project success of a BI\&A project in an organization
Results	Independent sample results indicate that there is a significant difference between the perception of different organizations having different analysis duration regarding the following variables: front-end management compatibility competition government
Researchers observations	Different analysis duration groups have a different perception of the front-end management of a BI project with p=.022 significance, the compatibility of a BI&A project with the organization with p=.006 significance, the competition in the environment with p=.002 significance, and the government variable with p=.042 significance
Conclusion	The null hypothesis is retained for the front-end management, compatibility, competition, and government variables

10-DISCUSSION

10.1 Introduction

This chapter discusses the results of this research. This research aims to examine the factors that impact the adoption process of a BI&A project in an organization. These factors are grouped into three main categories: technology, organization, and environment. The adoption process of a BI&A project is composed of three main stages: front-end management, project portfolio management, and project success. The thesis examines the impact of the factors on the adoption process. In the previous chapters, four main analysis techniques were conducted to verify the proposed research model: correlation analysis, simple regression, and multiple regression. Also, the ranking of the factors is conducted to give an overall idea on how respondents with different experiences and roles view those factors.

10.2 Dependent variables-research question 1

Research question 1: What are the stages in the adoption process for a BI&A project in an organization?

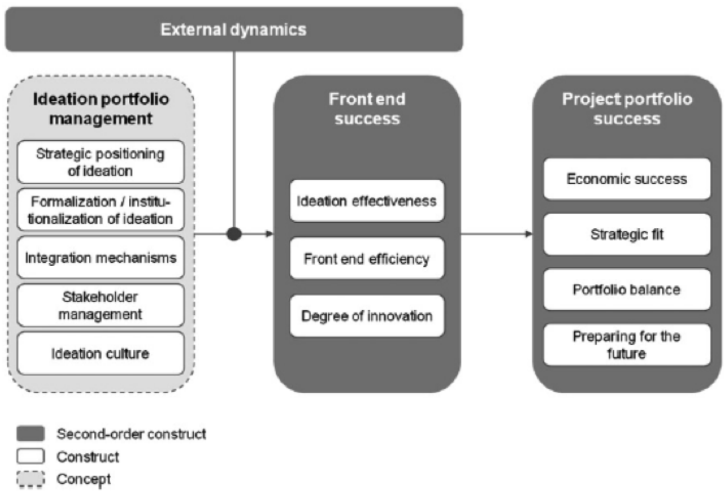
This research question is approached by extensively analyzing the literature. This research is mainly based on the model proposed by Heising (2012). Heising (2012) proposes a model that links the ideation process and front-end management with project portfolio management and eventually business success. This model appreciates the importance of project portfolio management as it helps organizations choose and evaluate all the ideas that come through in the front-end management phase. This evaluation eventually leads to business success. The proposed model by Heising (2012) is shown in figure 10.1.

This research adopts a similar model to the one proposed by Heising (2012). An extensive literature review realizes three main phases for BI&A project adoption: pre-adoption, adoption, and post-adoption such as in the works of Zhu et al. (2006) and Lee et al. (2009). These phases, in a project management context, translates to front-end management, project portfolio management, and project success. It is important to translate the innovation process stages to a project management context as organizations typically take any huge endeavor in the form of a project (Jonas 2010).

10.2.1 Front-end management

Front-end management is the initial stage of a BI&A project. In this stage, organizations document the explicit definition of the project and consider major vendors. As discussed in the proposed model chapter, this variable depends on technology, organization, and environment variables. These independent constructs need to influence the dependent variable by making the BI&A project pass this stage and be initiated in the organization.

Figure 10.1: Detailed conceptual research framework for the integration of ideation and project portfolio management by Heising (2012)



Some authors think of front end management as a comprehensive view of the initial stage of the new product or project idea generation while others do not. For instance, Montoya-Weiss & O'Driscoll (2000) define front end management as the transformation of a new product, project, or service idea into an assessed product concept. On the other hand, other authors do not include the idea assessment phase in the front-end management stage. For instance, McAdam (2004) supports the separation between the idea generation phase and the formal idea evaluation in front end management. In fact, there is very limited research in the area of front end management which indicates the lack of consensus among authors about what front end management really is (Schulze & Hoegl 2008). In fact, there is lack of well-defined and reliable information and proven decision rules in the front-end management stage. This is why front end management is usually referred to as the fuzzy front end. This fuzziness results in unstructured front end management processes which in turn force top management to follow their gut feeling (Schulze & Hoegl 2008).

The front end management phase is important because it can yield better results and distinguish the winners in the market from the losers (Langerak et al. 2004). In addition, a well-performed front end management process would yield superior performance (Langerak et al. 2004). In fact, any slight improvement in the front end management phase would lead to significant time and money savings in the future (Montoya-Weiss & O'Driscoll 2000, Reid & De Brentani 2004). Moreover, a good set of front end management processes would improve idea generation in the organization and improve the quality of creative problem solving (McAdam 2004). This would eventually lead to an innovative organization. Also, top management would not have to use their gut feeling but instead depend on well defined processes and rules that improve decision making. As twice as much money is usually spent in this phase (Langerak et al. 2004), and due to the reasons mentioned above, it is important to pay careful attention to the execution of the front end management phase.

Idea generation would typically trigger the need for front-end management to manage those generated ideas (Schulze & Hoegl 2008, McAdam 2004). To begin with, there are different triggers that initiate ideas in organizations. The most basic ones are customer needs. Whenever a customer makes a special request, an idea could be triggered in the organization (Langerak et al. 2004). Also, knowledge management, specifically socialization, would improve idea generation in organizations. Informal meetings, organizational gatherings, and networking events improve the flow of information among various individuals in the ecosystem (Schulze & Hoegl 2008). These events have been proven to improve idea generation and eventually innovation in organizations. Also, a supportive culture and a proper organization strategy would motivate idea generation (McAdam 2004). The external environment is also an important trigger to idea generation (McAdam 2004). In fact, Reid & De Brentani (2004) claim that it is the main sources of information which would eventually help in generating more ideas and eventually triggering the front end management process. A company would typically imitate, benchmark, and get inspired of what their competitors or partners are performing. These triggers would increase the likelihood of initiating ideas and eventually the front end management process.

In general, front end management includes a series of activities such as product strategy, formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews (Khurana & Rosenthal 1997). As a proper front end management process would result in great benefits, different authors propose different processes to optimize the front end processes (Reid & De Brentani 2004). The most basic one is the process proposed by Cooper (1980) which is called stage-gate process. This process enables the idea to flow from one stage to the other by passing the go or kill test. This test is a set of examining criteria that allows the idea to go to the next stage, or kills/terminates it. The criteria may differ from one organization to the other. Cooper (1980) then proposed a modified front end process which included the following four phases: idea generation, initial screening, preliminary evaluation, and concept evaluation. Idea generation is the first step where ideas are just created and gathered from employees or external sources. After that, the initial screening would eliminate in-feasible, unrealistic, and unwanted ideas. The surviving ideas will then go through preliminary evaluation where more criteria are evaluated. If the idea passes this step, it turns into a more mature form called the concept. The final stage in the front end management is concept evaluation. This would indicate whether the idea would get implemented or not. These four stages bring structure to the front end management process. The proposals from other authors followed a more or less similar style. For instance, Koen et al. (2001) propose a five stages front end process that includes the following stages: opportunity identification, opportunity analysis, idea genesis, idea selection and concept development. This process will start with opportunity identification which is usually triggered through customer needs or undergoing market research (Langerak et al. 2004). Those opportunities get preliminary evaluation based on a preliminary analysis. If the opportunity succeeds, the idea genesis stage indicates the birth of the idea. Only suitable ideas will be selected and passed into the concept development stage. Another variation of the front end management process in the literature is by Reid & De Brentani (2004) who propose a front end process that starts with problem identification, then information collection, and finally informal pre-screening.

Despite the differences in the front end management processes, they typically follow the stage-gate system proposed by Cooper (1980). The criteria that organizations use to evaluate ideas to pass to the other stage differ. That is, organizations use a different set of criteria to evaluate ideas. In general, organizations should consider the following in evaluating whether ideas should move to the next stage or not: user needs, market trends, market potential, competition, concept definition, technological feasibility, resources and skills, synergy with business strategy, and idea novelty (Montoya-Weiss & O'Driscoll 2000). Organizations could use these criteria as guidelines and customize them to fit their needs. As a general guildeline, organizations need to reduce market and technological uncertainties in order to have a successful front end management process. Also, the intensity of planning should be appropriate depending on the organizational needs (Verworn et al. 2008).

This research defines front-end management as the phase where the idea of a BI&A project is initiated. The nest stage is project portfolio management.

10.2.2 Project portfolio management

PPM is the second stage of a BI&A project. In this stage, organizations evaluate BI&A projects against other projects and examine whether the BI&A project will maximize the overall return of the portfolio. As discussed in the proposed model chapter, this variable depends on technology, organization, and environment constructs. These independent constructs need to influence the dependent variable by making the BI&A project pass this stage and become considered in the PPM of the organization.

PPM is gaining a lot of importance as it helps businesses improve their results (Meskendahl 2010). In addition, a lot of organizations are undertaking huge endeavors in the form of a project, therefore, managing multiple projects in the portfolio is important for success (Jonas 2010). Moreover, projects compete for resources and therefore it is important to select the projects that are right and optimum for the organization (Voss 2012).

Managing a single project is difficult, let alone managing multiple projects in the portfolio (Costantino et al. 2015). Different authors propose several solutions to minimize the complexity of managing a project portfolio. For instance, Teller et al. (2012), Gutiérrez & Magnusson (2014), Kaiser et al. (2015) prove that formal, legitimate, and bureaucratic processes improve the overall success of managing the project portfolio. This corresponds to the resource based view (RBV) which states that organizations need to use their resources in an optimum way to achieve competitive advantages (Lerch & Spieth 2013). However, another school of thought supports that organizations need to be flexible and dynamic in the selection and execution of projects in the portfolio. For instance, resource allocation could be changed depending on the context and circumstances (Daniel et al. 2014). This view builds on the dynamic capability view (DCV) theory where organizations need to reconfigure their resources based on the changes in the dynamic environment (Lerch & Spieth 2013, Killen & Hunt 2013). In fact, organizations should adopt a hybrid strategy in managing project portfolio management (Müller et al. 2008). For instance, at the beginning, the organization can be informal and flexible. However, the evaluation, prioritization, and selection that happen in managing the portfolio should be formalized and structured. In addition to formalization, involving stakeholders, both internal and external, is very important to achieve a successful PPM (Beringer et al. 2013). Stakeholders include employees, managers, customers, executives, vendors, or partners. Stakeholders are basically anyone who is involved directly or indirectly with the project. It is also important to deploy good project management practices which would eventually lead to the success of the portfolio itself (Bonham 2005, Ajjan et al. 2013). Levine (2007) also argues that integrating PPM with the business operations such as financial and marketing operations is important to achieve success in both disciplines. PPM should support and be supported by these business operations.

When a new idea passes the initial evaluation stage and develops into a concept, it gets toughly evaluated, screened, and assessed in the portfolio. This phenomenon is known as project portfolio structuring (Meskendahl 2010). The assessment procedure differs from one project to the other and from one project to the other (Meskendahl 2010). Organizations should typically structure their portfolio using a set of guidelines that match their context and the project context. Meskendahl (2010) proposes four main guidelines when a new or ongoing project is introduced to the portfolio. These criteria are: alignment of the projects in the portfolio with the strategy in the organization, formalization in assessing the projects, the integration and involvement of internal and external stakeholders, and finally selecting projects that fit within the organization in terms of the available resources and the organization's future vision. Some organizations employ technical methodologies to perform the portfolio structuring. Kaiser et al. (2015) propose optimization algorithms such as genetic algorithms, fuzzy decision support system, data envelopment analysis, and analytic network process that aid the company in evaluating and selecting projects in the portfolio. Costantino et al. (2015) discuss economic probabilistic models and neural networks that some organizations use to perform the portfolio structuring. Ajjan et al. (2013) discuss alignment methods, ranking and scoring techniques, financial methods, and objective analysis as techniques to support the PPM process.

PPM includes several projects that the management should consider along with their interplay while evaluating the portfolio (Martinsuo 2013). It is true that single project success would improve the overall PPM. However, it is not enough (Meskendahl 2010). Using a bottom up view, a PPM would be successful if the average single project success is high, there are synergies and collaborations among projects, there is synchronization between the portfolio and the organization's strategy, and that the portfolio is balanced with different projects that fulfill the different organizational needs (Meskendahl 2010). In general, Cooper (1980) suggests that the project portfolio should have the following main aims: maximizing returns and financial value of the portfolio, linking the portfolio to the organizational strategy, and balancing the portfolio in accordance to the available resources. Some authors introduce different variations to these objectives. According to Ajjan et al. (2013), a successful PPM would result in the following objectives: managing the right projects in the optimum way, aligning the projects with the organizational strategy, reducing costs, improving communication among the stakeholders involved in the project, and improving the overall decision making process in projects.

The literature discusses a lot of studies that manage the project portfolio in relation to innovation projects (Brook & Pagnanelli 2014, Hunt et al. 2008). This notion is actually referred to as the innovative project portfolio management (IPPM) (Lerch & Spieth 2013). IPPM is a dynamic process that evaluates, prioritizes, and selects innovative projects to reach the objectives of maximizing the return, balancing the types of projects in the portfolio, aligning the projects with the business strategy, and efficiently and effectively allocating resources. IT/IS PPM is as important as innovation PPM. IT/IS PPM is a dynamic process that evaluates and selects IT/IS projects to implement in the organization (Bonham 2005). In fact, IT PPM deserves a lot of attention due to the rate of complexity and change in IT/IS projects (Bonham 2005). ITPPM specifically requires significant organizational changes, data collection, and synchronization between people, processes, and the technology itself (Ajjan et al. 2013). A research conducted by Ajjan et al. (2013) utilizes the TOE conceptual model in order to study the factors that impact the adoption of ITPPM in organizations. The authors conclude that external pressure, cost, stakeholder support, data quality, and number of projects impact the likelihood of adopting ITPPM.

Therefore, and based on the discussion above, it is important to perform good PPM practices as they have a direct impact on the success of the projects (Hunt et al. 2008). This research aims at studying the factors that impact the evaluation, prioritization, and selection of a BI&A project in the project portfolio. A BI&A project would be selected in the portfolio if it: maximizes the organization's return on investment, helps the organization prepare for the future, is aligned with the organizational strategy, and is ranked among other projects. If an organization utilizes the right factors and practices into managing a BI&A project into the portfolio, the project would be successful and would eventually impact the overall business success.

10.2.3 Project success

Project success is the last stage of a BI&A project. In this stage, organizations aim to successfully finish the BI&A project within cost, schedule, and scope. As discussed in the proposed model chapter, this variable depends on technology, organization, and environment constructs. These independent constructs need to influence the dependent variable by making the BI&A project pass this stage and become successful.

BI&A projects are discussed in the literature through different applications. Hwang et al. (2004), Bole et al. (2015), Nie et al. (2009), Wixom & Watson (2001) discuss the success and CSFs of several BI&A systems such as data warehouses which are mainly used to store the data and data mining tools which are mainly used to analyze the data .

Project success is defined differently in the literature. Bole et al. (2015) define a data mining project to be successful if top management gets involved in the projects, if the users actually use the system, if the quality of the data produced by the data mining system is acceptable, and if the overall perceived net benefits of the data mining projects are high. Nemati & Barko (2003) utilize the iron triangle to define whether a data mining project is successful or not. That is, the authors consider a data mining project to be successful if it is completed within time, budget, and quality constraints. Also, the authors realize that the iron triangle, despite being very helpful in measuring project success, is not enough. In fact, they extend the iron triangle to the square view where the iron triangle definition is extended to include benefits to stakeholders, benefits to organizations, and information systems profitability. A well-cited study by Wixom & Watson (2001) defines the success of data warehouse projects using three main categories: organizational success, project success, and technical success. These three categories result in improved data quality, system quality, and higher perceived net benefits. Similarly, Yeoh & Koronios (2010) propose that a BI&A project is successful if it produces high quality information such as output accuracy, acceptable system quality, availability and reliability of the system, system use by different types of stakeholders, and is completed within budget and schedule constraints.

Different organizations define BI success differently depending on their expectations (Işık et al. 2013). For instance, some organizations define BI success as higher profitability, lower costs, and improved productivity (Watson & Wixom 2007). Others define it using quantifiable measures such as return on investment (ROI) or the percentage of increased profits (Watson & Wixom 2007). Others perform cost benefit analysis to examine whether the benefits outperform the costs of the system (Işık et al. 2013). Another study defined success using two main criteria: Infrastructure performance success and Process performance success (Yeoh & Koronios 2010). Infrastructure performance is the quality of the system and the output while process performance is how well the implementation process went. Infrastructure success is measured in terms of system quality, information quality, and system use. Process success is measured in terms of budget and time schedule. Dawson & Van Belle (2013) extend the study of Wixom & Watson (2001) to specifically apply it to BI&A systems where he proposes that a BI&A project is successful if it meets project and organization success criteria. Project criteria includes the iron triangle while organization criteria includes increased profitability.

It seems that information quality is an important factor in defining whether a BI&A project was successful or not (Yeoh & Koronios 2010). However, Nie et al. (2009) consider data quality as a prerequisite for the success of data mining projects. Specifically, the study categorizes data quality into four main criteria: data accessibility which includes security, data representation which includes ease of understanding, contextual quality which includes completeness, and intrinsic quality which include accuracy. In fact, data quality could be considered as both a prerequisite and also an outcome of a successful BI&A project.

There is numerous amount of research on critical success factors that contribute to the success of projects. In general, Mishra & Mishra (2011) claim that a project is successful if it is supported by a good project manager with a high emotional intelligence and good leadership and commitment skills, a good team with high skills and coordination among themselves, and high quality tools that help in planning and resource allocation. Another study by Costantino et al. (2015) concludes the following project success factors using artificial neural networks: project mission, top management support, project schedule/plan, client consultation, personnel, technical tasks, client acceptance, monitoring and feedback, communication, and trouble shooting. A more specific study by Sudhakar (2013) which explains the important factors that contribute to the success of software projects include the following: top management support, clear project goal, project planning, team work, team coordination, reliability of output, quality control, client acceptance, accuracy of output, reduction of ambiguity, maximization of stability, realistic expectations, and user involvement . The author grouped these factors into seven main categories: communication, technological, organizational, environmental, project, team, and project management practices.

There are a lot of inconsistencies in the results in the literature, even if they are studying the same application. For example, according to Nie et al. (2009), data mining applications need high quality data, human skills, financial resources, and top management support to be successful. On the other hand, Bole et al. (2015) conclude that data mining projects need the following factors to be successful: business champion, external pressure, stakeholder support, steep learning curve in the organization, problem solving skills, data availability and high data quality. Similarly, Nemati & Barko (2003) conclude a different set of CSFs that contribute to the success of data mining projects. These factors include high data quality, data integration, technical integration, team expertise, user involvement expertise, and outsourcing strategy. A doctoral dissertation for identifying Critical Success Factors (CSFs) for data mining projects synthesized the CSFs into seven main factors: action, dataset, communication, output, business mission, consultation, and business environment. The dissertation also proves that data set is the only significant factor for successful data mining projects (Jaesung Sim 2003).

The consistencies in research results extend to data warehouse applications too! For example, Hwang et al. (2004) conclude that a data warehouse application is successful if there is top management support, large sized organization, availability of project champion, internal needs, and competitive pressure. On the other hand, the study by Wixom & Watson (2001) concluded top management support, quality of source systems, availability of championship, technical development skills, resources, user involvement and skills, and team skills as important factors to the success of data warehouse projects.

These inconsistencies are also applied to BI&A projects. Olbrich et al. (2012) conclude data sources, top management support, business strategy, budget, user involvement, market dynamics, organizational resources, IT infrastructure, management methods, and competition as important factors to the success of a BI&A project. Another study by Dawson & Van Belle (2013) concludes top management support, project champion, business vision, user involvement, and data quality as CSFs to the success of BI&A projects. Yeoh & Koronios (2010) provide a more detailed CSFs list for BI&A projects to be successful. These CSFs include the following: top management support, clear business vision, well-established business case, project champion, balanced team in terms of skills and interdisciplinary departments, iterative development process, user oriented change management, flexible technical conceptual model, and sustainable data quality.

This research will define a BI&A project to be successful using mainly the iron triangle approach developed by Atkinson (1999). That is, a BI&A project is said to be successful if it is completed within time, budget, and quality constraints. In addition, operating according to original concept and scope is added to the definition of the project success. Therefore, if a project is used and adopted by employees after its implementation, this means it is successful. The study will then relate the critical success factors to project success based on its provided definition.

10.3 Independent variables

After examining the three phases that explain the adoption of a BI&A project in an organization, it is important to study the factors that impact these stages. These independent factors are grouped into three main groups: technology, organization, and environment. These categories are inspired by the Technology, Organization, Envrionment (TOE) framework proposed by Tornatzky & Klein (1982).

10.3.1 Technology variables-research question 2

Research question 2: What are the technological factors that impact the adoption of a BI&A project in an organization?

This research question is approached by studying the technology adoption literature and examining the significant technological factors that impact this adoption process. After that, these technological factors are empirically analyzed using the following statistical tests: ranking and descriptive statistics, correlation analysis, simple regression, and multiple regression.

The hypotheses and their summary results used for this research question are presented in table 10.1.

Cost

Cost is the amount of money spent in setup, running, and training of a BI&A project (Kuan & Chau 2001).The cost factor is proven to be a significant variable in the adoption of a certain technology. For instance, Lin (2014) prove a significant rela-

Table 10.1: Summary hypothesis results for the technology variables

Hypothesis	Supported variables	Unsupported variables
H1a: technology variables are significantly correlated to the front-end management of a BI\&A project in an organization	complexity, advantage, compatibility	cost
H1b: technology variables are significantly correlated to the PPM of a BI\&A project in an organization	advantage, compatibility	complexity, cost
H1c: technology variables are significantly correlated to the success of a BI\&A project in an organization	compatibility	complexity, advantage, cost
H2a: technology variables significantly impact the front-end management of a BI&A project in an organization	complexity, advantage, compatibility	cost
H2b: technology variables significantly impact the PPM of a BI&A project in an organization	advantage, compatibility	complexity, cost
H2c: technology variables significantly impact the success of a BI&A project in an organization	compatility	complexity, advantage, cost
H3a: technology variables significantly impact the front-end management of a BI&A project in an organization relative to other variables	complexity, advantage, compatibility	cost
H3b: technology variables significantly impact the PPM of a BI&A project in an organization relative to other variables	advantage	compatibility, complexity, cost
H3c: technology variables significantly impact the success of a BI&A project in an organization relative to other variables	compatibility	complexity, advantage, cost

tionship between perceived costs and adoption of electronic supply chain management systems with beta value $= -0.233$. Cost is also proven as a significant factor in determining the adoption of electronic data interchange systems with beta value -0.4954 (Kuan & Chau 2001). However, in this research, cost is not a significant factor in explaining the adoption of BI&A projects in the PPM phase. First, cost had a low ranking of 11 out of 14 independent variables. Also, cost does not significantly correlate or impact any of the adoption stages of a BI&A project in an organization. This could be explained as perhaps the cost of a BI&A system is relatively lower than other systems. Also, most of the respondents use their current ERP systems as a BI&A tool where there are no extra costs endured. In addition, cost is not considered in multiple research such as in the work of Paul Jones et al. (2013), Tsou & Hsu (2015). Although cost might be an important factor,it is not significant enough to explain any of the adoption stages of BI&A projects in organizations.

Compatibility

Compatibility is how compatible the BI&A project is with the culture, work practices, and business values of an organization (Hernández-Ortega 2011). Compatibility is proven to be a significant factor in the adoption of a certain technology. For instance, Lee et al. (2009) propose a relationship between compatibility of knowledge management system diffusion in Chinese organizations. In this research, compatibility plays an important role with an overall ranking of 6 out of 14 independent variables. Also, compatibility significantly correlates with the front-end, PPM, and project success phases with r values of .330, .260, and .276, respectively. Using simple regression, compatibility also significantly impacts the front-end, PPM, and project success phases with beta values of .385, .231, and .317, respectively. When combined with other independent factors using multiple regression, compatibility significantly impacts the front-end management phase and the project success phase with beta values of .385 and .317, respectively. These results agree with the literature where Tornatzky & Klein (1982) and Hardgrave et al. (2003) prove the significance of compatibility in explaining technology adoption.

Advantage

Advantage, also known as perceived benefits factor, reports the perception of respondents on how the BI&A project would increase the profitability of the business, help with timely decision making (Premkumar & Roberts 1999), and improve employee job performance (Moore & Benbasat 1991*a*). Advantage is proven to be a significant factor in the adoption of a certain technology. For instance, Lin (2014) proves a significant relationship between perceived benefits and adoption of electronic supply chain management systems with beta value $= 0.381$. This is also proven in Pan & Jang (2008) with a significant beta value of $= 0.967$. In this research, the advantage of a BI&A project is important with an overall ranking of 3 out of 14 independent variables. Also, advantage significantly correlates with front-end and PPM phases with r values of .235 and .451, respectively. Using simple regression, advantage also significantly impact the front-end and PPM phases with beta values of .337 and .494, respectively. When combined with other independent factors using multiple regression, advantage significantly impacts the PPM phase beta values of .494. These results are inconsistent with the literature.

Complexity

Complexity measures how complex the skills to use a BI&A project is for the employees of the organization (Moore & Benbasat 1991*a*). Complexity is proven to be a significant factor in the adoption of a certain technology. For instance, Lee et al. (2009) propose a relationship between complexity of knowledge management system diffusion in Chinese organizations. In this research, complexity is ranked last with an overall ranking of 14 out of 14 independent variables. In consistency with the literature, complexity significantly negatively correlates with the front-end with r value of -.216. Using simple regression, complexity also significantly impacts the front-end phase with beta value of -.134. However, when combined with other independent factors using multiple regression, complexity is not significant in impacting any of the adoption phases of a BI&A project in an organization.

10.3.2 Organization variables-research question 3

Research question 3: What are the organizational factors that impact the adoption of a BI&A project in an organization?

This research question is approached by studying the technology adoption literature and examining the significant organizational factors that impact this adoption process. After that, these organizational factors are empirically analyzed using the following statistical tests: ranking and descriptive statistics, correlation analysis, simple regression, and multiple regression.

The hypotheses and their summary results used for this research question are presented in table 10.2.

Table 10.2: Summary hypothesis results for the organization variables

Hypothesis	Supported variables	Unsupported variables
H1d: organization variables are significantly correlated to the front-end management of a BI\&A project in an organization	top management, experience, culture, strategy & project management	infrastructure, resources
H1e: organization variables are significantly correlated to the PPM of a BI\&A project in an organization	top management, experience, culture, strategy & project management, resources	infrastructure
H1f: organization variables are significantly correlated to the success of a BI\&A project in an organization	top management, experience,infrastructure, strategy & project management, resources	culture
H2d: organization variables significantly impact the front-end management of a BI&A project in an organization	top management, experience, culture, strategy & project management	infrastructure, resources
H2e: organization variables significantly impact the PPM of a BI&A project in an organization	top management, experience, culture, strategy & project management, resources	infrastructure
H2f: organization variables significantly impact the success of a BI&A project in an organization	top management, experience,infrastructure, strategy & project management, resources	culture
H3d: organization variables significantly impact the front-end management of a BI&A project in an organization relative to other variables	None	
H3e: organization variables significantly impact the PPM of a BI&A project in an organization relative to other variables	culture, experience	infrastructure, top management, strategy & project management, resources
H3f: organization variables significantly impact the success of a BI&A project in an organization relative to other variables	strategy & project management	infrastructure, top management, culture, experience, resources

Strategy & project management

Strategy is a measurement of how BI&A projects are aligned with the goals of the organization (Grover 1993). Project management is a measurement of how well the BI&A project implementation is managed (Yap et al. 1994). After factor analysis, these two variables are merged together. Strategy is a significant statistical indicator in explaining the adoption of a certain technology (Basole et al. 2013, Yeoh & Koronios 2010). In this research, strategy and project management of an organization is important with an overall ranking of 4 out of 14 independent variables for strategy variable and 7 our of 14 independent variables for project management variable. Also, strategy and project management significantly correlates with front-end, PPM, and project success phases with r values of .343, .335 and .317, respectively. Using simple regression, advantage also significantly impacts the front-end, PPM, and project success phases with beta values of .366, .250, and .359, respectively. When combined with other independent factors using multiple regression, advantage significantly impacts the front-end and project success phases with beta values of .215 and .359, respectively. These results are inconsistent with the literature. The results are consistent with the work of Cooke-Davies (2002).

Top management

Top management measures how enthusiastic the top management of the organization is about BI&A projects. Top management is proven to be a significant variable in the adoption of a certain technology. For instance, Lin (2014) proved a significant relationship between top management support and adoption of electronic supply chain management systems with beta value $= 0.414$. In this research, top management of an organization is important with an overall ranking of 2 out of 14 independent variables. Also, top management significantly correlates with front-end and PPM with r values of .258 and .342, respectively. Using simple regression, top management also significantly impacts the front-end, PPM, and project success phases with beta values of .450, .345, and .304, respectively. When combined with other independent factors using multiple regression, top management does not impact any of the BI&A adoption phases. Top management is not that significant when combined with other variables because organizations now are becoming more and more flat which gives autonomy to employees (Laudon & Laudon 2004). Also, top management did not also show significant support in the work of Pan & Jang (2008), Kuan & Chau (2001), Seah et al. (2010).

Culture

Culture measures how important information is to the organization (Thong & Yap 1995). Culture is proven to be a significant construct in the adoption of a certain technology. For instance, Lin (2014) proves a significant relationship between culture and adoption of electronic supply chain management systems with beta value $= 0.742$. In this research, culture of an organization is important with an overall ranking of 1 out of 14 independent variables. Also, culture significantly correlates with front-end and PPM with r values of .274 and .397, respectively. Using simple regression, culture also significantly impacts the front-end and PPM phases with beta values of .427 and .472, respectively. When combined with other independent factors using multiple regression, culture impacts the front-end and PPM phases with beta-values of .266 and .374, respectively.

Resources

Resources measures how much time and money an organization has to implement a BI&A project (Chang et al. 2007). Resources is proven to be a significant construct in the adoption of a certain technology such as in the work of Mahler & Rogers (1999). In this research, resources of an organization has an overall ranking of 10 out of 14 independent variables. Resources significantly correlates with PPM and project success phases with r values of .264 and .274, respectively. Using simple regression, resources also significantly impact the PPM and project success phases with beta values of .173 and .232, respectively. When combined with other independent factors using multiple regression, resources does not impact any of the BI&A adoption phases. Resources is not that significant when combined with other variables because organizations might not need a lot of resources to execute BI&A projects as most of the respondents used the embdedded BI&A tools in ERP systems. Generally speaking, BI&A systems do not need a lot of extra resources in order to be implemented (Shyandilya et al. 2014). Resources did not also show significant support in the work of Vukšić et al. (2013), Hwang et al. (2004)

Infrastructure

Infrastructure measures how well the organization maintains data (Laudon & Laudon 2011). A proper infrastructure is important for the implementation of a BI&A project (Yeoh & Koronios 2010, Choy Chong 2006). In this research, infrastructure of an organization has an overall ranking of 8 out of 14 independent variables. Resources significantly correlates with project success phase with r value of .307. Using simple regression, resources also significantly impact the project success phase with beta value of .327. When combined with other independent factors using multiple regression, infrastructure does not impact any of the BI&A adoption phases. Maintaining clean data for the success of BI&A projects as indicated by the results of simple regression. However, when combined with other variables, it is not significant. Also, infrastructure did not show a significant support such as in the work of Lin (2014), Pan & Jang (2008), Wixom & Watson (2001).

Experience

Experience measures how familiar the organization is in implementing technologies similar to BI&A projects (Lin 2014). Experience is proven to be a significant construct in determining the adoption of a certain technology. For instance, Kuan & Chau (2001) proved a significant relationship between technical competence and adoption of electronic data interchange with beta value $= 0.7784$. In this research, experience of an organization has an overall ranking of 5 out of 14 independent variables. Experience significantly correlates with front-end, PPM and project success phases with r values of .360, .353 and .303, respectively. Using simple regression, experience also significantly impact the front-end, PPM and project success phases with beta values of .365, .283 and .295, respectively. When combined with other independent factors using multiple regression, experience significantly impact the front-end and PPM phases with beta-values of .198 and .217, respectively.

10.3.3 Environment variables-research question 4

Research question 4: What are the environmental factors that impact the adoption of a BI&A project in an organization?

This research question is approached by studying the technology adoption literature and examining the significant environmental factors that impact this adoption process. After that, these environmental factors are empirically analyzed using the following statistical tests: ranking and descriptive statistics, correlation analysis, simple regression, and multiple regression.

The hypotheses and their summary results used for this research question are presented in table 10.3.

Table 10.3: Summary hypothesis results for the environment variables

Hypothesis	Supported variables	Unsupported variables
H1g: environment variables are significantly correlated to the front-end management of a BI\&A project in an organization	competition, vendor support	government
H1h: environment variables are significantly correlated to the PPM of a BI\&A project in an organization	competition	vendor support, government
H1i: environment variables are significantly correlated to the success of a BI\&A project in an organization	None	competition, vendor support, government
H2g: environment variables significantly impact the front-end management of a BI&A project in an organization	competition, vendor support	government
H2h: environment variables significantly impact the PPM of a BI&A project in an organization	competition	vendor support, government
H2i: environment variables significantly impact the success of a BI&A project in an organization	None	competition, vendor support, government
H3g: environment variables significantly impact the front-end management of a BI&A project in an organization relative to other variables	competition, vendor support	government
H3h: environment variables significantly impact the PPM of a BI&A project in an organization relative to other variables	competition	vendor support, government
H3i: environment variables significantly impact the success of a BI&A project in an organization relative to other variables	None	competition, vendor support, government

Competition

Competition measures how the market influences the organization to adopt a BI&A project (Grandon & Pearson 2004). Competition factor is proven to be a significant variable in the adoption of a certain technology. For instance, Lin (2014) proves a significant relationship between competitive pressure and adoption of electronic supply chain management systems with beta value $= 0.243$. In this research, competition in the market has an overall ranking of 9 out of 14 independent variables. Competition significantly correlates with front-end and PPM phases with r values of .296 and .293, respectively. Using simple regression, competition also significantly impacts the front-end and PPM phases with beta values of .262 and .198, respectively. When combined with other independent factors using multiple regression, competition significantly impacts the front-end and PPM phases with beta-values of .212 and .198, respectively.

Vendor support

Vendor support measures how reliable the vendor is supporting the organization in implementing a BI&A project (Chang et al. 2007). Vendor support is very important in increasing the liklihood of adopting BI&A projects in organizations in the front end management phase (Bradford et al. 2014). In this research, competition in the market has an overall ranking of 12 out of 14 independent variables. Vendor support significantly correlates with front-end phase with r values of .364. Using simple regression, vendor support also significantly impacts the front-end phase with beta value of .350. When combined with other independent factors using multiple regression, vendor support significantly impacts the front-end phase with beta-values of .309.

Government

Government variable measures the progressive measures governments take to encourage organizations to implement a BI&A project (Grandon & Pearson 2004). Government factor is proven significant in some studies. For instance, Kuan & Chau (2001) finds a significant relationship between perceived government pressure and the adoption of electronic data interchange systems with beta value $= 0.2152$. In this research, competition in the market has a low overall ranking of 13 out of 14 independent variables. Also, government does not significantly correlate or impact any of the adoption stages of a BI&A project in an organization. Despite the fact that UAE won the EXPO 2020 award, it seems that the government does not provide any significant impact on organizations to implement BI&A projects. Perhaps the government focus on more tangible implementations such as the Dubai Tram or more city attractions. The results are consistent with the work of Hwang et al. (2004), Vukšić et al. (2013), Işık et al. (2013).

10.4 Difference in perceptions between groups

Research question 5: Are there differences between perceptions of respondents in how they view the adoption of a BI&A project in an organization?

By empirically examining this research question, it seems that respondents from different backgrounds and different organizations have different perceptions of the adoption of BI&A projects. In this research, respondents with different ethnic backgrounds, experience in organization, role in organization have different perceptions of BI&A projects adoption. Also, respondents who work in organizations with different IT project budget, type of BI system, storage duration, and analysis duration have different perceptions of BI&A projects adoption.

Respondents with different backgrounds respond differently to questionnaires. In fact, individuals answer relative to the members of their culture. For example, a 170 cm East Asian is considered tall compared to similar East Asians. However, a 170 cm American is considered short compared to similar Americans(Heine et al. 2002).

10.5 Summary

This chapter discussed the results of this research. This research proposes a model that explains the adoption of a BI&A project in an organization in three main phases: front-end, project portfolio management, and project success. These phases are impacted by three main categories of independent variables: technology, organization, and environment. The model is empirically validated using the following analysis techniques: ranking, correlation, simple regression, and multiple regression analysis. Also, different between independent samples test is conducted and discussed in the independent samples chapter.

11-CONCLUSION

11.1 Introduction

This chapter explains the conclusion of this study. First, the objectives of the research are presented along with the corresponding results. After that, contribution to knowledge is explained. Moreover, a discussion of the implications on policies by organizations is explained. Next, the study limitations are explained. Finally, recommendations for future research are discussed.

11.2 Summary of the study

The overall question of this research is to examine why some organizations invest in a BI&A project while others do not. The research investigates this question by examining the factors that impact the adoption process of a BI&A project in an organization.

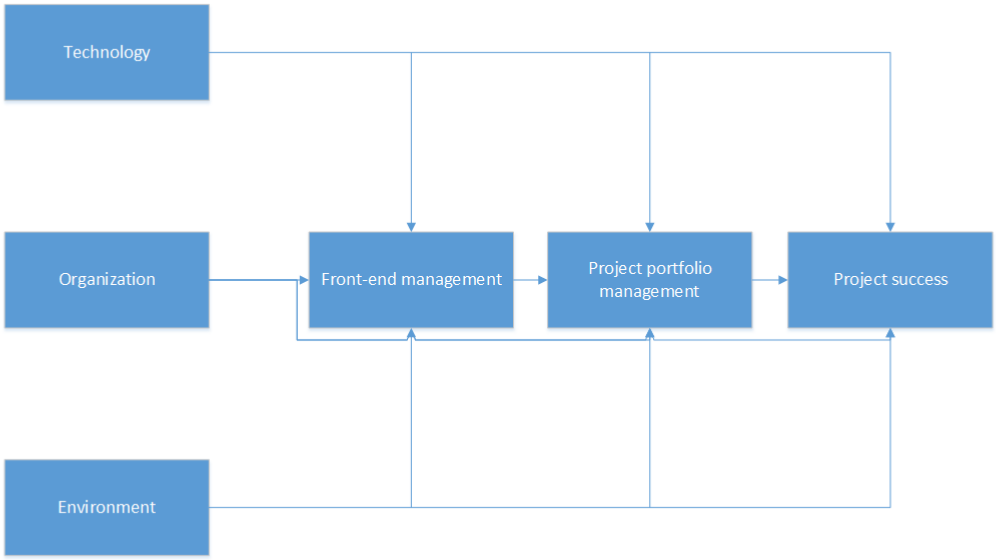
The research is undertaken in two main phases: literature review and quantitative analysis. The literature review phase examines the adoption process of a BI&A project and summarizes the adoption phases into three main phases: pre-adoption, adoption, and post-adoption. Since most organizations take huge endeavors in the form of a project (Jonas 2010), these adoption phases are translated into: front-end management, project portfolio management, and project success. These phases depict the phases that a BI&A project goes through when an organization decides to adopt it. Also, the literature review lists the main factors that impact these phases. These phases, adopted from the TOE framework, are grouped into three categories: technology, organization, and environment. The second phase of this research empirically verifies the relation between the independent factors from the TOE framework to the dependent adoption phases. The empirical analysis is undertaken using the following tests: ranking, correlation, simple regression, multiple regression, and difference between samples.

11.2.1 Adoption phases of a BI&A project in an organization

Research question 1: What are the stages in the adoption process for a BI&A project in an organization?

This research question aims to describe the adoption process of a BI&A project through the combination of the innovation literature and the project management literature. The innovation literature summarizes the adoption process into three main phases: pre-adoption, adoption, and post-adoption (Zhu et al. 2006). Since most organizations take huge endeavors in the form of a project (Jonas 2010), these adoption phases are translated into the following phases: front-end management, project portfolio management, and project success. These phases are impacted by three main categories of factors: technology, organization, and environment. The research model is shown in figure 11.1.

Figure 11.1: Proposed research model



11.2.2 Technological factors

Research question 2: What are the technological factors that impact the adoption of a BI&A project in an organization?

This question examines four technology variables: cost, complexity, compatibility, and advantage. In this research, cost does not correlate or impact any of the adoption phases of a BI&A project. As mentioned earlier, perhaps cost is not a major factor when it comes to the adoption decision of a BI&A project. Also, cost is not considered in similar research such as in the work of Paul Jones et al. (2013). Complexity correlates and influences front-end management of a BI&A project adoption. The more complex a BI&A project is perceived, the less likely it will be initiated as an idea in the organization. Compatibility correlates and influences all three phases of a BI&A project. If the BI&A project is perceived as compatible with the organization, it will more likely be initiated as an idea, selected as a project to be implemented, and become successful. Advantage correlates and influences the front-end management and project portfolio management phase of a BI&A project adoption process. This means that the if the BI&A project is perceived as beneficial, it is more likely that it will be initiated as an idea in the front-end management phase and eventually selected as a project in the project portfolio management phase. The relations are depicted in table 11.1.

Table 11.1: Conclusion of technology variables

	Front-end management	**PPM**	**Project success**
Cost			
Complexity	correlation, simple regression, multiple regression		
Compatibility	correlation, simple regression, multiple regression	correlation, simple regression	correlation, simple regression, multiple regression
Advantage	correlation, simple regression, multiple regression	correlation, simple regression, multiple regression	

11.2.3 Organizational factors

Research question 3: What are the organizational factors that impact the adoption of a BI&A project in an organization?

This question examines six organization variables: top management, culture, strategy & project management, resources, experience, and infrastructure. Top management correlates and influences front-end management, PPM, and project success phases of a BI&A project. This means that if top management is enthusiastic about BI&A project, it is more likely to initiate the BI&A project idea, implement it, and make it successful. This is consistent with the work of Lee et al. (2009), Zhu et al. (2006). Also, an organizational culture that depends on data correlates and influences the front-end management and PPM phases of a BI&A project. If the culture depends on data, it is more likely that the BI&A project idea will be initiated and implemented. Strategy & project management is an important variable that correlates and influences front-end management, project portfolio management, and project success. The strategy and project management practices in the organization increase the likelihood of initiating the BI&A project idea, implementing it, and making it successful. This result is consistent with the work of Ko et al. (2008). Resources of the organization correlate and influence the PPM and project success phase of a BI&A project. That is, if the organization has enough resources, it is more likely to implement the BI&A project and complete it successfully. This is consistent with the work of Wu & Chen (2014). Experience is an important factor that correlates and influences the front-end management, PPM, and project success phases of a BI&A project. That is, if the organization has a previous similar experience to a BI&A project, it is more likely to initiate, implement and complete a BI&A project successfully. This is consistent with the work of Kuan & Chau (2001), Borgman et al. (2013). Infrastructure correlates and influences the project success phase. If the organization has proper data, the BI&A project is more likely to be completed successfully. The relations are depicted in table 11.2.

Table 11.2: Conclusion of organization variables

	Front-end management	PPM	Project success
Top management	correlation, simple regression	correlation, simple regression	correlation, simple regression
Culture	correlation, simple regression	correlation, simple regression, multiple regression	
Strategy & project management	correlation, simple regression	correlation, simple regression	correlation, simple regression, multiple regression
Resources		correlation, simple regression	correlation, simple regression
Experience	correlation, simple regression	correlation, simple regression, multiple regression	correlation, simple regression
Infrastructure			correlation, simple regression

11.2.4 Environmental factors

Research question 4: What are the environmental factors that impact the adoption of a BI&A project in an organization?

This question examines six environment variables: competition, vendor support, and government. Competition correlates and influences the front-end and PPM phases of a BI&A project adoption. That is, if the organization faces a tough competition, they are more likely to initiate the BI&A project idea and implement it. This is consistent with the work of Zhu et al. (2006). Also, vendor support correlates and influences the front-end management phase of a BI&A project. That is, the vendor will spread the word of mouth and increase the likelihood of the organization initiating the idea of a BI&A project. This is consistent with the work of Wu & Chuang (2010). Government does not influence or impact any of the adoption phases of a BI&A project. Perhaps this is because the government did not take any measures for organization to adopt a BI&A project yet. The relations are depicted in table 11.3.

11.2.5 Difference between samples

Research question 5: Are there differences between perceptions of respondents in how they view the adoption of a BI&A project in an organization?

For this research question, different groups of respondents are examined to see whether they have different perceptions about the variables concerning the adoption

Table 11.3: Conclusion of environment variables

	Front-end management	PPM	Project success
Competition	correlation, simple regression, multiple regression	correlation, simple regression, multiple regression	
Vendor support	correlation, simple regression, multiple regression		
Government			

of a BI&A project. The independent sample tests conclude that respondents with different ethnic backgrounds perceive the infrastructure of their organization differently. Moreover, respondents with different experience perceive the advantage of a BI&A project and the culture of their organization differently. In addition, respondents with different roles in the organization perceive the infrastructure, resources, strategy & project management, and experience of their organization differently. They also view the advantage of a BI&A project differently. Furthermore, respondents with organizations that have different IT project budgets perceive infrastructure and strategy & project management of their organization differently. They also perceive the success of the BI&A project differently. Moreover, respondents with organizations that use different BI&A systems perceive the advantage of the project differently as different systems have different benefits. In addition, respondents with organizations that have different storage duration perceive the competition in the environment differently. Finally, respondents with organizations that have different analysis duration perceive front-end of the adoption phase differently. They also perceive the compatibility of the BI&A project with the organization different. Moreover, they perceive the competition in the environment and government impact differently. The results are summarized in table 11.4.

Table 11.4: Conclusion of independent samples test

	Variable with different perception
Ethnicity	Infrastructure
Experience	Advantage, culture
Role	Infrastructure, advantage, resources, strategy & project management, experience
IT project budget	Infrastructure, strategy & project management, project success
Type of BI system	Advantage
Storage duration	Competition
Analysis duration	Front-end, compatibility, compeitition, government

11.3 Contribution to knowledge

The main contribution of this research was to show why some organizations adopt a BI&A project while others do not. Therefore, this research fulfills the following aims and objectives:

- Describing the adoption phases of a BI&A project in an organization
- Listing and explaining the technological factors that impact the adoption of a BI&A project in an organization
- Listing and explaining the organizational factors that impact the adoption of a BI&A project in an organization

- Listing and explaining the environmental factors that impact the adoption of a BI&A project in an organization
- Examining whether there are differences in perceptions of respondents regarding different variables in the adoption of a BI&A project in an organization

This research results in an empirically validated research model explaining the main factors that impact the adoption and implementation of BI&A projects in organizations. This is an important extension to both the project management body of knowledge and the innovation body of knowledge. Most organizations undertake huge endeavors in the form of a project (Jonas 2010). If a project is new to the organization, it is considered as an innovation. Innovation is performed in three main phases: pre-adoption, adoption, and post-adoption (Zhu et al. 2006). Therefore, when an organization decides to adopt a BI&A project, the following happens: (1) the project idea gets initiated in the pre-adoption (front-end management) phase, (2) then the idea gets evaluated and chosen among other projects in the adoption (PPM) phase, (3) finally the project gets completed in the post-adoption (project success) phase. Heising (2012) discusses a similar model where projects go through those three main phases. However, that research does not involve or tailor to innovation adoption phases.

Also, this research examines the impact of technology, organization, and environment factors, inspired from the TOE framework, on the three adoption phases: front-end management, PPM, and project success. The research empirically validates the impact of these factors on the three adoption phases.

11.4 Policy and managerial implications

This research will help managers with the process of implementing BI&A projects by dividing the process into three main phases: front-end management, project portfolio management, and project success. Also, the research will help managers focus on the main factors that significantly impact the adoption process.

The research findings will also help consultants and vendors in promoting their BI&A projects to other organizations as it will provide them with guidelines on how to implement the system.

11.5 Research Limitations

This section will explain the main limitations of this research. Specifically, there are three main limitations in this research: factors not proposed or tested in the model and cultural considerations.

11.5.1 Sample size

Another limitation of this study is the sample size of 100 qualified responses. However, this sample size is acceptable in the literature of technology adoption (Hwang et al. 2004, Işık et al. 2013). Moreover, the data survived all the assumptions before applying the statistical analysis. Also, the number of respondents represent 35.4%

response rate. This response rate is typical for web-based surveys (Işık et al. 2013).

11.5.2 De-selected factors of the Theoretical Framework

There are many factors, more than 100 factors, that have been studied in the literature in relation to the process of technology diffusion (Jeyaraj et al. 2006). However, this model will only include significant factors that have been studied thoroughly in the literature. In addition, it is important not to include all factors to create a simple research model that is easy to understand.

11.6 Future research

Future research could attempt to verify the research by duplicating the results through qualitative analysis rather than quantitative analysis. This would also give better insights and explanations for the unsupported hypothesis.

Another direction for research is to apply this model from the individual level of analysis rather than the organizational level of analysis. This is important since individuals need to adopt the system after the organizations have actually acquired and adopted the BI&A project.

In addition, future research could test the model in different cultures to examine if there are any cross-cultural differences. This will improve the generalization of the results.

Also, the model could be applied to other technologies to see if a BI&A technology is really different than other technologies. It will be interesting to observe what makes a certain technology different than the others to the extent of having a separate theoretical model for each one of them.

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Appendix A

Factors impacting Business Intelligence/Analytics Project(s) Adoption

"Business Intelligence is a set of technologies and processes that allow users to access, analyze, and explore data for decision making. These technologies include both the backend data warehouse systems and the front-end user tools." (Definition adopted from the book "Successful Business Intelligence: Secrets to making BI a killer app" by Cindi Howson.) Some of Business Intelligence tools include: Excel Sheet, Part of Enterprise Solution, Independent System, Written Codes, Dashboards...etc.

The purpose of this questionnaire is to understand the main reasons behind investments in Business Intelligence/Analytics Project(s). In addition, the questionnaire looks at what makes these projects successful. The findings of this study are very important as it helps organizations and decision makers create the right ambiance for their investments in Business Intelligence/Analytics project(s).

Please take a few minutes to answer this questionnaire. Your participation is voluntary and all responses will be kept confidential. Only aggregate results will be published. If you are interested in receiving a report about the result as soon as it becomes available, please send an email request to (namer@aus.edu). Also, as a way of thanking you for your input, survey respondents will be entered into a random draw to win a free copy of the famous book: "Successful Business Intelligence: Secrets to making BI a killer app" by Cindi Howson. In order to be entered into this drawing, your questionnaire must be complete and you must provide your contact details. Winners will be notified by email in May 2015.

If you have any questions about the questionnaire, please send an email to the researcher (namer@aus.edu) or call on (+-971-56-1889564).

Thank you for your time.

Instructions:
The questionnaires will consist of five main parts.
Part 1: Demographics
Part 2: Business Intelligence/Analytics Project(s)
Part 3: Technology
Part 4: Organization
Part 5: Environment

* Required

This document is created by Noha Tarek Amer. For further information, contact "noha.tarek90@gmail.com"

Part 1-Demographics

1. **Gender** *

   Mark only one oval.

   ◯ Male
   ◯ Female

2. **Which of the following best represents your racial or ethnic heritage?** *
Mark only one oval.

- Native American or Alaskan Native
- Middle Eastern or Arab American
- South Asian or Indian American
- East Asian or Asian American
- Latino or Hispanic American
- Black, Afro-Caribbean, or African American
- Non-Hispanic White or Euro-American
- Other: ....

3. **Please select your country location: (the country where your organization is located)**
Mark only one oval.

- UAE
- Qatar
- Saudi Arabia
- Bahrain
- Oman
- Kuwait
- Other: ....

4. **What best describes your role in the organization?**
Mark only one oval.

- Corporate IT Professional
- Business User
- Hybrid Business/IT Person
- Independent consultant or System integrator
- Vendor (Sales, Service, Support, or development)
- Other: ....

5. **Experience in Current Organization**
Mark only one oval.

- Less than 1 year
- 1 to 3 years
- 3 to 5 years
- 5 to 8 years
- More than 8 years

6. **Experience in Current Position**

Mark only one oval.

- ( ) Less than 1 year
- ( ) 1 to 3 years
- ( ) 3 to 5 years
- ( ) 5 to 8 years
- ( ) More than 8 years

7. **Type of organization** *

Mark only one oval.

- ( ) Manufacturing
- ( ) Service

8. **Number of Employees** *

Mark only one oval.

- ( ) Less than or equal to 100 employees
- ( ) 101-500 employees
- ( ) 501-1000 employees
- ( ) 1001-2000 employees
- ( ) 2001-5000 employees
- ( ) More than 5000 employees
- ( ) Do Not Know

9. **Specialty of organization** *

Mark only one oval.

- ( ) Public Sector
- ( ) Health care
- ( ) Financial Services
- ( ) Education
- ( ) Consulting
- ( ) Hotels
- ( ) Recreation & Entertainment
- ( ) Real Estate
- ( ) Beauty Services
- ( ) Airlines
- ( ) Telecommunications
- ( ) Automotive
- ( ) Transportation/Logistics
- ( ) IT/Software
- ( ) Construction Services
- ( ) Pharmaceutical/chemical
- ( ) Other: ....

10. **Age of Organization** *
Mark only one oval.

- Less than 1 year
- 1 to 3 years
- 3 to 5 years
- 5 to 8 years
- More than 8 years
- Do Not Know

11. **Average Annual Revenues**
Mark only one oval.

- Less than 10 million DHS
- 10-100 million DHS
- 101-300 million DHS
- 301-600 million DHS
- 601 million-1 billion DHS
- More than 1 billion DHS
- Do Not Know

12. **Percentage of IT projects budgets compared to overall organizational budget** *
Mark only one oval.

- 1%-10%
- 10%-30%
- 30%-50%
- More than 50%
- Do Not Know

Part 2- Data Management & Analytics

13. **Our organization uses a Data Management (Database) System?** *
Mark only one oval.

- Yes
- No
- Do Not Know

14. **Our organization adopted/implemented a Business Intelligence/Analytics project(s) to solve an organizational problem?** *
Mark only one oval.

- Yes
- No *Skip to question 37.*
- Do Not Know *Skip to question 37.*

Part 2- Data Management & Analytics Details (Continued)

15. **What type of Business Intelligence/Analytics System(s) do you use? (pick all that are applicable)** *

Check all that apply.

- [ ] Excel sheet analysis
- [ ] Part of Enterprise solution
- [ ] Independent system
- [ ] Written codes
- [ ] Other: ....

16. **What Business Intelligence/Analytics activities do you perform? (pick all that are applicable)** *

Check all that apply.

- [ ] Data cleansing and pre-processing
- [ ] Data Analysis
- [ ] Making conclusions and/or actions
- [ ] Other:

17. **The average number of members who are typically involved in a Business Intelligence/Analytics project(s)?** *

Mark only one oval.

- ( ) Less than 5 members
- ( ) 6-9 members
- ( ) More than 9 members

18. **For how long has the organization been storing data?** *

Mark only one oval.

- ( ) Less than 1 year
- ( ) 1 to 3 years
- ( ) 3 to 5 years
- ( ) 5 to 8 years
- ( ) More than 8 years

19. **For how long has the organization been using the Business Intelligence/Analytics System(s)?** *

Mark only one oval.

- ( ) Less than 1 year
- ( ) 1 to3 years
- ( ) 3 to 5 years
- ( ) 5 to 8 years
- ( ) More than 8 years

To What extend do you agree with the following statements

20. **Front End Management** *
Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization has performed evaluation for a Business Intelligence/Analytics project(s)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Major vendor considerations are considered at the initial planning of our project management practices	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Business Intelligence/Analytics project(s) definition is explicitly developed and documented in the initial stage of the project	⬭	⬭	⬭	⬭	⬭	⬭	⬭

21. **Project Portfolio Management** *
Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
We believe that Business Intelligence/Analytics project(s) will maximize our returns and/or minimize our costs	⬭	⬭	⬭	⬭	⬭	⬭	⬭
There is alignment between Business Intelligence/Analytics project(s) and the organizational strategy	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Business Intelligence/Analytics project(s) is ranked against other projects in the portfolio	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Business Intelligence/Analytics project(s) helps our firm prepare for the future	⬭	⬭	⬭	⬭	⬭	⬭	⬭

22. **Project Success** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
The Business Intelligence/Analytics project(s) has met (or expected to meet) project SCHEDULE							
The Business Intelligence/Analytics project(s) has met (or expected to meet) project BUDGET							
The Business Intelligence/Analytics project(s) has met (or expected to meet) project SCOPE							
The Business Intelligence/Analytics project(s) has been used by employees (or expected to be used)							
The Business Intelligence/Analytics project(s) operates according to original concept							

Part 3-Technology

23. **Complexity** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
I would find a Business Intelligence/Analytics system to be flexible to interact with							
The skills required to use a Business Intelligence/Analytics system are too complex for our employees							
Overall, I believe that a Business Intelligence/Analytics system is easy to use							

24. **Relative Advantage** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
A Business Intelligence/Analytics system will allow us to better communicate with our business partners	◯	◯	◯	◯	◯	◯	◯
A Business Intelligence/Analytics system will allow us to cut costs in our operations	◯	◯	◯	◯	◯	◯	◯
Implementing a Business Intelligence/Analytics system will increase the profitability of our business	◯	◯	◯	◯	◯	◯	◯
Adoption of a Business Intelligence/Analytics system will provide timely information for decision makers	◯	◯	◯	◯	◯	◯	◯
Using a Business Intelligence/Analytics system improves the employees job performance	◯	◯	◯	◯	◯	◯	◯

25. **Compatability** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
The Business Intelligence/Analytics system is compatible with our culture	◯	◯	◯	◯	◯	◯	◯
The Business Intelligence/Analytics system is compatible with our work practices	◯	◯	◯	◯	◯	◯	◯
The Business Intelligence/Analytics system is compatible with our business values	◯	◯	◯	◯	◯	◯	◯

26. **Cost** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Business Intelligence/Analytics systems have high set up costs	◯	◯	◯	◯	◯	◯	◯
Business Intelligence/Analytics systems endure high running costs	◯	◯	◯	◯	◯	◯	◯
Business Intelligence/Analytics systems endure high training costs	◯	◯	◯	◯	◯	◯	◯

27. **IT Infrastructure** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization has a good Database infrastructure	◯	◯	◯	◯	◯	◯	◯
There are different database applications for different functions	◯	◯	◯	◯	◯	◯	◯
Business Intelligence/Analytics system is compatible with our Information Systems infrastructure	◯	◯	◯	◯	◯	◯	◯
Our organization maintains clean data	◯	◯	◯	◯	◯	◯	◯
Our organization maintains the integrity of the data	◯	◯	◯	◯	◯	◯	◯

Part 4-Organization

28. **Top Management** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Top Management is interested in Business Intelligence/Analytics project(s)	◯	◯	◯	◯	◯	◯	◯
Top Management is enthusiastic in the Business Intelligence/Analytics project(s)	◯	◯	◯	◯	◯	◯	◯
Top management is aware of the benefits of Business Intelligence/Analytics system(s) to the organization	◯	◯	◯	◯	◯	◯	◯
top management actively encourages employees to use Business Intelligence/Analytics system(s) in their daily tasks	◯	◯	◯	◯	◯	◯	◯

29. **Culture** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization encourages employees to submit new ideas	◯	◯	◯	◯	◯	◯	◯
our organization encourages contributions of team members from different cultures	◯	◯	◯	◯	◯	◯	◯
Access to data is overly controlled, and executives fear workers know too much	◯	◯	◯	◯	◯	◯	◯
Our organization is dependent on up to date information	◯	◯	◯	◯	◯	◯	◯
It is important to have access to reliable, relevant, and accurate information	◯	◯	◯	◯	◯	◯	◯
It is important to access information fast	◯	◯	◯	◯	◯	◯	◯
Decisions are made from gut feel and not fact-based analysis	◯	◯	◯	◯	◯	◯	◯

30. **Resources** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization has extra resources	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our organization has enough time resources to execute Business Intelligence/Analytics project(s)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our Organization has enough funding resources to execute Business Intelligence/Analytics project(s)	⬭	⬭	⬭	⬭	⬭	⬭	⬭
We have good IT human resources	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our organization has enough data to use in a Business Intelligence/Analytics system(s)	⬭	⬭	⬭	⬭	⬭	⬭	⬭

31. **Strategy** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our Business Strategy includes innovation strategy	⬭	⬭	⬭	⬭	⬭	⬭	⬭
There is continuous assessment of technologies in Information Systems planning	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Information Systems Management is constantly involved in Business Planning	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our Business Intelligence/Analytic project(s) is/are aligned with company goals	⬭	⬭	⬭	⬭	⬭	⬭	⬭

32. **Experience** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization implemented a lot of new technologies in the last three years	◯	◯	◯	◯	◯	◯	◯
Our organization has a high level of investment in technology	◯	◯	◯	◯	◯	◯	◯
Our organization has necessary knowledge to learn and implement a Business Intelligence/Analytics project(s)	◯	◯	◯	◯	◯	◯	◯
A Business Intelligence/Analytics project(s) is/are compatible with our experience in similar systems	◯	◯	◯	◯	◯	◯	◯

33. **Project Management Practices** *

Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization performs adequate Business Intelligence/Analytics project(s) scope	◯	◯	◯	◯	◯	◯	◯
Our organization performs adequate Business Intelligence/Analytics project(s) plan	◯	◯	◯	◯	◯	◯	◯
The project manager has an understanding of Business Intelligence/Analytics systems	◯	◯	◯	◯	◯	◯	◯
Our Business Intelligence/Analytics Project is well managed	◯	◯	◯	◯	◯	◯	◯

Part 5-Environment

34. **Competitive Pressure** *
Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our organization would have experienced a competitive disadvantage if we didn't implement a Business Intelligence/Analytics system	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Competition is a factor in our decision to adopt a Business Intelligence/Analytics system	⬭	⬭	⬭	⬭	⬭	⬭	⬭
our industry is pressuring us to adopt a Business Intelligence/Analytics system	⬭	⬭	⬭	⬭	⬭	⬭	⬭

35. **Vendor Support** *
Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
Our vendor is very knowledgeable in Business Intelligence/Analytics systems	⬭	⬭	⬭	⬭	⬭	⬭	⬭
The vendor provides adequate training	⬭	⬭	⬭	⬭	⬭	⬭	⬭
The vendor provides adequate support	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our organization trusts the vendor	⬭	⬭	⬭	⬭	⬭	⬭	⬭

36. **Government** *
Mark only one oval per row.

	Strongly disagree	Disagree	Disagree somewhat	Neutral /undecided	Agree somewhat	Agree	Strongly agree
There are progressive government measures to implement a Business Intelligence/Analytics system	⬭	⬭	⬭	⬭	⬭	⬭	⬭
Our organization is pressured by the government to adopt/implement a Business Intelligence/Analytics system	⬭	⬭	⬭	⬭	⬭	⬭	⬭

Submit Form

37. **Would you be interested to implement a Business Intelligence/Analytics Project(s) in the future?** *

Mark only one oval.

- Yes
- No
- Do Not Know

38. **Any Further Comments?**

Thank you very much for completing the survey. Your help is highly appreciated. Kindly provide the below information to help us contact you for any follow up or further questions. The researcher assures the confidentiality of the results and that only aggregate results will be published. Also, entering your contact information guarantees your eligibility to enter a draw to win a free copy of the famous book: "Successful Business Intelligence: Secrets to making BI a killer app" by Cindi Howson.

39. **Name of Company**

40. **Name of Respondent**

41. **Email Address**