THE ADOPTION OF INTERORGANISATIONAL INFORMATION SYSTEMS BY SOUTH AFRICAN FIRMS:

A TECHNOLOGICAL, ORGANISATIONAL AND ENVIRONMENTAL PERSPECTIVE

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I declare that this research report is my own work, except as acknowledged in the text. It has not been submitted before for any other degree or examination in this or any other university.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Interorganisational information systems (IOIS) are automated systems which allow one or more firms to connect to their suppliers or customers in order to exchange data and information. Previous literature has suggested that the adoption of interorganisational information systems presents several benefits and challenges. IOIS is assumed to offer organisations the capability to improve business processes and provide better working relations with business partners. Despite this advantage that IOIS offers, adoption of IOIS presents complexities such as those associated with compatibility with a firm's IT infrastructure, lack of available skills, and concerns over data security and system failures.

Through a review of existing IOIS literature, this study identified that four types of IOISs are available in South African, namely dyadic, multilateral, community, and hub and spoke. In addition, the technological, organisational and environmental (TOE) factors influencing the adoption IOIS were identified. A model exploring the effects of the pre-determined TOE factors on the adoption of IOIS was developed and tested. The TOE framework provided a theoretical contribution and addressed a gap in the literature into the barriers and determinants of the adoption of interorganisational information system (IOIS) across various organisations.

A quantitative study was carried out and survey data was collected from a sample of 119 organisations across different sectors in South Africa. Data was collected using a structured questionnaire instrument administered online to a single key informant from each sampled organisation. The results revealed that multilateral IOIS are the most adopted systems while Hub and spoke IOIS are the least used. Furthermore, from the elven technologies which were identified in the literature review, the study revealed that groupware technologies, electronic payment system/online banking, video conferencing and electronic data interchange were the most adopted IOIS technologies within the sampled organisations.

Adoption of IOIS was defined in two ways. First, IOIS adoption was measured as the number of implemented IOIS technologies. Second, as the extent which IOIS is used as communication medium with business partners and supports an organisation in decision making, business operation and replaces legacy technologies. Correlation analysis was used to test the model's hypotheses and multiple regression was used to test the overall TOE model. The results showed that perceived compatibility, competition, and IS technical skill and education and training are most correlated with the adoption of IOIS, where adoption is measured as the extent of IOIS used as communication medium with business partners and used as support within an organisation. Top management support, trading partner pressure and perceived relative advantage of IOIS were also positively correlated with adoption, where adoption is measured as implemented IOIS technologies. Perceived complexity was found to be a barrier to IOIS adoption. This study serves as a guide for assessing factors contributing to interorganisational information system adoption and provides organisations with greater insight into the factors likely to enable and inhibit IOIS adoption.

Keywords: IOS, IOIS, Technology-Organisation-Environment (TOE) Framework, information technology, IS department.

CHAPTER 1. INTRODUCTION

The first section of this chapter provides the general context and background of the study. The remaining sections of the chapter discuss problem statement, purpose of the study, intended contributions and delimitations.

1.1 Background

The term interorganisational information system (IOIS) refers to an information system which is used jointly by business partners, or group of companies, with shared or common information technology (IT) capabilities (Lyytinen and Damsgaard, 2011). Shared IT capability refers to common databases, communication networks, and common applications which enables trading companies to electronically send each other business information across organisational boundaries (Lyytinen and Damsgaard, 2011, Johnston and Vitale, 1988). IOIS allows organisations to improve business operations and trading partner relationships by connecting linkages between trading partners (Soliman and Janz, 2004). In addition to the above, IOIS allows business partners to jointly improve their market expansion, to identify and meet customer needs, and enhance their responsiveness and delivery of products to consumers (Soliman and Janz, 2004; Li and Lin, 2006). Plus, IOIS enables organisations to improve their business-IT alignment, business process and cost reduction (Rajaguru and Matanda, 2012; Lee and Kim, 2007).

There are different types of interorganisational information system, such as the traditional value added network based electronic data interchange (EDI), internet based EDI, extranets, and B2B exchanges (Lyytinen and Damsgaard, 2011, Johnston and Vitale, 1988). Understanding the type of IOIS to adopt in business enables an organisation to understand information exchange platforms to use for different business channels and enables organisation to re-engineer their business process to take full advantage of communication medium and achieve seamless integration of key processes (Soliman and Janz, 2004; X.-H. Lu et al., 2006).

However, implementation of shared IT capability can be complex because of the diverse interests, cultures, and strategic intentions required across multiple partners (Ireland and Webb, 2006; Rajaguru and Matanda, 2012). As a result IOIS involves substantial effort to redefine internal operations technically and strategically (Hult, Ketchen, and Slater, 2004; Kim, Ryoo, and Jung, 2011; Rajaguru and Matanda, 2012). Recent literature discussed in greater detail in this paper, indicates that the state of IOIS adoption in some cases has been low (Rodon et al., 2011)

Although past studies in developed country contexts have extensively studied the adoption of IOIS (Soliman and Janz, 2004), factors affecting the implementation of IOIS (Kim and Lee, 2008), continued use of IOIS (Ortega et al., 2014) and strategic choices in development of IOIS (Choudhury, 1997), there are limited studies of IOIS in developing countries. Thus greater insight is needed into the types of IOIS in use within firms operating in developing countries such as South Africa as well as the factors influencing the uptake of IOIS technologies in such contexts. The following section will discuss the problem statement, purpose of the study, intended contributions and delimitation.

1.2 Problem statement

IOIS includes electronic data interchange (EDI), business-to-business (B2B) and e-commerce (Choudhury, 1997; Lyytinen and Damsgaard, 2011). IOIS are often developed on internet-based technologies and the use of open standard networks (Zhu et al., 2006). Yet, the uptake and implementation of IOIS across South African firms is not well described and we have limited insights into the state of adoption. Without such a description, practitioners and technology researchers in South Africa have insufficient insights into the types of IOIS available for adoption and the types of IOIS which have diffused within the South Africa context. Moreover, without such description, firms are not able to determine which system can be used to achieve competitive advantages and the factors required to succeed with IOIS adoption in certain organisational contexts. This study intends to examine the different types of inter organisational information system used in South African firms as well as to describe the different types of IOIS adopted across industry sectors. Thus, the following research question is posed:

> ***RQ1****: What are the types of IOIS used by South African firms?*

IOIS is assumed to offer trading partners the capability to improve business processes and provide better working relations with business partners (Soliman and Janz, 2004). This study contributes to this area of research by investigating IOIS adoption at the organisation level in South Africa. IOIS adoption refers to (1) an organisation ability to adopt and use an IOIS, (2) extent to which an organisation are using various IOIS technologies and (3) the IOIS technologies which are currently in use (Zhu et al., 2006). This study draws on the Technology-Organisation-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as a lens through which the impacts of technological, organisational and environmental factors on the likelihood to adopt IOIS are identified and explored. To this end, the following research question is posed:

> ***RQ2****: What are the technological, organisational and environmental factors influencing adoption of IOIS by organisations in South Africa?*

1.3 Purpose of the study

Several studies discussed different typologies used to identify the types of IOIS and ways in which IOIS can support an exchange relationship with trading partners (Choudhury, 1997; Lyytinen and Damsgaard, 2011). Thus to answer research question 1, the typologies identified inform a literature review were used identify a list of potential IOIS which could be adopted by firms in South Africa. An online questionnaire was used to collect data from key informants within South African firms listed in the http://www.whoownswhom.co.za/. The empirical data is used to illustrate the types of IOIS available in South African firms and address the first research question.

To address research question 2, a model of the factors impacting the adoption of IOIS in the sampled South African firms is developed using the TOE framework as a theoretical lens. Using the survey data collected, the model is tested. Specifically, factor analysis (FA) and multiple regression models were used to determine the relative impact of the factors drawn from the TOE framework and their influence on the state of IOIS adoption.

1.4 Intended contributions of the study

This study will inform practice of the current factors influencing the adoption of IOIS and explain the impact associated with the factors of the adoption. There are also implications for theory. These are discussed next.

Contributions to Practice

This study seeks to provide guidance to professionals who would want to understand the factors influencing other organisations decisions to adopt IOIS. Although such studies have been carried out elsewhere, there is the possibility of differences in terms of economic status, nature of IT infrastructure, managerial capabilities, and differences in regulations of countries that might account for differences in the factors influencing adoption. For instance, Kim and Lee (2008) performed a study on the factors affecting the implementation of Electronic Data Interchange (EDI) which is a subset of IOIS, in Korea, by applying TOE framework. They found that factors such as high implementation cost, and complication in terms of contractual relationships with other suppliers detracted from adoption (Kim and Lee, 2008). This research will investigate different factors' impacting the nature of IOIS adoption by South African firms and it will provide some important findings for scholars and practitioners. The results could highlight various factors that have strong potential to stimulate adoption. The results would provide both business managers' and regulators insights into interventions that could be applied to mitigate the effects of factors detracting from IOIS adoption, while strengthening those factors found to promote IOIS adoption in South Africa. The results of the study can be used to inform IOIS business partners on how to better facilitate the adoption of IOIS. Successful adoption of IOIS will enable firms' to exchange information efficiently and facilitate business transactions. In addition, the results can be used to provide practitioners insights into the types of IOIS available for adoption, and which have been most popular already as a means to link trading partners.

Contributions to Theory

For academics, this study conceptualized IOIS adoption from the diffusion model (Rogers, 1995), and integrates the models with the technology organisation-environment framework (Tornatzky and Fleisher, 1990). This approach has not been used in South African context, to the best of my knowledge. This study therefore addresses the gap in the literature, where this framework has not been extensively used to understand IOIS adoption. To address this gap, a quantitative empirical study on IOIS adoption in South Africa is performed; the study will identify and define variables within a conceptual model, and provide empirical evidence of their effects. For example, it is not known which of the technology factors such as perceived compatibility, perceived relative advantage; or the organisational factors such as top management support, size, IS technical skill and education and training; or the environmental factors such as trading partner pressure, government regulation and competition exert the strongest effects on IOIS adoption by South African firms.

1.5 Delimitations of the study

The study assumes that the variables used within the TOE framework, are the only contributing factors, it does not identify other complex factors. The study also seeks to establish adoption of IOIS at organisational level in South African firms only. In addition to the above, in terms of data collection, quantitative survey based data is used as opposed to qualitative data. The variables contained in the survey were identified from prior literature.

1.6 Structure of the research report

This chapter presented the background of IOIS and gave the rationale for conducting the research. The intended contribution of the study to both practice and academia are documented in this chapter and the delimitation of the study were outlined. The aim of the study of surveying the types of IOIS used across different industry sectors in South Africa and the factors influencing the adoption of interorganisational information system by South Africa firms are detailed and will further be discussed in subsequent chapters. The remaining sections of the research paper will be structured as follows:

Chapter 2, Literature Review will first classify the types of IOIS typically in use, which will subsequently be examined in South African firms so as to answer the first research question. Next, the chapter will discuss the benefits and challenges of IOIS, and present the state of IOIS adoption studies in the literature with a discussion of their contributions and shortcomings. Finally, to be able to address the second research question, a research model is developed underpinned by the TOE framework as a theoretical lens. The research model hypothesizes the effects of various factors on the adoption of IOIS in the South African firms.

Chapter 3, Research Methodology will discuss in detail the quantitative research design used to address the second research question which is, what are the TOE factors influencing the adoption state of IOIS in South Africa. The chapter will provide an explanation as to why the quantitative research approach was chosen. It will also further explain the construction of the questionnaire, sampling and data sources, and testing strategy.

Chapter 4, Results and analysis will discuss the statistical techniques used in analysing the collected data and data interpretation

Chapter 5, Discussion will present the findings and interpretations drawn from the data analysis with reference to past literature.

Chapter 6, Conclusion will detail the results of the study, the implications of the study and future research directions.

CHAPTER 2. LITERATURE REVIEW

This chapter presents a review of existing literature into the factors influencing the adoption or use of interorganisational systems. The first section describes how a systematic review of past studies was carried out and presents the results of that systematic review. Next, the shortcomings and contributions of existing research into IOIS are described. Thereafter, the study's theoretical underpinnings, research model and the associated hypotheses are developed.

2.1 IOIS adoption studies

To identify past studies into IOIS adoption, a systematic review of the literature was carried out adapting framework by Uman (2011). The following databases were utilised; EBSCO, ProQuest, Science Direct, JSTOR, IEEE Xplore and Google Scholar. These databases were selected to assist with identifying primary study sources as they collectively index the senior scholar's basket of journals selected by Association for Information System (2010). AIS is the premier professional association for individuals and organisations who lead the research, teaching, practice, and study of information systems worldwide (AIS, 2010).

To perform database lookups to obtain articles, the following search terms were used; "IOIS adoption" or (adoption AND "interorganisational information system") or interorganisational information system. The term IOIS is referenced differently in publications; therefore these terms were also used in the search string: "IOS" or "EDI" or "B2B" or ("B2B" and developing countries). In selecting journals, the following inclusion criteria were applied:

- Articles were selected if they included the keywords in the title, abstract, addressed the relevant outcomes (i.e. the adoption of IOIS).
- Articles were selected if they were published in highly ranked Information Systems journals.
- Articles that have been cited by others were preferred.

The following exclusion criteria were applied:

- Articles which did not include IOIS
- Articles which did not address the IOIS as an outcome

The search revealed a total of 76 studies which discussed the adoption of IOIS. These studies employed different data collection methodologies such as surveys, case studies and interviews. Of these articles, only 32 were quantitative empirical studies and are used to indicate the current state of IOIS adoption research, assist with identifying the classification of IOIS and are used in the development of the conceptual model.

In addition to the above, to find IOIS adoption studies carried out in South African, the following search terms were used; ("EDI" "South Africa") and ("B2B" "South Africa") on Google Scholar. In selecting the journals, the articles were selected if they included the keywords in the title, abstract, addressed the relevant outcomes (i.e. the adoption of EDI or B2B in South Africa). The search revealed a total of 88 studies which were related to the adoption of IOIS. Articles were excluded if they were not carried out in South Africa and were not addressing IOIS adoption as an outcome. Based on the search applied, only three articles addressed the inclusion criteria. Articles were selected, if they included the keywords in the title, abstract, addressed the relevant outcomes (i.e. the adoption of IOIS) and were carried out in South Africa.

2.1.1 *IOIS adoption studies in developed countries*

Previous research on IOIS adoption has been carried out in both developing (China, Jordan, Indonesia) and developed countries such as Germany, United Kingdom, Ireland situated in Europe, Australia, United States of America, Korea and Singapore situated in the Asia region to mention a few. These studies where across various industries such as banking, insurance, stock trading, retail, transport, airlines, communication, health care, agriculture, mining, energy, manufacturing, business services, hotels, education, construction, public administration, media (Teo et al., 1995; Thong,1999; Kuan and Chau, 2001; Soliman and Janz, 200; 3 Zhu et al.2003; Soliman and Janz,2004; Lu et al.2006; Zhu et al.2006; Lee and Kim, 2007; Lai et al.,2013). This therefore indicates the need to conduct research into IOIS in a developing country context such as South Africa.

Studies on IOIS adoption are mostly conducted at organisational level and a few studies are conducted at country level. For instance, a study by Zhu et al., (2003) was conducted across eight European countries to help understand the adoption of eBusiness which is a subset of IOIS. In addition to this study Zhu et al., (2006) conducted a study across 10 countries to understand assimilation of eBusiness. However most of the studies presented in this paper are conducted at organisational level, the above supports that IOIS adoption study can be conducted at organisation level. In addition to the above, the following organisational level adoption studies analysed factors that influence firms to adopt IOIS in the context of EDI (Kuan and Chau, 2001; Soliman and Janz, 2003), and internet based information systems (Lee and Kim, 2006). This influenced this study to be conducted at organisational level

Below is discussion on the studies which have used various theories to study IOIS adoption. In one of the earliest studies, Teo et al. (1995) used the diffusion and innovation theory to examine factors affecting the adoption intention of financial EDI in Singapore in the present and future. The sample was made up of organisations listed on the Singapore stock exchange. Findings from the study illustrated that complexity, operational risk and strategic risk had largest influence on intention to adopt financial EDI in the present, while relative advantage and observability had less significance for intention to adopt in the present. However, complexity, observability and strategic risk were important to adopt financial EDI in the future, while trialability showed lesser effects on intention to adopt in the future (Teo et al., 1995).

Additionally, the study by Ibrahim and Ribbers (2009) uses resource based view (RBV) and Transaction cost economies to explain how trust is required to influence interorganisational relationships and the extent to which joint resources are incorporated by both organisations to facilitate the relationship. Without trust between companies, IOIS is less likely to be adopted and organisations are less likely to commit their joint resources to develop an IOIS system. In addition to the above, a study by Lai et al. (2013) used a trust model to investigate the perceptions regarding the impact of company, subject, and system characteristics on trust factors affecting the adoption of internet based interorganisational information system in Hong Kong.

The study performed by Wen and Zhongming (2010) used network effects theory and institutional theory to analyse the influence of other firms' behaviour for a local firms decision to adopt an open IOS. The constructs used in analysing the impact of IOS adoption were organisational context and technological context. The results from the study demonstrated that mimetic pressure influences a firm to adopt IOIS.

Kim and Lee (2007) replicated studies from Europe and United States of America (US) examining factors affecting implementation of EDI in Korea. Technical support by EDI vendors, education and training, top

management support amongst other factors were important determinants of implementation of EDI. In addition, top management support and trading partners had an effect on EDI operation (Kim and Lee, 2007). Combination of theories mentioned above illustrates organisational and environment influences which affects adoption decision at organisational level.

A number of studies were found which drew on the technological, organisational and environmental framework of (Teo et al., 1995; Thong, 1999; Kuan and Chau, 2001; Soliman and Janz, 2004; Lippert and Govindarajulu, 2006; Zhu et al., 2006) so as to provide for a more holistic examination of the factors influencing IOIS adoption. Table 1 below illustrates studies which have used the TOE framework as well as studies which combined the TOE framework with other theories. Their works confirm that the TOE framework is a suitable framework to underpin quantitative research study into the factors influencing IOIS adoption at an organisational level.

Author	IT Adoption	Analysed Variables	Theory	Methods	Data, and context	limitations
(Teo et al., 1995)	EDI	Relative advantage Compatibility Complexity Observability Trialability risk	TOE and DOI	Survey	Questionnaires were sent out to 474executives	Examined in firms from Singapore
(Thong,1999)	IS Adoption	CEO characteristics CEO's innovativeness CEO's IS knowledge IS characteristics Relative advantage of IS Compatibility of IS Complexity of IS. Organisational characteristics Business size Employees' IS Knowledge Information intensity.	TOE and DOI	Survey	Questionnaires	Only examined in small firms across Singapore
(Kuan and Chau, 2001)	EDI	Technological context Perceived direct benefits Perceived indirect benefits Organisational context Perceived financial cost Perceived technical competence Environmental context Perceived industry pressure Perceived government pressure	TOE	Survey	Questionnaires	Only examined in small firms across Hong Kong

(Soliman and Janz,2004)	Internet Based IOS	Exploratory study Security Scalability Complexity	TOE	Survey	Questionnaires	Only examined in United States of America across logistics companies
(Lippert and Govindarajulu ,2006)	Web services	Technological context Security concerns Reliability Deployability Organisational context Firm size Firm scope Technological knowledge Perceived benefits Environmental context Competitive Pressure Partner readiness Trust	TOE	Case study	Interview	Limited to developed countries
(Zhu et al., 2006)	E-business	Technological context Technology readiness Technology integration Organisational context Firm size Global scope Managerial obstacles Environmental context Competition intensity Regulatory environment	TOE	Survey	Interview	Only examined in industrialized countries

Table 1: Adoption factors considered in this study and other authors who have used TOE variables in their study.

2.1.2 *IOIS adoption studies in South Africa*

Moreover, there are limited studies on IOIS adoption in the South African context for instance, a study by Naicker and Pillay (2009) evaluated the state of EDI and the willingness of Small medium enterprises to adopt the technology using the Iacovou et al. (1995) model. This study found that a few small firms adopted EDI and the external pressure was the strongest positive factor associated with the intent to adopt EDI. In addition, it suggests that there is a need for managerial support to understand issues around EDI security and compatibility with systems amongst small firms. To add, other studies (Moodley, 2002; Cloete and Tanner, 2009) evaluated the state of B2B adoption in manufacturing and retail companies respectively. The study by Cloete and Tanner (2009), used TAM and revealed that B2B e-marketplace at the time of the study had not been adopted by most retail companies in South Africa, with an exception of large retail companies. In contrast, Moodley (2002) study used the transaction cost economics model and found that manufacturing firms in South Africa were starting to explore B2B e-commerce. The study found that most companies were using the traditional EDI and limited companies were using the internet for transferring information, electronic payment system, receiving order and supply chain management system and logistics. Of the companies which were using the internet, the internet was mainly used for communicating within the firm or between business partners and for displaying product information. The table below illustrates a few IOIS adoptions studies found in the South African context.

Author	IT Adoption	Analysed Variables	Theory	Methods	Data, and context	limitations
(Naicker and Pillay, 2010)	EDI	Organisational readiness External pressure Perceived benefits Security	Iacovou et al. (1995) model	Survey	Questionnaire	Only examined in SME firms across South Africa
(Moodley, 2010)	B2B E-Commerce	Process improvements Direct information improvements Indirect benefits	Transaction Cost Economics Model	Survey	Questionnaire and interviews	Only examined in large South African owned manufacturing firms
(Cloete and Tanner, 2009)	B2B	Perceived usefulness Perceived ease of use Factors of non-adoption Intention to use/ continue use Actual use Organisation size Retail product category	TAM	Survey	Questionnaire	Only examined in South African retail firms

Table 2: IOIS adoption studies in the South African context.

2.2 Classifying the types of IOIS

To answer the research question of what types of IOISs are available in South African firms, it is necessary to understand the types of IOIS examined in past literature.

According to Swanson (1994) IS innovations can be classified into three types, namely Type I, Type II and Type III. Type I innovations are pertinent to the technical tasks. These include innovations such as the introduction of the systems programming and chief programmer team in the 1960s and 1970s respectively and the use of application prototyping methods in the 1980s (Swanson, 1994). Type II innovations support business administration. An example of a Type II innovation would be automated financial accounting systems, payroll and personnel record system introduced in the 1950s (Swanson, 1994). Type III innovations are rooted in the core of the business (Chau and Tam, 1997; Zhu et al., 2003). These include innovations such as material requirements planning (MRP) systems introduced in the 1950s, airline reservation system introduced in the 1970s and 1980s and interorganisational information systems introduced in the 1980s (Swanson, 1994).

Based on the above, an IOIS can be deemed as the type of innovation which is rooted in the core of a business process i.e. a Type III innovation. There are a number of ways in which IOIS are rooted in the core of a business process. IOIS can be used to simplify information sharing across functional departments, e.g., making use of a company internal internet share information between sales and finance departments. IOIS can also be used to offer real-time customer service such as using the internet to check flight status. Moreover, IOIS can be used to streamline integration with suppliers, distributors and customers. For example, the use of internet-based system to exchanging payment files between companies (Chau and Tam, 1997).

Although the study by Choudhury (1997) mentioned that there is no standard typology of IOIS, several adoption studies have created frameworks for categorising IOIS. For instance a study performed by Johnston and Vitale (1998) classifies IOIS according to the relationship between the sponsoring organisation business and other participants and the purpose of the system (Johnston and Vitale, 1988). In another study by Choudhury (1997) a typology is created to assist organisations with identifying the kind of relationship it wishes to implement with its suppliers or buyers (Choudhury, 1997). A recent study by Lyytinen and Damsgaard (2011) creates a framework which illustrates that the structure and the strategy of an IOIS are interdependent because an IOIS can be adopted in different ways due to variation in institutional, industrial, organisational and technological contexts (Lyytinen and Damsgaard, 2011).

Despite the inconsistent approaches that have been used in past literature to classify IOIS, the most comprehensive attempts have been created by Choudhury (1997) and Lyytinen and Damsgaard (2011). Based largely on their work, IOIS can be classified into four types based on their key functionality. A key functionality is defined as the scope and content of data exchanges and related business function (Lyytinen and Damsgaard, 2011). The four types of IOIS that then emerge are summarized in Table 2 together with relevant examples.

Typology	Key functionality	Example of a system	Author
Dyadic	Allows bilateral exchanges between a selected numbers of partners. E.g. sharing of information with external systems through a link.	EDI links; Tracking system	(Kuan and Chau, 2001; Kim and Lee,2008; Singerling et al.,2015)
Hub and Spoke	Sharing of information across functional departments of multiple trading partner firms in a central hub	ERP, EDI	(Lyytinen and Damsgaard, 2011; Pan and Jang, 2008)
Multilateral IOIS	Allows organisations to exchange of both information and files using web technologies with a large number of partners through a single system.	Shared B2B online purchasing portal (Internet based IOIS)	(Lyytinen and Damsgaard, 2011; Lee and Kim,2007; Teo et al. 2006; Zhu et al., 2003; Zhu et al. 2006; Singerling et al.,2015)
Community	Exchange information across regions or other public institutions at national level	e-government systems	(Lyytinen and Damsgaard, 2011)

Table 3: IOIS typology

Thus far, there is limited knowledge of the extent to which these different types of IOIS technologies have diffused within the South African context. Therefore, to address the study's research question, it is necessary to examine the extent to which dyadic, hub and spoke, multilateral and community IOIS are in use, as well as the extent to which they are enabled by technologies such as the internet, intranet, e-mail, groupware tools, and EDI as mentioned in the study by Zhu et al. (2003) and Solimanz and Janz (2004). The study by Zhu et al. (2003) also identifies online procurement, online selling and eCash payment systems as technologies since internet based interorganisational information system enable trading partners to conduct business operations online. Table 3 summarizes the IOIS enabling technologies as platforms on which information sharing can take place. The table summarizes the technologies and provides a context to where these technologies would apply.

Technology	Types of IOIS	Context	Author
Online (Procurement, banking, selling, shopping)	Multilateral	Platform for buyers, sellers, industry participants to exchange good, data and other services	(Zhu et al.2003)
Fax, Email, Groupware tools, video conferencing , Intranet	Hub and Spoke	Mode of communicating with other employees and trading partners	(Soliman and Janz,2004; Zhu et al.2003)
Internet	Multilateral	Internet based business to business (used to communicate with multiple trading partners),	(Soliman and Janz,2004; Zhu et al.2003)
EDI	Dyadic	Creates links with trading partners and transferring data	(Kuan and Chau,2001; Iacovou et al.1995; Soliman and Janz,2004; Zhu et al.2003)
eCash payment, EFT	Multilateral	System for transferring money	(Lee and Kim,2007; Zhu et al.,2003)

Table 4: Facilitating technologies

The following figures below illustrate the types of IOIS. The first figures show a concept of multilateral IOIS in an electronic market.

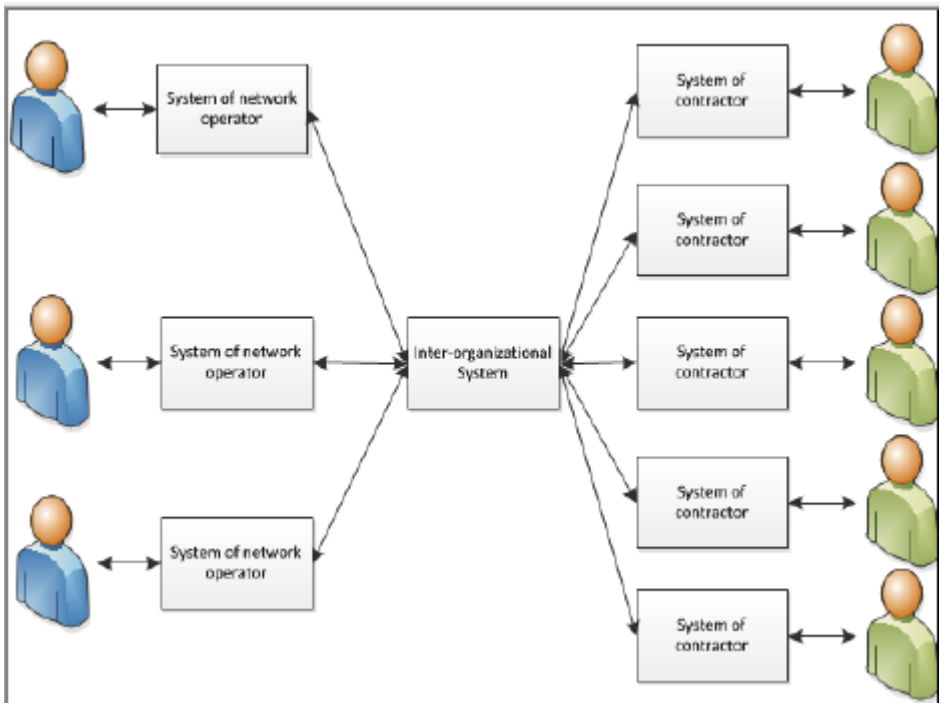


Figure 1: Concept of multilateral IOIS (adapted from Choudhury 1997)

DHgate.com (see Figure 2 below) provides a multilateral IOIS platform to facilitate B2B exchange (Source: http://www.dhgate.com/ Accessed 06/03).

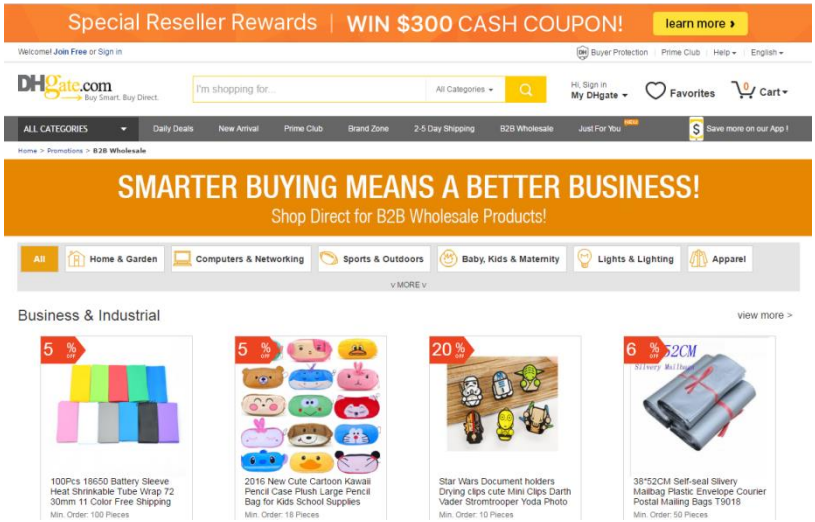


Figure 2: Example of multilateral IOIS

The figure below show a concept of dyadic IOIS, where there is a bilateral exchange of information between business partners.

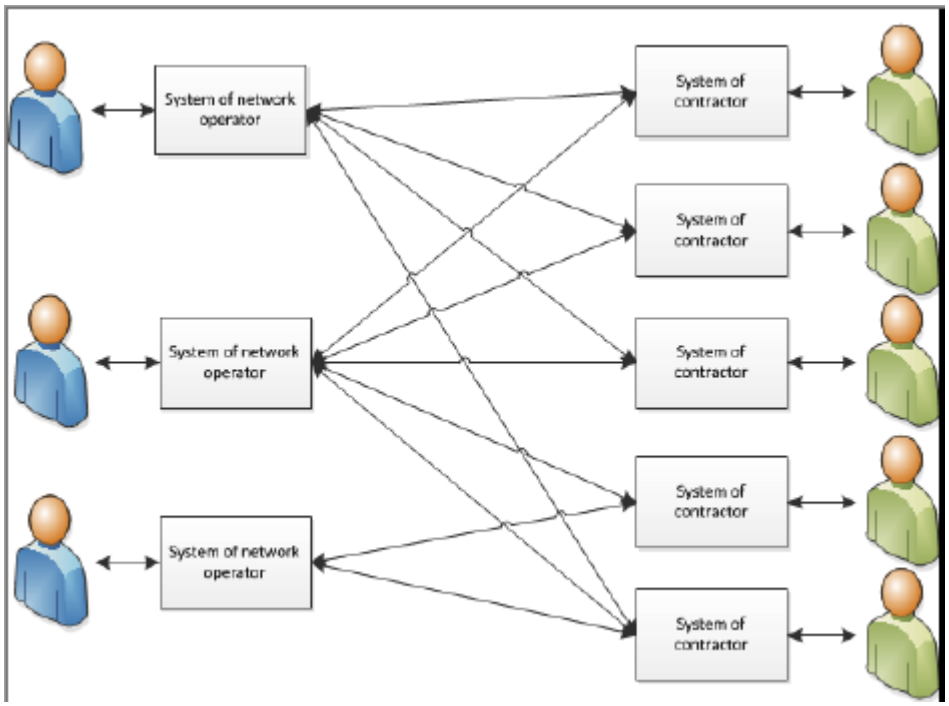
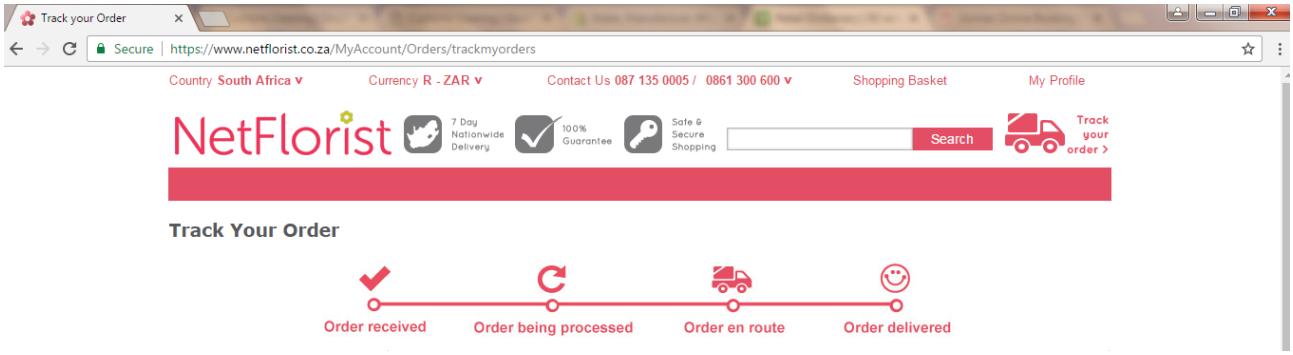


Figure 3: Concept of dyadic IOIS (adapted from Choudhury 1997)

NetFlorist (see Figure 4 below) provides a tracking system where bilateral link between a buyer and a seller is established (Source: http://www.netflorist.co.za/ Accessed 06/03).



Trueerp (see Figure 4 below) provides a dyadic IOIS platform by creating EDI link between a buyer and a seller (Source: Trueerp.co.za Accessed 06/03).

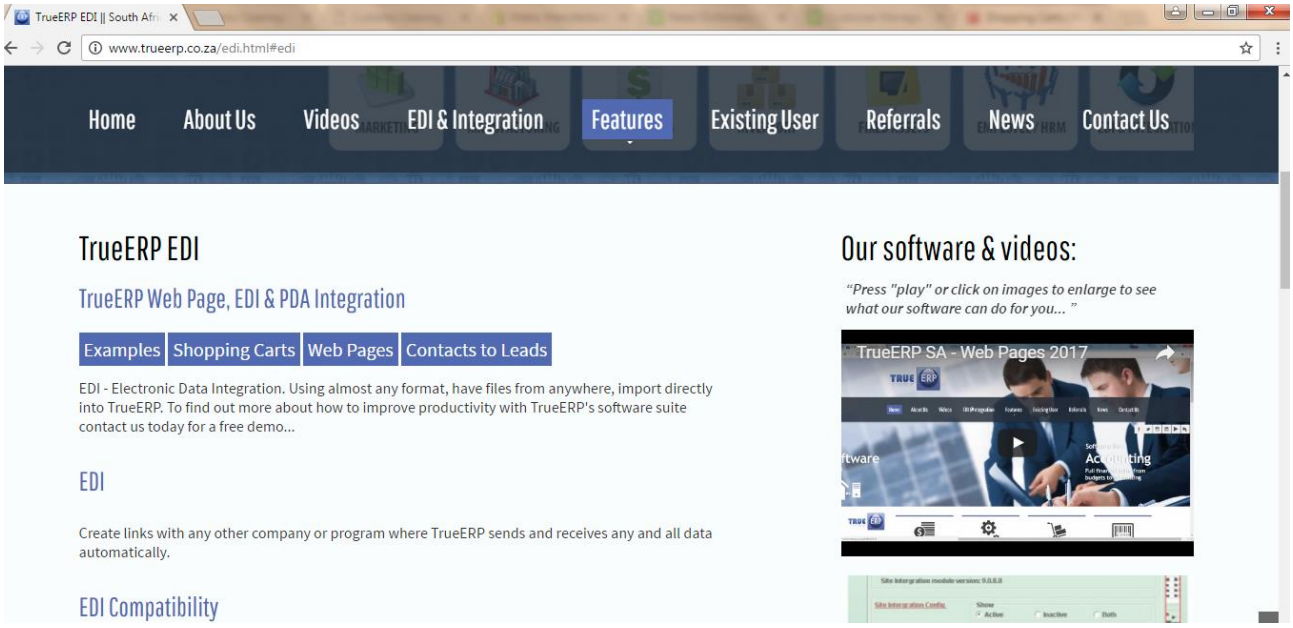


Figure 4: Example of dyadic IOIS

Walmart implements a hub-and-spoke IOIS called Retail Link that allows its suppliers to track stock levels in Walmart stores. (Source: https://retaillink.wal-mart.com Accessed 06/03)

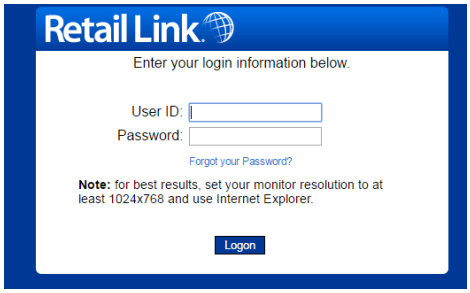
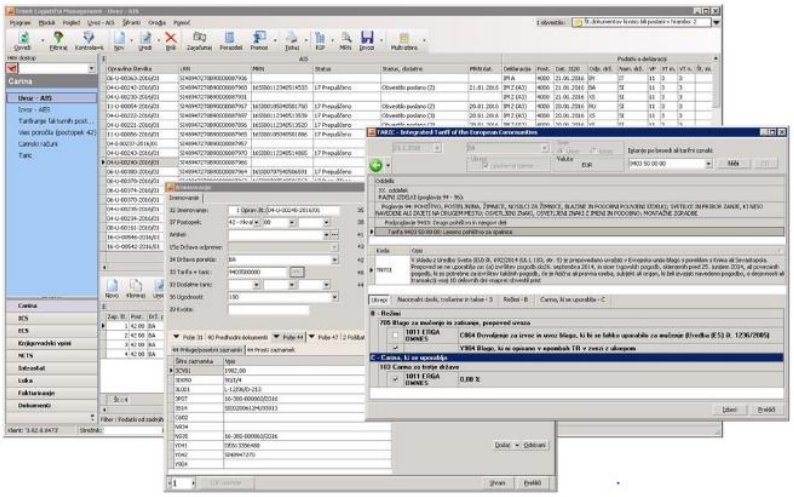


Figure 5: Example of hub-and-spoke IOIS

Trinet informatika offers a community IOIS called Automated Import system designed specifically for customs clearance (Source: https://www.trinet.si/en/home/carina Accessed 06/03).

AIS - Automated Import System



The AIS module is designed for customs clearance of imported goods coming from countries outside the European Union. The Automated Import System is a unified European system for the registration of goods and the control of import procedures. AIS is based on the exchange of electronic messages between the customs offices of entry (where the goods actually enter the EU customs territory) and the import offices (where the import declaration is lodged), thus providing control over the termination of import procedures. AIS also includes security and safety requirements.

Figure 6: Example of community IOIS

The above IOIS technologies offer much potential. Yet there are also challenges associated with their implementation. The benefits and challenges of IOIS are discussed next.

2.3 Benefits of IOIS

A number of benefits of IOIS have been identified by past studies. First, IOIS facilitate information sharing and enhances the quality of shared information among business partners. According to Rajaguru and Matanda (2012) quality information refers to information that is accurate, easily accessible and useful. In support of the view above, a study by Forslund and Jonsson (2007) reveals that IOIS use increases the accessibility of shared information. For instance, in a multilateral IOIS a buyer can access an online procurement or purchasing system to view or compare prices of a product offered by myriad of sellers. In this way it reduces the buyer's search cost by making the information required by the buyer to be easily accessible (Choudhury, 1997).

Secondly, IOIS enhances organisational flexibility and responsiveness, minimizes risk and cost (Rajaguru and Matanda, 2012). To support the above, according to Lyytinen and Damsgaard (2011) dyadic IOIS (e.g. EDI links or tracking system), can either be constructed to create an electronic partnership for virtual business integration or enable trading partners to seek dominant position in the market which require trading partners to have a highly integrated business processes. As a result of highly integrated business processes, trading partners can benefit from the exchange of technologies by learning about specific technologies faster. As well as enables the business to reduce the risk in the organisation and forecast on their clients' needs and delivery of products and services (Lyytinen and Damsgaard, 2011; Li and Lin, 2006; Soliman and Janz, 2004).

Thirdly, the adoption of an IOIS can increase competitiveness and encourage global communication. For instance, a community type of IOIS (e.g. e-government systems) encourages the public to engage with public institutions or government and is implemented with the aim of leading competitive advantage over other regions or nations.

Moreover, IOIS can help improve the quality of interorganisational relationships (Venkatesh and Bala (2012), Patnayakuni et al. 2006; Rai et al. 2006, 2009; Straub et al. 2004). As mentioned earlier, shared IOIS capabilities allows organisations to improve business operations and trading partner relationships by connecting linkages between trading partners (Soliman and Janz, 2004). In the case of hub and spoke IOIS, the initiator (hub) persuades smaller firms (spokes), mostly suppliers, to adopt an IOIS (e.g. EDI). According to Lyytinen and Damsgaard (2011), the trading partners benefit from the implementation of an IOIS as the hub offers IOIS services to the trading partners as an additional benefits when doing business or improve virtual business integration. However adoption of this type of IOIS is driven by trust factors, if for instance there is resistance with sharing business information amongst the business partners, certain challenges could potentially evolve.

2.4 Challenges of IOIS

Although IOIS can offer a number of benefits, the implementation of IOIS is not without its challenges. Lyytinen and Damsgaard (2011) indicate that complexity in the adoption of an IOIS could be as a result of multiple social constructions and network effects. In other words, IOIS integration process is complex as it requires a variety of hardware, software, networking protocols to enable multiple transactions for several business partners (Klein and Rai, 2009). This creates challenges in relation to IS employees' technical skills as the staff needs to implement a system for use by people outside the organisation who may have different IS infrastructure. This suggests that there are also technological and business compatibility challenges. A study by Rajaguru and Matanda (2012) suggests that for IOIS implementation success, partnering organisations' information systems should be compatible, that is the system should share network commonality, software, point-of-sale (POS) terminals, business-oriented technology, and operational and technical business processes (Sarkar et al., 2001, Rajaguru and Matanda, 2012).

Additionally the integration process creates a challenge in relation to perceived insecurity in data sharing and information (Rajaguru and Matanda, 2012). The common problem of IOIS integration is information transformation insecurity, that occurs when trading partners with different systems share information (Ngai and Gunasekaran, 2004; Rajaguru and Matanda, 2012). Likewise, a study by Zhu et al. (2006) highlights

unclear consumer protection laws, security and privacy concerns and inadequate legal protection for online business activities as challenges.

Moreover, IOIS can also be complex to implement because of the diverse interests, cultures, and strategic intentions required across multiple partners (Ireland and Webb, 2006; Rajaguru and Matanda, 2012). This creates challenges in relation to trust among trading partners. Premkumar (2000) states that if the task of opening up the information flow within the organisation is perceived to be difficulty then it tends to be more difficult across organisations that service multiple business partners as they have different business objectives and different stakeholders. This therefore requires a very high level of trust among trading partners.

In addition to the above, another challenge when implementing IOIS lies with aligning IS with business and redefining internal operations, both technically and strategically (Hult et al., 2004; Hartonoa et al., 2010; Kim et al., 2011; Rajaguru and Matanda, 2012). A study by Johnston and Vitale (1988) indicates that training of operational employees who are impacted by the adoption of IOIS is often neglected yet it is an important step toward system success. For example, a client facing employee must be knowledgeable about the new system and be able to assist customers who are not technologically advanced. The study further adds that the adoption of IOIS often requires those internal procedures which are impacted by IOIS to be redesigned to fit the system. As a result of the above, the adoption of IOIS requires changes in employee skills, underlying processes and top managements understanding of the impact of the new IOIS.

Yet there is often difficulty experienced when it comes to convincing top management to approve the process of integrating an IOIS system. This is because, in some organisations, top management may not perceive information systems to influence structure or strategy. Much effort is often required to ensure top management understands the capabilities of an IOIS system and the possible opportunities and threats from the system (Johnston and Vitale, 1988; Lee et al., 2005). According to Hartonoa et al. (2010), top management support would include encouraging enterprise-wide commitment, the allocation of resources required in implementing IOIS, the alignment of the firm's strategy with the IOIS strategy, the assurance of effective communication and coordination with business partners (Hartonoa et al., 2010).

2.5 Shortcomings and contributions of past studies

First, the literature review assisted with identifying the relevant types of IOIS and underlying IOIS technologies that can be investigated. A notable shortcoming in the literature are limited past studies that describe the state of adoption of such IOIS technologies in the South African context. Second, several studies presented in the literature review also highlight factors influencing the adoption of IOIS. These previous studied justified the need to examine multiple technological, organisational and environmental factors for their influence on IOIS adoption. Based on that literature review two theories are applied to this paper to understand IOIS adoption in South Africa, namely Rogers' (1995) diffusion of innovation theory and Tornatzky and Fleischer's (1990) technology-organisation-environment (TOE) framework. Both of these theories influenced the direction of the work presented in this paper.

2.6 Development of the research model

The first research question, intends to investigate the different types of interorganisational information system used in South African firms. The literature review illustrated classification of IOIS which were studied in the past research. In addition, it demonstrated a research gap that the TOE framework - has been used in developed countries and was found useful to explaining IOIS adoption (Zhao et al. 2008; Kurnia et al. 2015; Alsaad et al. 2007). However, its application in South African context to understand IOIS adoption is limited, yet TOE has been found useful in the South African context to study other technologies such as Open source software (Van Belle and Reed, 2012) and Open source ERP (Tome et al., 2014). To answer research question 2 regarding the factors influencing the adoption of IOIS, the next section develops a research model that identifies the factors influencing IOIS adoption at organisational level in South Africa using TOE framework as theoretical lens.

2.7 Theoretical underpinning

Technology, Organisation and Environment (TOE) Framework

The technology-organisation-environment framework was established by Tornatzky and Fleisher in 1962. The technology-organisation-environment (TOE) framework is an organisational level theory which describes how the firm context has influences on the adoption and implementation of innovations. The TOE framework has three elements which influence the adoption process; the technological context, the organisational context, and the environmental context (Tornatzky and Fleisher, 1990). Technology context and organisational context are consistent with DOI theory (Oliveira and Martins, 2011). Technological context infers that the adoption of technology internal and external to a firm, including applications in the marketplace, are characterised by the perceived relative advantage, compatibility, complexity, trialability and observability of the innovation (Awa et al.2012; Tornatzky and Fleisher, 1990). The organisational context refers to top management support, complexity or managerial structure, size, the amount of slack resources and communication processes (Awa et al.2012; Tornatzky and Fleisher, 1990). According to Awa et al. (2012), the environmental context refers to constraints and facilitating factors for technological innovation. These factors include size and structure of the industry, the firm's competitors, the macroeconomic context and regulatory environment. While all three elements influence the firm's technological innovation, the relative strength of their effects may differ for different technologies and types of organisations (Oliveira and Martins, 2011).

The TOE framework has been applied in several empirical studies to examine technology adoption. For example, the adoption of EDI (Kuan and Chau, 2001), ERP (Pan and Jang, 2008), B2B (Kim and Lee, 2007), and Internet-based information systems (Lee and Kim, 2006) have all been explored through the lens of TOE. Pan and Jang (2008) used the TOE framework to investigate factors influencing adoption of ERP in the communication industry in Taiwan. Kim and Lee (2007) developed a research model based on the TOE framework to evaluate and test the influence of technological, organisational, and environmental factors on EDI and B2B implementation. Kaun and Chau (2001) used only the TOE framework to understand the antecedent factors that influence EDI adoption. The analysed factors were perceived benefits in the technological context, perceived financial cost and perceived technical competence in organisational context and perceived industry pressures and perceived government pressures in environmental context. Iacovou et

al. (1995) model investigated three factors which influence the EDI adoption in small business, perceived benefits, organisational readiness (technological and organisational context) and external pressures (environmental context). Their model used TOE framework alongside other theories (competitive advantage), for instance the organisational readiness constructs are IT resources and financial resources. These previous studies that used the TOE framework have demonstrated that the TOE framework can be applied in different settings. Moreover, in comparison to the Rogers innovation diffusion theory alone, the TOE framework is shown to be better able to explain inter-organisational innovation diffusion and can be used for studying the adoption and assimilation of different types of IT innovation (Hsu et al. 2006).

Authors who have conducted studies on IOIS have indicated the difference between organisational level theories. For instance, a literature review conducted by Oliveira and Martins (2010) highlighted that Diffusion of innovation (DOI) theory suggest that individual characteristics, internal characteristics of organisational structure, and external characteristics of the organisation are important signs to organisational innovativeness. The institutional theory is better able to explain organisational decisions, which are not motivated purely by rational goals of efficiency, social and cultural factors and concerns for legitimacy. The institutional theory is compatible with TOE framework in that the environmental external pressures such as pressure from competitors and pressure exerted by trading partners can be explained by institutional theory (Oliveira and Martins, 2011). In comparison to the discussed theory, Technology Organisation Environment (TOE) framework subsumes within itself the factors drawn from important theories such as DOI and Institutional theory. Consequently, it was identified as a valuable theoretical framework to underpin this study of IOIS adoption. The theoretical underpinning for the adoption concept is discussed next.

Organisational Level Adoption Process

Rogers (1995) five stage model of innovation and implementation in an organisation suggests that innovation consist of five stages: (1) knowledge, which occurs when the adopter (an organisation or the unit of analysis) initially learns of an innovation from different channels, (2) persuasion, which refers to prior adopters persuading the adopter to try the innovation, (3) adoption which refers to a decision to accept or reject an innovation, (4) implementation which refers to the initial use of an innovation and lastly, (5) confirmation, decision to continue using the innovation to its full potential.

Besides Rogers organisational and implementation process model, there are other adoption and implementation process model which have been identified by other authors. For instance Fichman and Kemerer (1999) suggest that IT innovation follow a two-part adoption process, the first being a decision to make an innovation available in an organisation formally, and second being a decision of whether to use the technology.

Taken together, adoption is defined for the purposes of this study in two ways, namely

1. Adoption of IOIS as the availability of IOIS tools and technologies for use in the firm – equivalent to stage three in Rogers five stage model or stage 1 in the Fichman and Kemerer model, and
2. Adoption of IOIS as the extent to which IOIS is used as a communication medium with business partners, supports an organisation in decision making and business operation and is replacing legacy technologies – equivalent to stage four in Rogers five stage model or stage 2 in the Fichman and Kemerer model.

Research Model and Hypotheses

Figure 1 present the study research model. It depicts the effects of selected technological, organisational and environmental factors on the state of IOIS adoption. The dependent variable in the conceptual model determines whether or not an organisation has adopted IOIS along two dimensions. It focuses on firstly, IOIS technologies which are currently being used in the firms. Secondly, the extent to which firm's use IOIS technologies to communicate and transact with business partners, replaces legacy technologies and support an organisation in management decisions and business operations. The selected TOE factors were drawn from literature. Each of the factors and their hypothesized effects on IOIS adoption are discussed next.

2.7.1 *Technological factors*

Three technological factors are considered, namely compatibility, relative advantage and complexity. These factors are drawn from meta-analysis of technological innovation literature concerning characteristics of innovation (Thong, 1999; Tornatzky and Fleisher, 1990). They have been selected because they seek to identify factors which drive adoption based on technologies that are already in use at the firm as well as those that are available in the marketplace but not currently in use (Teo et al.2003; Rogers, 1995; Tornatzky and Fleisher, 1990).

Perceived Compatibility

Compatibility with existing IS infrastructure may indicate less resistance to the adoption process. Compatibility in this context refers to the degree to which technological innovation is viewed as being coherent with the requirements of a potential adopter, the existing values and the past experiences (Rogers, 1995). Premkumar et al., (1994) suggested that a potential adopter is likely to adopt an innovation if the innovation is viewed as being uniform with the current system, the current procedures and the values of the potential adopter. IOIS makes it possible for information exchange on communication networks using secured standardized forms between business entities. For this reason, it is important in an IOIS setting for business transaction to be valid and complete (Kim and Lee, 2008). This is possible only when the existing infrastructure is able to support the interaction between internal and external systems. Without a well suited infrastructure it is possible that the information exchange objective might be unmanageable and unrealized. IOIS requires a commitment to information sharing and exchange with business partners. This requires a compatible value system to ensure the benefits of information exchange materialize. It is hypothesized that organisations are likely to adopt IOIS only if the existing infrastructure and organisational processes will require less modification (Lee and Kim, 2007; Kim and Lee, 2008). Hence:

Hypothesis 1: The perceived compatibility of existing information systems with IOIS has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Perceived Relative advantage

Relative advantage of an innovation, refers to the degree to which an innovation is viewed as an improvement of the current system or idea (Rogers, 1995). Relative advantages from the adoption of IOIS might serve as one of the main factor for the adoption. The perceived reasons for adopting IOIS could be that it enables an organisation to improve its business processes, improve communication with key trading partners, establish economic gains and improve its status by improving sales and reduce cost (Teo et al., 2003; Zhu et al., 2006). Relative advantage can be characterised by savings in time and reducing administrative costs (Gatignon & Robertson, 1989; Kim and Lee, 2008; Tornatzky & Klein, 1982). IOIS can also provide advantages in improving the security and accuracy of data shared between firms and reducing system errors and failures (Kaun and Chau, 2001). Organisations that do not perceived any advantages from IOIS are unlikely to adopt the technology. Hence:

Hypothesis 2: The perceived relative advantage of IOIS has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Perceived Complexity

Complexity can be described as the degree to which using and understanding an innovation is viewed as being difficult (Teo et al, .2003; Thong, 1999). Previous literature suggested that a complex innovation would require great effort to implement and more technical skills if it is not easily understood (Teo et al, .2003). The complexity of an innovation becomes a barrier and could have a negative influence on the adoption of IOIS. If more technical understanding is required to use an IOIS and if IS resources lack the technically capability to use the system then adoption of IOIS is less likely (Kim and Lee, 2007). Hence:

Hypothesis 3: The perceived complexity of IOIS has a negative influence on availability of IOIS technologies and the extent of IOIS use.

2.7.2 *Organisational factors*

When firms engage in interorganisational information sharing, the decision to adopt an IOIS is likely to be influenced not only by technology factors but also organisational factors. Organisational factors such as information intensity (Thong, 1999), formalization and decentralisation (Kim and Lee, 2008), perceived financial cost and perceived technical competence (Kaun and Chau, 2001), perceived benefits and firm scope (Lippert and Govindarajulu, 2006), and global scope (Zhu et al., 2006) were considered important in past work. However, the most relevant factors for IOIS adoption have been found to be those related to firm size (Thong, 1999; Lippert and Govindarajulu, 2006; Zhu et al., 2006; Kim and lee,2008), senior managerial support (Thong, 1999; Lippert and Govindarajulu, 2006; Zhu et al., 2006; Kim and Lee,2008), IS knowledge and skills (Thong, 1999; Lippert and Govindarajulu, 2006; Zhu et al., 2006), and education and training (Kim and Lee, 2008). Four organisational factors are considered for this study and depicted in Figure 1, namely Top management support, IS technical skills, Education and training, and Size. These factors are drawn from previous literature for example eBusiness adoption and implementation of EDI (Kim and Lee, 2008; Zhu et al., 2003; Zhu et al., 2006). They have been selected because they have been consistently recognized as factors influencing technology adoption in existing literature as described further below.

Top Management Support

Top management support refers to management being aware and committed in adopting the technology. Previous literature suggests that top management facilitation in the adoption and implementation of IOIS has an effect in an organisation performance and competitive position (Kim and Lee, 2008; Soliman and Janz, 2004; Wade and Hulland, 2004). When there is lack of top management support, IS resources could find it difficult to implement strategic information technologies and might have minimal effect on achieving strategic objectives required (Wade and Hulland, 2004). Therefore top management support would also include investing funds in IOIS and encourages the suitable alignment of the company's strategy with the IOIS strategy (Hartonoa et al., 2010). It is imperative that top management is highly interested in using IOIS and participates in implementing IOIS because without top management support it will be difficult to succeed with the organisational changes required to make IOIS effective. (Lee et al., 2005; Hartonoa et al., 2010). Hence:

Hypothesis 4: Top management support has a positive influence on availability of IOIS technologies and the extent of IOIS use.

IS technical Skills

An organisation with employees that have the necessary knowledge and technical skills are more likely to be less resistant to the adoption of an IOIS. In addition, the diversity in terms of knowledge and skills possessed by the IS staff would allow for more innovative ideas of implementing an application solution (Kim and Lee, 2007). Previous literature (Kim and Lee, 2007) has empirical evidence suggesting that an organisation that has insufficient technical skills exist, tends to have less technical potential to experiment with new technology. As a result the adoption and/or implementation of IOIS tends to be delayed. Therefore, top management would need to consider the technical skills within the organisation or employ people with the right skills. Hence:

Hypothesis 5: The existing IS technical skills has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Education and Training

User education and training on interorganisational information system reduces the resistance of users to change and therefore increases the likelihood of succeeding with the adoption of an IOIS (Kim and Lee, 2008). Existence and continuous education and training programs on interorganisational information system is not only pertinent to internal resources within an adoption organisation, this factor extends to recipients of the information, i.e. trading partners. Therefore when education programs are provided to internal resources and trading partners it could possibly lead to adoption of an IOIS (Kim and Lee, 2008). Without this factor, it is probable that users would resist using the system (Kim and Lee, 2008). Hence:

Hypothesis 6: The opportunity for user education and training has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Organisation Size

Previous studies highlighted that the size of an organisation is critical in adopting IOIS (Zhu et al., 2003; Pan and Jang, 2008). Larger firms tend to have several advantages over smaller organisations such as greater flexibility to absorb more risk. IOIS implementation requires large amounts of capital, which is likely to be more available within larger firms. Moreover, larger firms often have the capability and bargaining power required to persuade trading partners to adopt technology (Kim and Lee, 2008; Pan and Jang, 2008; Zhu et al., 2003).An example is when a large retailer might require their smaller suppliers to adopt an IOIS solution to facilitate transactions. Hence:

Hypothesis 7: The size of the organisation has a positive influence on availability of IOIS technologies and the extent of IOIS use.

2.7.3 *Environmental factors*

While past studies had different factors influenced by various theories and considered important in the past, three technological factors are considered in this study, namely trading partners, competition and government regulation. These factors are drawn from TOE framework and other studies which have used TOE with institutional theory. They have been selected because they are environmental factor included in the TOE framework and the institutional theory is more likely to explain external pressures such as pressure put forth by trading partners and competitors.

Trading Partner Pressure and Trust

Strategic alliances between trading partners is established by interorganisational systems (Chau and Tam, 1997; Soliman and Janz, 2004). The perceived reasons for trading partners to establish links with regards to the adoption of IOIS is associated with maintaining competitive position and improving strategic objectives (Soliman and Janz, 2004). A firm's decision to adopt an IOIS may be influenced by pressure to adopt from a specific trading partner or the adoption state of its trading partners. This is because information sharing cannot take place seamlessly if trading partners do not adopt compatible trading systems (Zhu et al., 2003; Premkumar et al., 1997; Ramamurthy et al., 1999). In addition, to the above, a firms decision to adopt IOIS may also be influenced by trust which previous literature (Lu et al., 2006) suggest to increase information sharing and improve the relationship between business partners. Hence:

Hypothesis 8: Trading partner pressure and trust has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Competition

Competition refers to intense business environment pressure in which the business operates (Thong, 1999). Tornatzky and Fleischer (1990) indicated that intense competition stimulates the adoption of innovation. Competition leads to environmental uncertainty which could potentially allow firms that adopt an IOIS to be able to change rules of the competition, modify or cause an effect on the industry structure, and find other means to perform better than the rivals (Thong, 1999; Zhu et al., 2003). In an instance whereby a firm wants

to keep up with or be ahead of the competitors, a firm may feel the need to adopt (Kuan and Chau, 2001). Hence:

Hypothesis 9: Competitive pressure has a positive influence on availability of IOIS technologies and the extent of IOIS use.

Government Regulation

In IOIS setting, there are privacy requirements imposed by government which may prevent organisations from sharing information with their clients and customer. Thus, government regulation can either encourage an innovation or discourage innovation. Previous studies (Kraemer et al. 2006; Zhu et al.2006) suggested that government regulation can encourage adoption of IOIS through developing business laws that support the use of IOIS, establish consumer protection and privacy regulation and policies, and provide government incentives for using an IOIS. An example of government incentives could be technical support, training, and funding for e-business use (Kraemer et al. 2006). In the South African context, the Electronic Communications and Transactions Act (2002) is an example of a supportive government regulation that provides communications and transactions assistance and regulation; promotes the use of e-government services; protection of personal information and prevent the abuse of information systems. Hence

Hypothesis 10: Supportive government regulation has a positive influence on availability of IOIS technologies and the extent of IOIS use.

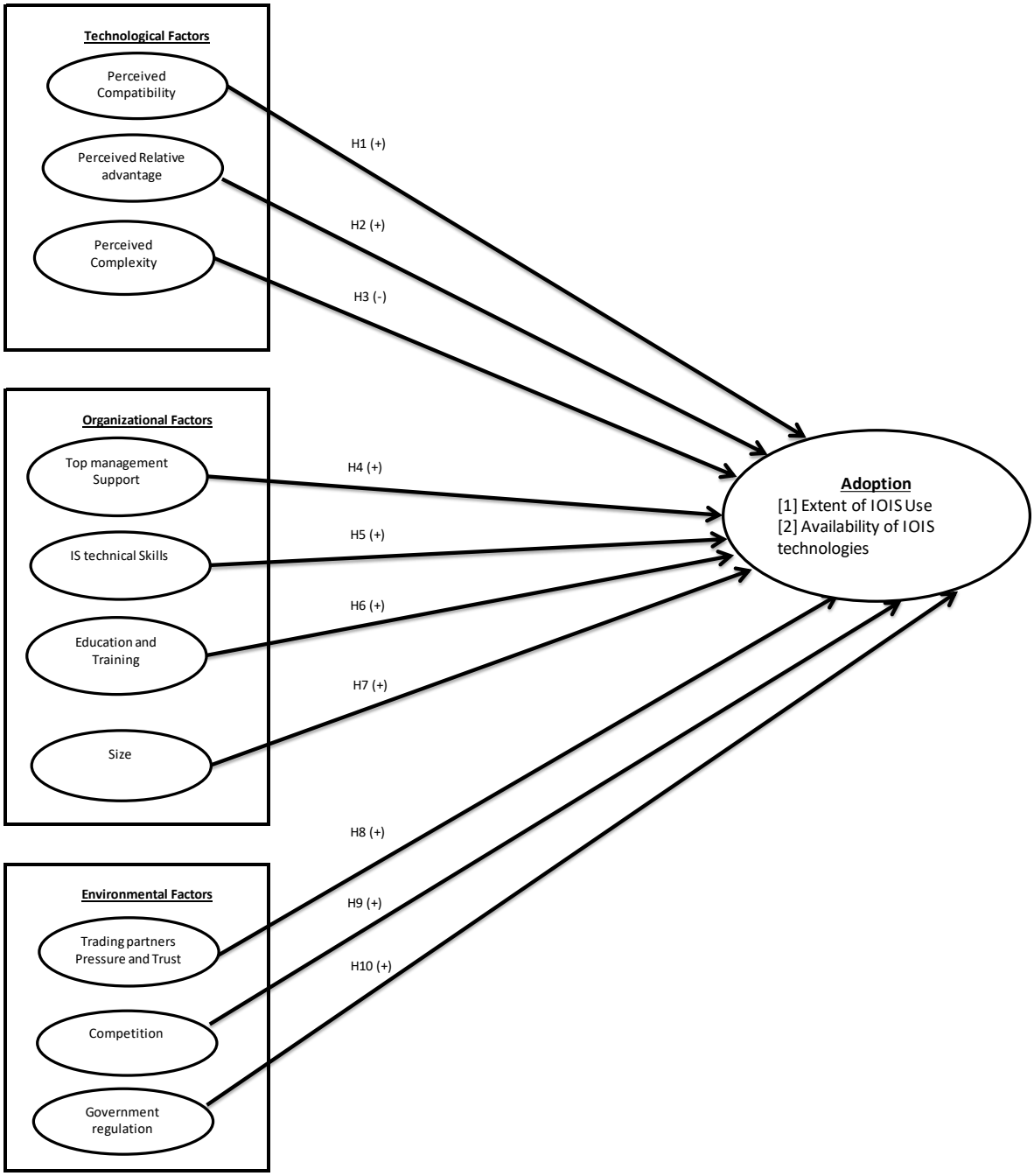


Figure 7: The conceptual model

Chapter Conclusion

This chapter presented the findings from the literature review, which aimed to evaluate existing studies pertaining to the factors influencing the adoption or use of interorganisational systems as well as to identify types of IOIS and underlying IOIS technologies that can then be examined in the South African context. The shortcomings and contributions of existing research into IOIS were described and the research model and the associated hypotheses relating the selected factors to IOIS adoption were developed. The next chapter presents the research methodology used to answer the study's research questions and test the study's research model.

CHAPTER 3. METHODOLOGY

Figure 2 depicts the various methodological considerations for the study (adapted from Saunders et al., 1997), and guides the chapter's structure. The first section discusses the research paradigm. The rest of the chapter relates to the research design and methods used to investigate the state of IOIS adoption and the factors influencing the IOIS adoption. This chapter discusses the methods of data collection and analysis along with ethical considerations for the study.

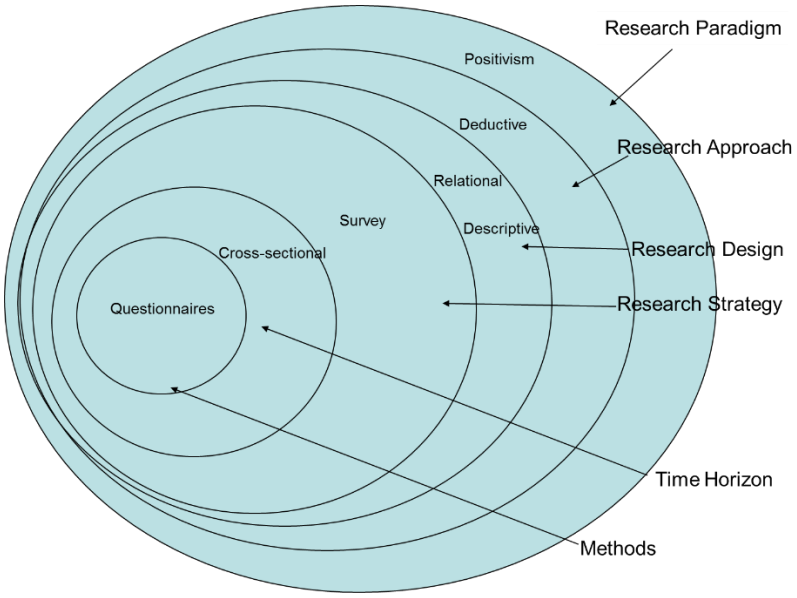


Figure 8: The research methodology

3.1 Research paradigm

The term paradigm refers to "the mental models or frames of references that we use to organize our reasoning and observation" (Bhattacherjee, 2012). The two common research paradigms are the positivist paradigm and the interpretivist paradigm (Bhattacherjee, 2012). These paradigms are shaped by different ontologies and epistemology, where ontology refers to assumptions the researcher takes to define reality and the truth. Epistemology refers to assumption about the way the researcher comes to know the truth and reality (Anti and Hamza, 2015).

The positivist paradigm is aimed at theory testing (Bhattacherjee, 2012).The ontological beliefs underlying the positivist paradigm are based on the assumption that reality is objectively given and data tends to be measured quantitatively, independent of the researcher (Anti and Hamza, 2015; Reeves & Hedberg, 2003). Positivist researchers believe that people's perceptions and statements are true or false, right or wrong. Positivist are concerned with finding facts and the research approach for positivist researcher tends to be a deductive approach, which involve theory or hypothesis testing using empirical data, under strictly controlled conditions and the results from test allow relationships of cause-and-effect to be investigated and

they focus on producing replicable results (Bhattacherjee, 2012). Characteristics of a good theory is that it should be falsifiable (theory can be proven or disproven), replicable (reproducible), parsimonious (use the simplest logical explanation) and consistent (Bhattacherjee, 2012). Positivist research designs tend to be exploratory, descriptive, relational or experimental (Bhattacherjee, 2012) employing research strategies such as field experiments and surveys (Anti and Hamza, 2015). Data collection methods in positivist research often employ questionnaires but observation is another popular method (Bhattacherjee, 2012). Positivists aim to generalize their findings and therefore prefer when possible to apply random sampling methods which would allow findings from the sample to be generalized back to the population (Anti and Hamza, 2015).

In contrast to the above, the interpretivist paradigm is aimed at theory building (Bhattacherjee, 2012). The ontological beliefs underlying the interpretivist paradigm are based on interpretation (Antwi and Hamza, 2015). Reality is subjective and there are no 'correct' or 'incorrect' theories (Walsham, 1993). Interpretivists assume that reality is the product of social processes (Anti and Hamza, 2015; Neuman, 2003). The research approach employed by the interpretivist researcher tends to be an inductive approach, which involves using observation and empirical data to build a theory (Bhattacherjee, 2012). The research strategies tend toward ethnographies, case studies, action research and grounded theory (Anti and Hamza, 2015). Data tends to be measured qualitatively (Anti and Hamza, 2015). Interpretivist researcher designs tend to be exploratory or explanatory. Interviews, focus group discussion, observations, and secondary data are popular data collection methods (Anti and Hamza, 2015).

This study has been informed by a positivist research paradigm which is consistent with its aim to examine the extent of IOIS adoption among SA firms and test the relationships between the identified independent variables (drawn from TOE) and the dependent variables (IOIS adoption).

3.2 Research design

Research design refers to an overall plan for associating the conceptual research problem to the relevant and realistic empirical research (Ghauri and Grønhaug, 2005). In short, the research design provides a plan for how the research will be conducted in order to address the research question. It is a blueprint for empirical research and should attempt to cover the fundamental processes of (1) data collection and data analysis, (2) instrument development, and (3) sampling (Bhattacherjee, 2012).

The first research objective for this study is to conduct a descriptive survey of IOIS adoption and the second research objective for this study is to identify the factors impacting the adoption of IOIS in South African organisations, using the TOE framework as a theoretical lens. The unit of analysis for this study are South African firms that have or are in the process of adopting IOIS. The survey research method is appropriate for this study as it allows for the variables defined in the theoretical framework to be tested using statistical inference and to provide for a generalised overview of IOIS adoption (Bhattacherjee, 2012; Pinsonneault & Kraemer, 1993). Surveys also allow the research to collect data from various sources and study a problem from multiple theories or perspectives (Bhattacherjee, 2012). However, "surveys are subject to respondent bias and because of their non-temporal nature, internal validity is difficult to infer" (Bhattacherjee, 2012:39). Similar designs had been used in past IOIS studies (Lai et al., 2011; Lee and Kim, 2007; Soliman and Janz, 2004).

In the next page, figure 1, is a summary of the research design used in this survey study, the arrows indicating the chronological order in which the various phases would be conducted.

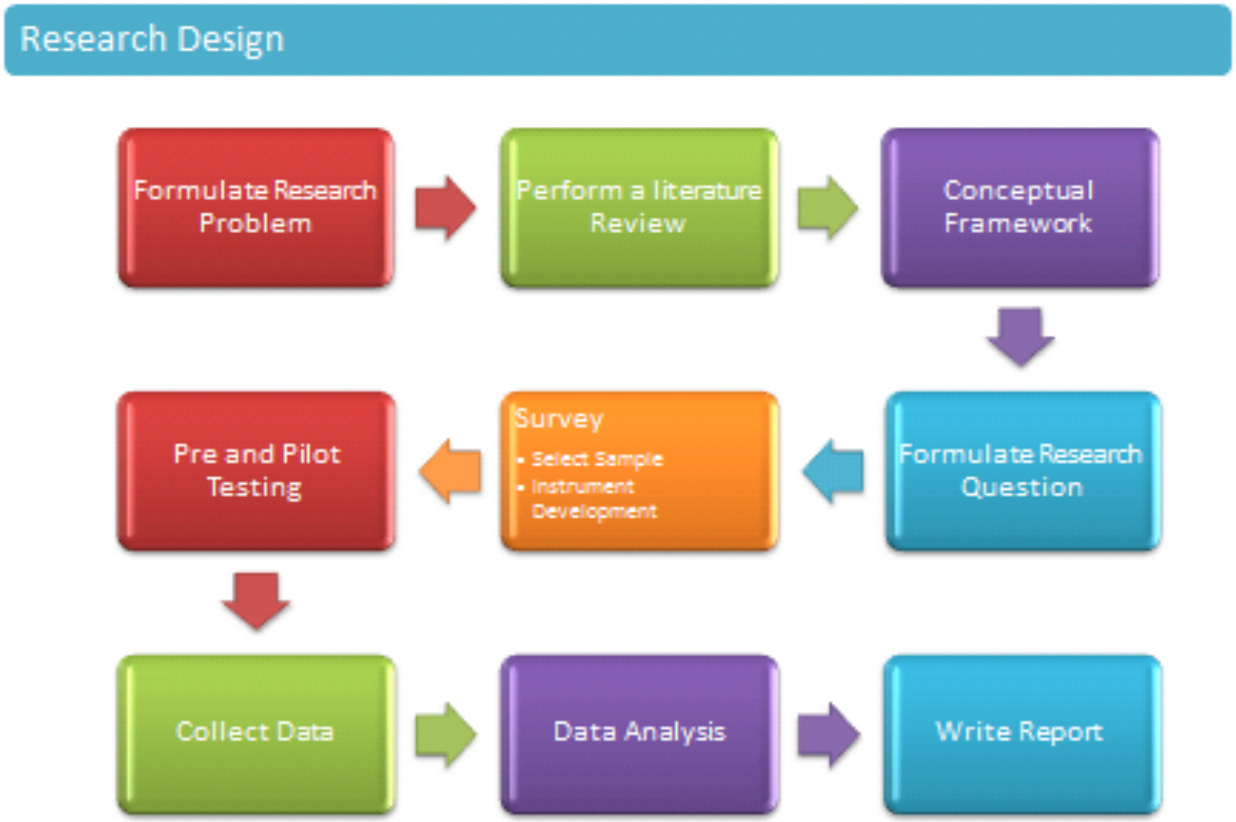


Figure 9: Research design for the survey study (Bhattacherjee, 2012)

3.3 Data collection methods

The study made use of primary data collected using survey as the method of data collection. The survey instrument was a structured questionnaire that included largely the use of multi-item 7 point Likert-type scales (1= Strongly Disagree to 7=Strongly Agree) to measure each of the model's independent variables. In addition, the dependent variable - IOIS adoption - was measured in part (refer to table 5) using the 5-point Likert-type scale (1= Not at all to 5= Very much). The questionnaire was administered via an online mail survey system as detailed below. Construction of the survey was based on the objectives of the study and from a collection of survey instruments which had been tested and used in previous studies. This helped to improve the content validity of the measures.

3.3.1 *Measures*

Dependent Variables

Adoption

Chapter 2 defined the adoption concept in terms of the Rogers' diffusion of innovation model and with reference to Fichman and Kemerer (1999). It was explained that adoption can be defined as the stage within the diffusion of an innovation where a firm decides to accept and make the innovation available within the organisation (Rogers, 1995; Fichman and Kemerer, 1999). In this case, it refers to the acceptance and availability of IOIS related tools and technologies. In addition, adoption to the acceptance phase, adoption can also be defined in terms of the actual use of the innovation within the business. In this case, it refers to the use of IOIS for conducting business operations (Zhu et al., 2006).

Based on this dual conceptualization of adoption, the dependent variable - IOIS adoption - was measured in two ways. First, adoption was measured as the total number of IOIS technologies that the respondents' organisation has accepted and made available for use. Eleven IOIS technologies were identified in the literature review and were presented in the questionnaire. The respondents were required to indicate whether they were using or planning to use the technology. The total number of "using" responses for each technology was used as an overall measure for adoption.

Secondly, the dependent variable was measured using nine items to reflect the extent to which IOIS is being used in the firm as a communication medium with business partners and used to support an organisation in decision making, business operation and replaces legacy technologies. The table below illustrates how the dependent variables measurement scale were developed and literature used in operationalizing scales.

Adoption variable	Conceptual definition	Operational definition	Literature support
Availability of IOIS technologies	Whether the organisation has adopted the selected IOIS technologies and made them available for use in the firm	Use of IOIS technologies, namely; Electronic Data Interchange (e.g. Order Management System), Electronic Payment System and Online Banking, Groupware (e.g. SharePoint, Shared calendars, email folder, address books) , Extranet, Online shopping, Reservation system, Supply Chain Management System, eProcurement, Inventory Management System, Freight Tracking System, Videoconferencing, Technology (Other)	(Iacovou et al.1995; Kuan and Chau, 2001; Zhu et al.2003; Soliman and Janz, 2004; Lee and Kim, 2007)
Extent of IOIS use	The extent to which the firm uses IOIS technologies to communicate and transact with business partners, replaces legacy technologies and support an organisation in management decisions and business operations.	Nine items were used to measure the extent of IOIS use within the firm to (1) support management decisions, (2) support business operations, (3) replace legacy technologies, (4) access business partners internal IT system, (5) have business partners access to the firm's internal IT system, (6) transact with business partners, and the, use of (7) e-mail, (8) groupware and (9) video conferencing to communicate with business partners. All 9 items were measured on a 5-point scale from 1=not at all to 5=very much	(Thong,1999; Zhu et al.2003)

Table 5: Dependent variable measure

Independent Variables

Technological context: Compatibility measurement

Various studies (Lee and Kim, 2007; Zhu et al., 2006) determined the following items for measuring the compatibility variables. These measures reflect the degree to which adoption of IOIS would be aligned with existing values and needs of business (Zhu et al., 2006). They are denoted with (COM 1-4). The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree

1. COM1:IOIS implementation would be compatible with existing business processes
2. COM2: IOIS implementation would be compatible with the beliefs and values existing in our firm.
3. COM3: The adoption of IOIS is compatible with our firm's IT infrastructure.
4. COM4: Data exchanged over IOIS between our firm and business partners requires a secured communication medium

Technological context: Relative advantage measurement

Several studies (Lee and Kim, 2007; Zhu et al., 2006) determined items for measuring the relative advantage variables, they are denoted as (RAD1-3). These measures reflect the degree to which adoption of IOIS is perceived to be better than the previous system (Zhu et al., 2006). In addition to the above, more items were added to measure the degree to which the adoption of IOIS is perceived to improve an organisation daily activities and are denoted (RAD4-6) (Kaun and Chau, 2001). All the items were adapted and used to measure the relative advantage environment variable in the context of IOIS.

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. RAD1: IOIS is likely to improve communication with our customers.
2. RAD2: IOIS is likely to help increase sales.
3. RAD3: IOIS is likely to help reduce cost.
4. RAD4: IOIS is likely to help improve data accuracy
5. RAD5: IOIS is likely to help improve data security
6. RAD6: IOIS performance is sensitive to system errors and failures

Technological context: Complexity measurement

Lee and Kim (2007) study determined the items for measuring the complexity variables. The items (denoted COS 1-3) are; the skills required in developing IOIS, the difficulty of maintaining IOIS in the current work practices, development methodologies for IOIS and the complexity with the implementation process and use of IOIS. These measures reflect the degree to which the knowledge required to implement an IOIS is perceived as being difficult (Lee and Kim, 2007). In addition to the above, more items were added to measure the degree to which adopting an IOIS is perceived as being difficult and are denoted (COS 4-5) (Teo et al., 2003).

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. COS1: The skills required to develop IOIS are too complex for our IS employees.
2. COS2: It will be very difficult to maintain IOIS in our current work practices.
3. COS3: All of our IS team staff are well versed about development methodologies for IOIS.
4. COS4: Our company believes that IOIS implementation is a complex process
5. COS5: Our company believes that using IOIS is difficult

Organisational context: top management support measurement

Kim and Lee (2008) designed four items for measuring the top management variables. These measures reflect the awareness of IOIS significance by top management and top management commitment in adoption process. Findings from the study indicated that top management support is an important factor contributing to adoption of technology. These items were adopted and used to measure the top management organisational variable in the context of IOIS, they are denoted with (TOP 1-4) (Kim and Lee, 2008).

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. TOP1: Top management invest funds in IOIS
2. TOP2: Top management is highly interested in using IOIS.
3. TOP3: Top management is aware of the benefits of IOIS technologies.
4. TOP4: Top management consider IOIS as strategically important

Organisational context: IS technical skills measurement

In the adoption process, it is critical that organisations have the knowledge and technical skills required to support IOIS systems. (Kim and Lee, 2007; Thong, 1999) defined indicators of IS technical skills as a staff awareness of advance IT methodology, the existence of a computer expert within the organisation, and staff's IT educational background. These items were adapted for this study and are denoted with (IST 1-3).

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. IST1: Our IS employees are generally aware of advance IT systems such as IOIS
2. IST2: We have many experts on advanced IT systems such as IOIS.
3. IST3: Our IS employees are trained in IOIS technology.

Organisational context: Education and training measurement

Kim and Lee (2008) designed three items for measuring the education and training variables. The measures support the notion of education and training being important factor in reducing users resisting to change and improving the propensity to adopt. All three items were adopted and used to measure the organisational variable in the context of IOIS; they are denoted with (EDT 1-3)

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. EDT1: Education and training on IOIS is offered to applicable staff sufficiently and continuously
2. EDT2:The content and structure of education and training in IOIS systems are appropriate
3. EDT3: There exist a number of education and training opportunities in IOIS for all staff members

Organisational context: Size measurement

The measuring items for size were taken from Zhu et al., (2003) study. The items is the number of employees

Environmental context: Competition measurement

Several studies determined two items for measuring the competition variables. The measures reflect the degree of pressure to which the firm was affected by competitors in the industry (Zhu et al., 2006). The two items were adapted and used to measure the competition environment variable in the context of IOIS, they are denoted with (COP 1-2) (Kaun and Chau, 2001; Soliman and Janz, 2004).

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. COP1: There is a trend in my industry to utilize IOIS for business related activities and business communication
2. COP2: Important competitors using or soon to be using IOIS for communication would put pressure on my firm to do the same

Environmental context: Government regulation measurement

Zhu et al., (2006) designed three items for measuring the regulatory environment in the use of IOIS. The three items were; business laws support use, incentives provided by the government, government procurement prerequisites and legal protection of consumers' purchases on the Internet. The items were adapted and used to measure the regulatory environment variable in the context of IOIS, they are denoted with (REG 1-3)

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. REG1: We are aware of applicable laws that support our use of IOIS
2. REG2: Incentives provided by government are important to our adoption of IOIS
3. REG3: There are effective regulation which protect sharing of business and consumer data

Environmental context: Trading partners pressure and trust measurement

Soliman and Janz (2004) designed four items, which reflect the degree to which adoption of IOIS is influenced by its trading partners, denoted (TPP1-4). More items were added from previous studies (Lu et al, 2005; Iacovou, 2004), adapted and used to measure the trading partner trust and were denoted with (TPP5- 9).

The items were all measured on a on a seven-point scale from 1=strongly disagree to 7=strongly agree:

1. TPP1: Our most important partners have requested that we transact with them using an IOIS
2. TPP2: The use of IOIS is recommended by our most important business partners
3. TPP3: The majority of our business partners have requested that we transact with them using an IOIS
4. TPP4: The use of IOIS is recommended by a majority of our business partners
5. TPP5: Relationships with our business partners are characterized by high levels of trust
6. TPP6: Our firm and our partners generally trust that each will stay within the terms of our agreements
7. TPP7: We and our partners are generally sceptical of the information provided to each other
8. TPP8: We can count on our partners to meet their obligations
9. TPP9: It is worthwhile to maintain close collaboration with our partners

3.3.2 *Pre and Pilot Testing*

In addition to the use of literature as the basis for developing the measurement scales, the performance of pre and pilot testing helped to further ensure the content and face validity of the survey instrument. Content validity can be understood to be an assessment of how well the items in the questionnaire fully represent the relevant content domain of the construct that it is trying to measure (Bolarinwa, 2015). Face validity is established when individual who is an expert or has expertise on the research subject examines whether the items in the questionnaire have meaning in the world of the respondent (Bolarinwa, 2015).

First, a pre-test was carried out to assist with identifying ambiguous or poorly worded items. An executive from practice and an information Systems researcher were requested to review the questionnaire. Where ambiguity was found, the statements were modified. Statements which were unclear were rephrased and more items were added. Ambiguous questionnaire items were identified and clarified i.e. unclear statements were rephrased. More specifically, it was recommended that additional items associated with perceived relative advantages (RA) and trading partner trust (TPP) be considered as effects of IOIS adoption. Subsequent literature support confirmed that relative advantage items (RA4 -RA6) and trading partner trust items (TPP5-9) could be included (Kaun and Chau, 2001; Lu et al, 2005; Iacovou, 2004).

Next, a pilot test was conducted using a convenience sample of IS professionals from 14 organisations who were familiar with IOIS adoption. The participants provided their email addresses and an online questionnaire was shared with them. The respondents were asked to suggest ways to improve the questionnaire. A total of 8 responses from the 14 organisations invited to participate were received. An analysis was performed to check if the respondents interpreted the items in the way in which it was intended. The results from the analysis indicated that some questions were difficult to understand and answer. A recommendation to add items associated with perceived complexity (COS) and education and training (EDT) be considered as additional effects of IOIS adoption. Subsequent literature support confirmed that perceived complexity items (COS4-5) and education and training (EDT3) could be included (Lee and Kim, 2007; Kim and Lee, 2008). Refer to Table below for the items which were added and rephrase. The final questionnaire is shown in Appendix B.

Pre -Items Test	Post Items Test	Changes made	Pre or Pilot Test Modification	Source
COM1:IOIS implementation would be compatible with existing business processes	COM1:IOIS implementation would be compatible with existing business processes			
COM2: IOIS implementation would be compatible with the beliefs and values existing in our firm.	COM2: IOIS implementation would be compatible with the beliefs and values existing in our firm.			
COM3: The adoption of IOIS would be compatible with firm's IT infrastructure.	COM3: The adoption of IOIS is compatible with our firm's IT infrastructure.	Item rephrased	Pre Test	(Lee and Kim, 2007; Zhu et al.,2006)
COM4: Data exchanged over IOIS between our firm and business partners requires a secured communication medium	COM4: Data exchanged over IOIS between our firm and business partners requires a secured communication medium			
RAD1: IOIS is likely to improve communication with our customers.	RAD1: IOIS is likely to improve communication with our customers.			
RAD2: IOIS is likely to help increase sales.	RAD2: IOIS is likely to help increase sales.			
RAD3: IOIS is likely to help reduce cost.	RAD3: IOIS is likely to help reduce cost.			
	RAD4: IOIS is likely to help improve data accuracy	Item added	Pre Test	(Kaun and Chau, 2001)
	RAD5: IOIS is likely to help improve data security	Item added	Pre Test	(Kaun and Chau, 2001)
	RAD6: IOIS performance is sensitive to system errors and failures	Item added	Pre Test	(Kaun and Chau, 2001)
COS1: The skills required to develop IOIS are too complex for our IS employees.	COS1: The skills required to develop IOIS are too complex for our IS employees.			
COS2: It will be very difficult to maintain IOIS in our current work practices.	COS2: It will be very difficult to maintain IOIS in our current work practices.			
COS3: Almost none of our IS team staff are well versed about development methodologies for IOIS.	COS3: All of our IS team staff are well versed about development methodologies for IOIS.	Item rephrased	Pilot Test	(Lee and Kim, 2007).
	COS4: Our company believes that IOIS	Item	Pilot Test	(Lee and Kim, 2007;

	implementation is a complex process	added		Teo et al., 2003).
	COS5: Our company believes that using IOIS is difficult	Item added	Pilot Test	(Lee and Kim, 2007; Teo et al., 2003).
TOP1: Top management is likely to invest funds in IOIS	TOP1: Top management invest funds in IOIS	Item rephrased	Pre Test	(Kim and Lee, 2008; Soliman and Janz, 2004).
TOP2: Top management is highly interested in using IOIS.	TOP2: Top management is highly interested in using IOIS.			
TOP3: Top management is aware of the benefits of these new technologies.	TOP3: Top management is aware of the benefits of IOIS technologies.	Item rephrased	Pre Test	(Kim and Lee, 2008; Soliman and Janz, 2004).
TOP4: Top management is likely to consider IOIS application as strategically important	TOP4: Top management consider IOIS as strategically important	Item rephrased	Pre Test	(Kim and Lee, 2008; Soliman and Janz, 2004).
IST1: Our IS employees are generally aware of advance IT systems such as IOIS	IST1: Our IS employees are generally aware of advance IT systems such as IOIS			
IST2: There exist many experts on advanced tools in IS.	IST2: We have many experts on advanced IT systems such as IOIS.	Item rephrased	Pre Test	(Kim and Lee, 2007; Thong, 1999)
IST3: Our IS employees have an IT education background.	IST3: Our IS employees are trained in IOIS technology.	Item rephrased	Pre Test	(Kim and Lee, 2007; Thong, 1999)
EDT1: Education and training on IOIS is offered to applicable staff sufficiently and continuously	EDT1: Education and training on IOIS is offered to applicable staff sufficiently and continuously	Item added	Pilot Test	(Kim and Lee, 2008)
EDT2:The content and structure of education and training in IOIS systems are appropriate	EDT2:The content and structure of education and training in IOIS systems are appropriate	Item added	Pilot Test	(Kim and Lee, 2008)
	EDT3: There exist a number of education and training opportunities in IOIS for all staff members	Item added	Pilot Test	(Kim and Lee, 2008)
COP1: There is a trend in my industry to utilize IOIS for business related activities and business communication	COP1: There is a trend in my industry to utilize IOIS for business related activities and business communication			(Zhu et al., 2006)

COP2: Important competitors using or soon to be using IOIS for communication would put pressure on my firm to do the same	COP2: Important competitors using or soon to be using IOIS for communication would put pressure on my firm to do the same			(Zhu et al., 2006)
REG1: There are applicable laws that support the use of IOIS	REG1: We are aware of applicable laws that support our use of IOIS	Item rephrased	Pilot Test	(Zhu et al.,2006)
REG2: Adoption of IOIS in our firm is driven by incentives provided by the government	REG2: Incentives provided by government are important to our adoption of IOIS	Item rephrased	Pilot Test	(Zhu et al.,2006)
REG3:There are effective regulation which protect sharing of business and consumer data	REG3:There are effective regulation which protect sharing of business and consumer data			
TPP1: Trading partner usually set the mode of communication (e.g. internet, fax, email etc.)	TPP1: Our most important partners have requested that we transact with them using an IOIS	Item rephrased	Pre Test	(Soliman and Janz, 2004).
TPP2: Trading partner decide on rules and regulation for using an IOIS	TPP2: The use of IOIS is recommended by our most important business partners	Item rephrased	Pre Test	(Soliman and Janz, 2004).
TPP3: Trading partner decides on pricing, delivery schedules	TPP3: The majority of our business partners have requested that we transact with them using an IOIS	Item rephrased	Pre Test	(Soliman and Janz, 2004).
TPP4: Trading partner decides on what information system application are to be exchanged with our firm	TPP4: The use of IOIS is recommended by a majority of our business partners	Item rephrased	Pre Test	(Soliman and Janz, 2004).
	TPP5:Relationships with our business partners are characterized by high levels of trust	Item added	Pre Test	(Lu et al, 2005; Iacovou, 2004)
	TPP6: Our firm and our partners generally trust that each will stay within the terms of our agreements	Item added	Pre Test	(Lu et al, 2005; Iacovou, 2004)
	TPP7: We and our partners are generally sceptical of the information provided to each other	Item added	Pre Test	(Lu et al, 2005; Iacovou, 2004)
	TPP8: We can count on our partners to meet their obligations	Item added	Pre Test	(Lu et al, 2005; Iacovou, 2004)
	TPP9: It is worthwhile to maintain close collaboration with our partners	Item added	Pre Test	(Lu et al, 2005; Iacovou, 2004)

Table 6: Pre and Pilot test results

3.3.3 *Sampling and Respondents*

The objective of the study is to understand the adoption of IOIS technologies and the extent to which IOIS is used by firms in transacting with business partners. The specific population of interest in this study is South African organisations.

Bhattacherjee (2012) defines sampling as the statistical procedure that is applied in selecting a subset of a population of interest. The purpose of sampling from a population is to allow one to draw inferences about the population based on the study of a representative subset of that population, and to ensure that the study is valid and replicable (Bolarinwa, 2015).

Following the definition of the population of interest, Bhattacherjee (2012) explains that the next step in the sampling process is to identify a sampling frame. A sampling frame is defined as an accessible set, typically a list, of the population from where a sample can be extracted (Bhattacherjee, 2012). For this study, it was important to identify a sampling frame that included a list of South African organisations operating in different industries. Therefore, it was decided to use Whom Own Whom (http://www.whoownswhom.co.za/) company directory as a sampling frame. Who own whom is an independent research organisation supplying research on African businesses. Whom Own Whom represents a useful sampling frame as it has comprehensive profiles on more than 15,000 companies, 10% of which are stock exchange-listed and the balance private companies or multinationals, operating in more than 280 key industries across the African continent ("Who Owns Whom", 2016). From this list, 500 South African companies were randomly selected. Bhattacherjee (2012) describes random sampling as a probability based sampling technique where all units in the sampling frame have an equal opportunity for selection. This sampling technique results in a sample that is considered to be unbiased and thus results are largely generalizable. The list of randomly selected companies was then exported onto an MS Excel spreadsheet. A target of 500 companies was based on the statistical technique applied on the study for instance, Siddiqui (2013) guideline suggest that for factor analysis the appropriate sample size for 25 items is 250 and this study had more than 30 therefore 500 seemed appropriate. In addition, it was also based on an expectation of a 20% response rate and a desire to analyse at least 100 responses.

Having not exhausted and not able to obtain any additional contact details and thus falling just short of the desired 500, it was decided at this point to supplement the Whom Own Whom sampling frame with a convenience sample of companies. A convenience sample of 38 companies with contact details was available on LinkedIn and was selected. Convenience sampling occurs when a researcher uses his/her discretion to select a sample of units that is opportunistically available (Bhattacherjee, 2012). It is a form of non-probability sample because some members of the population are systematically excluded. The decision to supplement the Who Owns Whom list with the use of LinkedIn as an alternative source was because it was a time and cost efficient approach and necessitated by the limited resources available for this study. Taken together, 469 companies (with available contact details) were identified from the Who Own Whom and LinkedIn sampling frames, and invited to participate in the study.

Within each firm, relevant key informants needed to be targeted. These key informants were typically an IS/IT manager or Non- IS manager in the selected firms who are knowledgeable about their firm's use of IOIS systems. To approach the key informant, an email was sent to each company contact

mentioned on the company website requesting relevant IT/IS manager contact details. Phone calls and online searches were also used to obtain contact details. Of the 500 companies selected from Whom Own Whom, contacts details where obtainable for 431 of those companies.

3.3.4 *Survey administration*

For each identified key informant, an email inviting this potential respondents to participate in the study was sent. The respondents were informed that they were being invited to complete an online questionnaire pertaining to their firms' adoption of IOIS. A cover letter and participant information sheet was emailed to them. (Refer to Appendix A). The cover letter contained a description of the study and of IOIS, and also included a link to the online questionnaire.

The online mail survey method can reach large pool of population from different regions; however, its disadvantage lies with its challenges with obtaining reliable responses from the questionnaire (Lee and Kim, 2007). To compensate for the weaknesses of online data collection methods, at the beginning of the survey, the screening question were asked to ascertain whether the respondents were IT managers or if they were knowledgeable about their firm's adoption of IOIS and therefore the most-informed person in the firm to answer the questionnaire.

During the data collection process, frequency counts of gathered data was monitored. After the initial invitation emails had been sent out, it was observed that only a few responses were received. Reminders via email and telephone were made, and where necessary alternative key informants identified were invited.

3.4 Data analysis methods

3.4.1 *Reliability and Validity*

Data will be analysed using the statistical software available at the university (SPSS). First, the validity of the measurement scales will be tested. Validity in research refers to the extent to which a measure represents the underlying construct which it is supposed to measure (Bhattacherjee, 2012). Discriminant and convergent validity are dimensions of construct validity (Bhattacherjee, 2012). Convergent validity demonstrates that measures which should be related are in reality related. To establish discriminant validity, Principal component analysis (PCA) was used (Bhattacherjee, 2012). PCA is used to identify hidden data structures. It is used to establish convergent validity by demonstrating that all items measuring a construct load highly onto the same component. In other words, items intended to measure the same construct are expected to be highly correlated with each other. Discriminant validity demonstrates that measures that should not be related are in reality not related (Bhattacherjee, 2012). It can also be established through PCA. Specifically, PCA demonstrates whether items have sufficiently low cross-loadings (i.e. load poorly) onto components they are not intended to measure.

In addition to convergent and discriminant validity, scale reliabilities will be tested. Reliability in research refers to the "degree to which the measure of a construct is consistent or dependable"

(Bhattacherjee, 2012 pp56). Reliability requires that a measure of a variable be consistent. In the case of a multi- item measure, Cronbach's alpha calculation can be applied to provide us a quantitative assessment of the amount of internal consistency that we have across a specified set of items. Once scales have been found reliable then composite scores can be calculated for use in subsequent hypothesis testing.

3.4.2 *Research questions and Hypothesis testing*

Research question 1 was stated as: What are the types of IOIS used by South African firms? To answer this question, data will be analysed descriptively through the use of mean, standard deviation and variance and percentage of for instance the firms across different industries that have adopted an IOIS. Table and figures will be used to visualize the extent of IOIS adoption.

Research question 2 was stated as: What are the technological, organisational and environmental factors influencing adoption of IOIS by organisations in South Africa? To answer this question, a model was developed hypothesizing the effects of the selected technological, organisational and environmental factors on the adoption outcome. Statistical tests of the hypotheses are carried out so as to infer whether the corresponding propositions of the model are valid. Hypothesis testing uses the observed data (sample), to infer whether hypothesis presented in this paper can be supported or rejected by empirical observation (Bhattacherjee, 2012). According to Bhattacherjee (2012), inferential statistics are used to draw associations between variables. Specifically, to test hypotheses for interval and ratio data, the common techniques used are correlation. Correlation analysis is carried out to examine the association between the independent variables (TOE factors) and the dependent variables (adoption of IOIS). Correlation analysis can be extended by regression analysis, which is a process used to estimate the combined effects of the independent variables on the dependent variables and the total amount of variance explained by the model (Bhattacherjee, 2012). Correlation analysis was used in the study to determine whether hypotheses are supported. Multiple regression analysis was then applied to bring further insights. If the p value is less than 5% then one can reject the null hypothesis and accept the alternative hypothesis i.e. that the relationship is statistically significantly different from zero. The study's research hypotheses will be supported if there is a statistically significant relationship between the independent variables (the selected technological, organisational and environmental factors) and the dependent variable (adoption).

3.5 Ethical consideration for the study

Research needs to be conducted within ethical confines to ensure that no harm comes to respondents (McLeod, 2007). Key ethical considerations include ensuring participants are informed about the purpose of the study, obtaining consent from the participants and protecting the confidentiality of data obtained from them (Davison, 2002).

The following ethical considerations were followed during the study:

1. **Informed consent ,Voluntariness and Right to withdraw :** This principle suggest that participants need to be fully aware of what the study entails at all times in order to reduce misunderstandings and participants must be informed that their participation is voluntary (Israel and Hay, 2000). This study applied this principle and participants were informed that

their informed decision to participate in the study by completing the online questionnaire will be taken as their consent. In an instance whereby researchers are unable to maintain agreement mentioned on the consent forms, and then participants would need to be told about this and reminded that they can withdraw from the study (Israel and Hay, 2000).

2. **Conflict of interest:** There was no conflicts of interest that had to be declare in this study as the researcher does not work for an IOIS vendor and is not directly engaged in the implementation of IOIS solutions in her firm. Participants were informed that the results of the research would not be used for any purposes other than completion of the study. This principle would have applied if personal, financial, political and academic matters coexisted, in order for one interest to illegitimately favour another. Thus, the action could make other reasonable people feel that they are misled or being deceived (Israel and Hay, 2000:120).

3. **Anonymity and Confidentiality:** For the study, the respondents were made aware of their right to anonymity and that they were not be required to identify themselves or their company anywhere on the questionnaire. They were also informed that data would only be reported in the aggregate and not by individual company. Finally, they were informed that the information provided by them would be confidential and would not be shared with any third parties. The participants were provided with alternative contact information should they wish to disclose something related to the research.

Approval of this study was granted by the relevant Human Research Ethics Committee (non-medical) of the School of Economic and Business Sciences at the University of the Witwatersrand, Johannesburg (protocol number: CINFO/1105). The researcher abided by the guidelines of the ethic committee to protect the rights of subject participants.

3.6 Limitations, Internal and External validity of the study

The methodology adopted for this study has potential limitations. First, the survey was self-completed by potential participants. If there is a non-response bias or self-selection bias, results will not necessarily represent the population of firms and thus limits the generalisability of the results of the survey. This could present a threat to external validity, which limits the degree to which one can infer that a relationship found in the sample holds in the population and therefore the findings are relevant to all the other unstudied organisations, contexts and members of the population (Bhattacherjee, 2012). Secondly, only online survey was used, limiting institutions which prefer to participate via paper-based surveys. Third, the questionnaire is structured and the content might not cover other additional decision factors influencing IOIS adoption. In other words, the questionnaires covers the types of IOIS studied and factors influencing adoption based on the TOE framework only. Fourth, surveys are subject to respondent bias, which is a potential limitation (Bhattacherjee, 2012). For example, there may be a social desirability bias, where participants might be reluctant to honestly disclose organisational data or their might provide socially desirable responses. As a result, this could pose threat to internal validity, which assess whether the observed change in dependent variable is caused by corresponding change in the hypothesized independent variable (Bhattacherjee, 2012). In addition, questions could potentially be misinterpreted; some respondents might not tell the truth. The participants could be non-IS senior business manager with some knowledge of IOIS and their views could differ from their senior managers. Lastly, random sampling technique was supplemented by a

convenience sampling method, this weakens the external validity of the results and findings cannot be generalised to all firms.

Chapter Conclusion

The first section of this chapter discussed research paradigm. The rest of the chapter related to the design and methods to be used during the study to investigate factors influencing adoption of IOIS. This chapter discussed the methods of data collection and analysis for the main aim of the study. Lastly a discussion on ethical considerations for the study and limitations was presented. In the next chapter, the data is analysed and the findings of the study are reported.

CHAPTER 4. Data Analysis

This chapter presents results of this study. Firstly, the chapter reports the results of the data screening and reverse scoring process, the results of missing data and outlier analyses. Secondly, a sample profile analysis of organisation is presented. Thirdly, the chapter answers the first research question by describing the state of IOIS adoption. Next, the second research question is addressed by assessing the validity and reliability of the various technological, organisational and environmental factor measures and testing the research model and hypotheses.

4.1 Data screening

A total of 119 responses were received after 12 weeks of data collection. There were 469 potential respondents, and thus a response rate of 25.37% was obtained. Prior to analysis of the data it was necessary to prepare the data and screen the 119 responses for missing values and outliers.

In addition to the above, according to Bhattacherjee (2012) an item with reverse meaning from the original construct requires reverse coding. In the questionnaire, the organisational variables were measured using 7 point Likert scale which assumes equal weights for all items (Bhattacherjee, 2012). Two items related to trading partner trust 13 (We and our partners are generally sceptical of the information provided to each other) and 14 (We can count on our partners to meet their obligations), had a reversed meaning. Therefore the items required reverse coding so that high scores reflect low resistance (or acceptance).

4.2 Missing values and outliers

Data was screened for missing values. From the 119 responses which were received, 23 respondents completed only the demographic information and provided no responses to the other significant questions and had to be removed, leaving a dataset of 96 records usable for this study.

These 96 responses were largely complete in respect to questions on the firm's usage of IOIS applications. Therefore, for the purposes of answering the study's first research question which addresses the types of IOIS adopted by South African firms, the sample of 96 records was used.

However, of these 96 records, 19 respondents did not provide enough complete data on the T.O.E factors driving adoption behaviours (i.e. more than 10% of the questionnaire items relating to adoption factors were missing responses). These 19 responses therefore had to be eliminated for the purposes of addressing RQ2. Table 5 summarizes the missing values analysis and strategy adopted.

Next, the remaining cases were examined for outliers. Outliers are responses with unusually high or unusually low values, which might suggest that the respondent is not from the same population as the other respondents. SPSS standardized score function was used to determine if any cases have standardized scores less than -3 or greater than 3 on more than one questionnaire item. An observation with a standardized scores less than -3 or greater than 3 would suggest an observations are 3 or more standard deviations away from the mean (Bhattacherjee, 2012). These cases would be considered to be potential outliers. Of the 77 cases analysed, two cases with outlying observation on multiple scale items were identified, which warranted for those cases to be removed from further analysis, leaving

75 usable responses. Consequently, for the purposes of answering the second research question which addressed the factors influencing adoption of IOIS, a data sample of 75 records were used.

Number of Missing values per Case	Number of Cases	Strategy
0	77 (75 excl. outliers)	Retained for RQ2
7 (COP1-2, REG1-3, TPP1-4)	7	Retained for RQ1 only
14 (COM1-4, RAD 1-6, COS1-5)	5	Retained for RQ1 only
19 (TOP1-4, IST1-3, EDT 1-3, TPP5-9)	7	Retained for RQ1 only
More than 20 items including IOIS adoption indicators	23	Eliminated

Table 7: Missing values

4.3 Sample profile analysis

4.3.1 *Job Titles*

The respondent's job titles, were classified as Executives, head of department, managers, architects, developers and engineers, analyst, consultants and advisors, auditors, support/admin and other. Majority of the respondents were analyst and managers. These respondents were selected as valid key informants and considered to be sufficiently knowledgeable about their firm's IOIS systems. Table below summaries the respondent's job titles.

Job Title	Total	Percent
Executives	5	5%
Head of Departments	5	5%
Managers	20	21%
Architects	3	3%
Developers and Engineers	11	11%
Analyst	23	24%
Consultants and Advisors	12	13%
Auditors	4	4%
Support , Admin and other	13	14%
Total	96	100%

Table 8: Job titles

4.3.2 *Types of industries and size of the organisation*

Table 9 shows the industries in which the responding firms operate. The responding firms were from across a range of industries but financial services had a much larger concentration than other types of firms. Thus, the results are more applicable to those firms and less so for organisations from under-represented industry sectors e.g. manufacturing and retail. Table 10 shows the distribution of the sample in terms of firm size (number of employees). The number of larger organisations is greater than that of smaller organisations. This is not unexpected as the sampling strategy focused on organisations across various firms in different industries sectors firms from the Who Owns Whom directory.

Types of the industries	Count of Industry	Percentage
Consulting	24	25%
Financial service	45	47%
Manufacturing	2	2%
Mining, Oil and Gas	4	4%
Retail	1	1%
Public services	5	5%
Telecommunication	4	4%
Transport and Logistics	2	2%
Commercial Properties & Facilities Management	1	1%
Education	1	1%
Information Technology	2	2%
Media	2	2%
Non-Governmental Agency	1	1%
HealthCare-Medical schemes	1	1%
Travel	1	1%
Total	**96**	**100**

Table 9: Types of industries

Firm size (number of employees)	No. of firms of this size	Per. of firms of this size
Less than 20	9	9.4%
21–50	5	5.2%
51–100	5	5.2%
101–200	6	6.3%
201–500	11	11.5%
501–1000	12	12.5%
More than 1000	48	50.0%
Total	**96**	**100**

Table 10: Size of organisations (no. of employees)

4.4 RQ1: IOIS technologies firms are using or plan to use in the near future

Respondents were asked to indicate whether their organisation had made available for use or plan to make available for use a variety of IOIS technologies which were identified from previous studies. Table below presents frequency counts for the different IOIS technologies which are *currently available for use* or are *planned to be used* within the respondents' organisations. The data below indicates that groupware technologies, video conferencing, electronic payment system and online banking are the most frequently available IOIS technologies. The least used IOIS technologies are Freight tacking systems and reservation systems. Given the profile of the sample where a larger number of service organisations in consulting and financial services chose to take part, it is not unexpected that more generic IOIS applications were reported to be in use than those which may be more specific to selected industries.

Types of Technologies	Using	Plan to use	Using%	Plan to use%
Electronic Data Interchange	58	13	60.42	13.54
Electronic Payment System and Online Banking	71	8	73.96	8.33
Groupware	81	6	84.38	6.25
Extranet	45	16	46.9	16.7
Online shopping	43	15	44.8	15.6
Reservation system	34	14	35.4	14.6
Supply Chain Management System	53	16	55.2	16.7
eProcurement	44	18	45.8	18.8
Inventory Management System	44	9	45.8	9.4
Freight Tracking System	24	16	25.0	16.7
Video Conferencing	72	12	75.0	12.5
Business Open Market (BOM) interfaces (APIs) for mobile apps production by partners and clients.	1	0	1	1
Dropbox	1	0	1	1
Online Project Management tools, Chase, Skype	1	0	1	1

Table 11: Frequency count of the type of IOIS technologies

A majority of the respondents were from financial services and consulting sectors. The Figure below, illustrates the top five most used technologies in the financial services and consulting sectors. Across these firms, the most adopted technologies were groupware, videoconferencing; electronic payment system and online banking, EDI and supply chain management systems. Results show that 91% of financial services firms are using groupware, compared to 88% in the consulting firms. Of the financial services firms, 80% are using videoconferencing and 80% are using electronic payment and online banking. In the consulting firms, 75% are using videoconferencing technologies and 58% are using electronic payment system and online banking. Although EDI and supply chain management systems are part of the top five adopted technologies, less than 50% of consulting firms use EDI (42%) or supply chain management systems (33%).

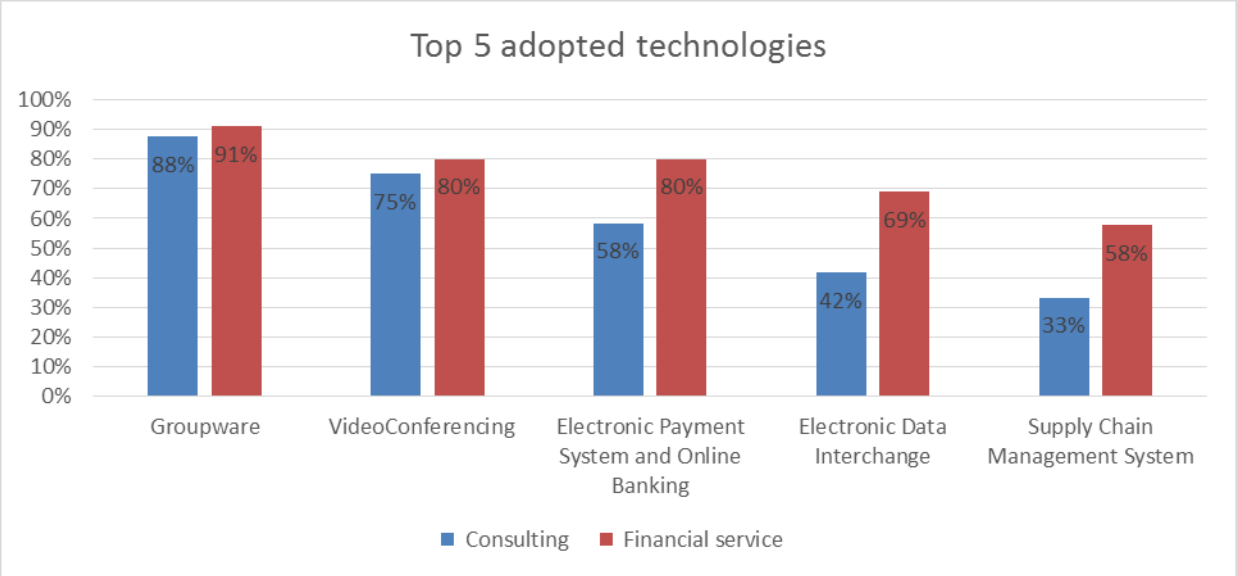


Figure 10: Top 5 most adopted technologies in consulting and financial services

The Figure below illustrates the top five most used technologies in the thirteen industries that were less well represented in the sample. Given the small number of firms, the results are more indicative than conclusive as regards to the penetration of IOIS technologies into those industries. Across the thirteen industries, groupware technologies had a total usage count of 19 (out of 24 firms) i.e. 79%. Videoconferencing and supply chain management systems had a total usage count of 18 across these firms from various industries (i.e. 78% for videoconferencing and 82% for supply chain management system). EDI and electronic payment system and online banking had a total usage count of 17 across industries (65% for electronic payment and online banking and 74% for EDI). Given the nature of these firms e.g. retail, manufacturing and mining among others, it is not surprising that IOIS such as supply chain management system and electronic data interchange have penetrated more into these types of firms.

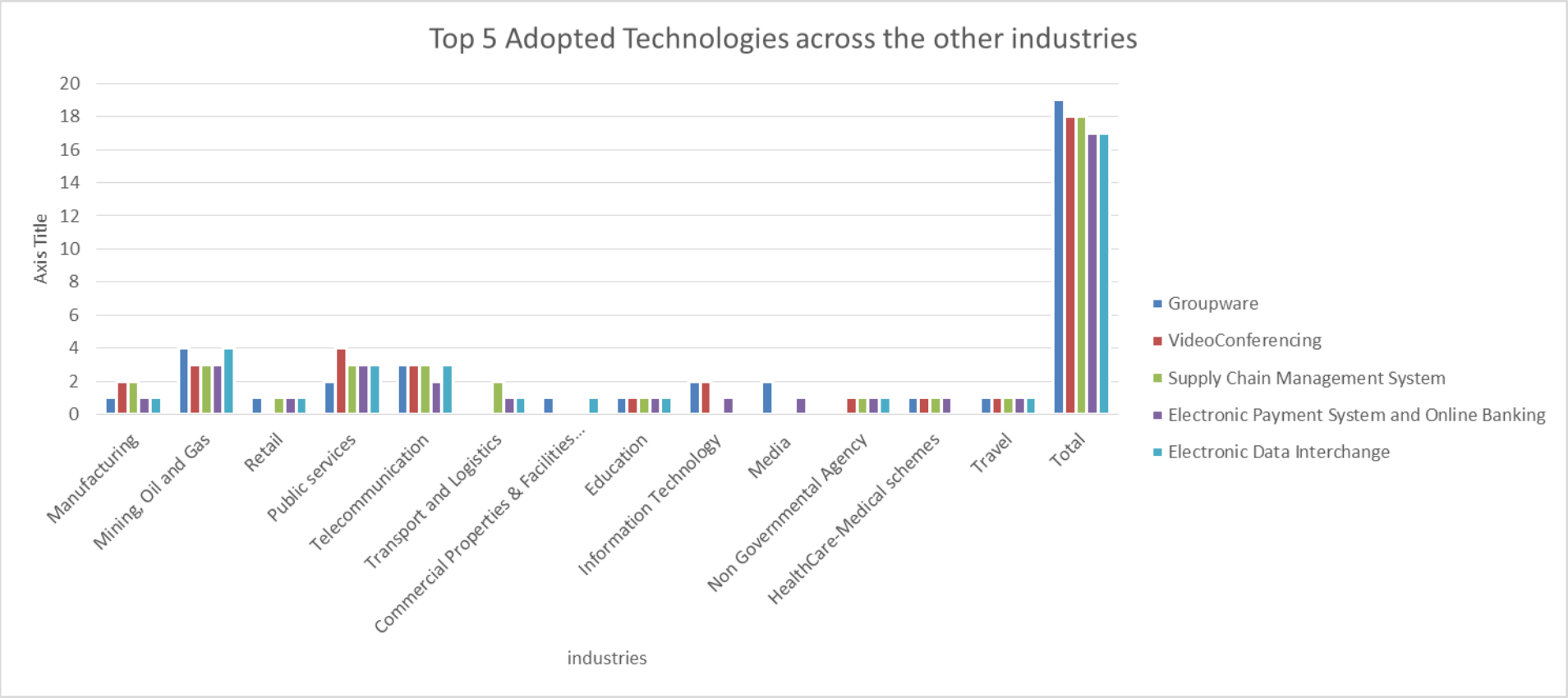


Figure 11: Top 5 adopted technologies across 13 industries

The Figure below illustrates the top three technologies which are not currently available for use but which are planned to be used by responding firms in the financial services and consulting sectors. Eight (8) respondents in financial services (i.e. 18%) indicated that supply chain management systems and freight tracking systems are planned to be used be used. Currently, 60% and 36% are already using those technologies respectively.

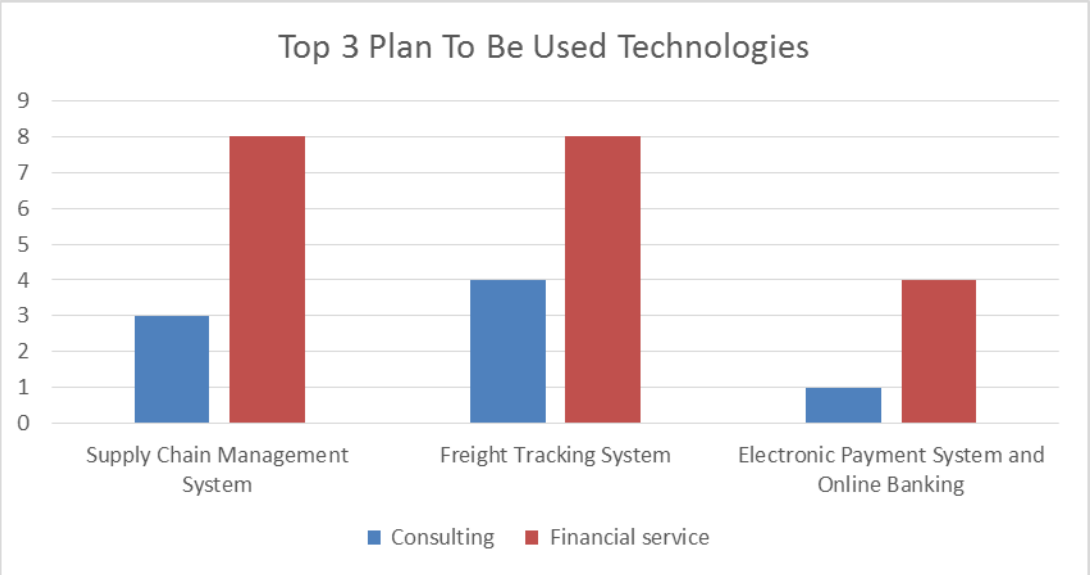


Figure 12: Plan to be used technologies

From the less well-represented industries, a total of 9 respondents indicated extranets are planned to be used, followed by a total of 7 respondents who indicated that videoconferencing and eProcurement and lastly, a total of 6 respondents indicated that supply chain management, online shopping, and EDI are planned to be used.

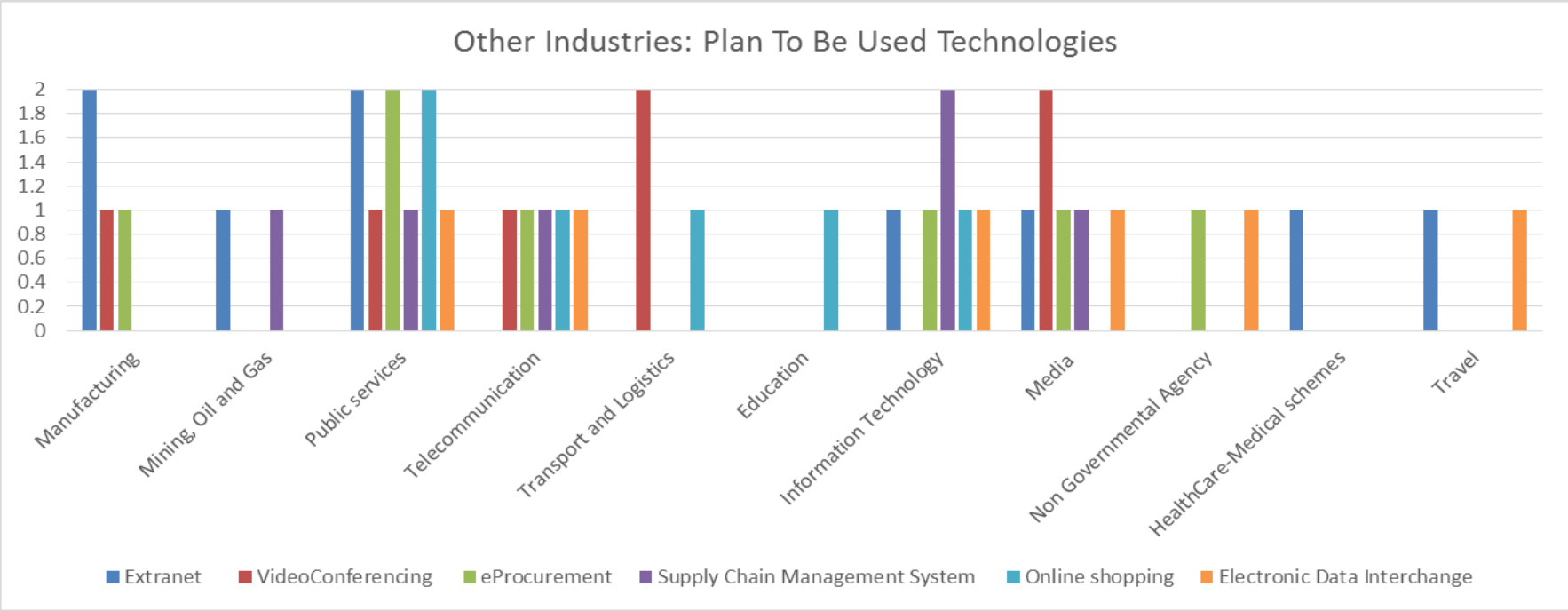


Figure 13: Other Industries – Plan To Use Technologies

The pie chart (Figure 14) illustrates the types of IOIS that have been adopted. Electronic Data Interchange (n = 58), Freight Tracking System (n=23), Groupware (n= 80), VideoConferencing (n=72) are classified as dyadic type IOIS (Lyytinen and Damsgaard, 2011; Soliman and Janz, 2004; Zhu et al., 2003; Kim and Lee, 2008; Singerling et al., 2015). Supply Chain Management System (n = 52), and Inventory Management System (n= 45) are Hub and Spoke (Rajaguru and Matanda 2012; Lyytinen and Damsgaard, 2011; Zhu et al. 2006; Zhu et al., 2003). Electronic Payment System and Online Banking (n= 67), Online shopping (n= 43), Reservation system (n= 34), eProcurement (n= 44), Extranet (n= 43), Dropbox, Mobile apps and online tools (n=5) are multilateral (Lyytinen and Damsgaard, 2011; Lee and Kim, 2007; Zhu et al. 2006; Soliman and Janz, 2004; Zhu et al., 2003). In total, 566 IOIS technologies have been adopted across the 96 South African firms. From which, 41% are dyadic (i.e. 233/566), 17% are Hub and Spoke (i.e. 97/566), 42% are multilateral (i.e. 231/566). None of the IOIS technologies presented to firms were community type IOIS given that the sampled firms were not public or governmental institutions.

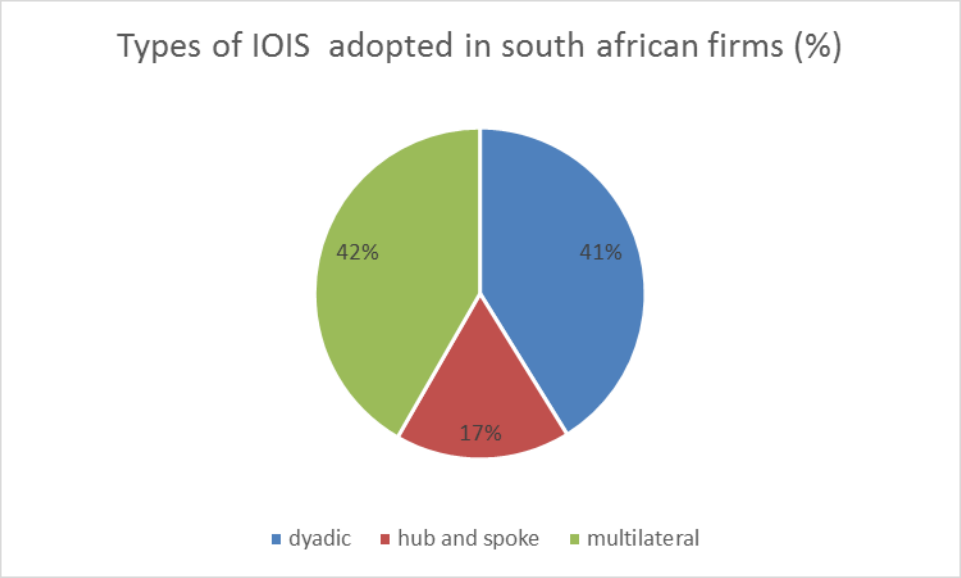


Figure 14: Types of IOIS adopted in South African Firms

4.5 RQ2: Factors that influence extent of IOIS adoption

Prior to answering research question 2 by testing the hypothesized research model linking various TOE factors to adoption, it was first necessary to establish the reliability and validity of the underlying measurement scales.

4.5.1 *Principal component analysis*

Principal components analysis (Factor Analysis) is a common statistical technique for examining the underlying factor structure of our data. Principal components analysis can provide us with evidence of convergent validity by demonstrating that all items measuring a construct load highly onto the same component. It can also provide us with evidence of discriminant validity by demonstrating that items have low cross-loadings.

a. *Convergent and Discriminant validity*

As part of the factor analysis, a kaiser-meyer-olkin measure of sampling adequacy and Bartlett test were assessed first, to verify whether the sample size with the given number of variables were sufficiently large to justify factor analysis. Bartlett test should be significant and the KMO measure should be above 0.500 (preferably above 0.800). Then a rotated Varimax solution with Kaiser Normalization illustrating the factor loading structure i.e. present non-overlapping/overlapping independent factors followed. All items that had a loading higher than 0.5 were considered acceptable and items that had a loading less than 0.4 or had high cross-loadings (i.e. load highly on more than one factor) were eliminated. Four sets of PCA analyses were run. The first focused on the dependent variables, the second focused on technological factors, the third focused on the Organisational factors, the last run focused on the Environmental factors. In each case, multiple iterations of PCA were run with items being dropped as necessary prior to a stable solution emerging.

IOIS adoption was measured in two ways, (1) the availability of IOIS technologies and (2) the use of IOIS technologies. Availability was a summated scale of availability for use of a basket of IOIS technologies in the firm. It did not need to be subjected to PCA analysis. The second measure of adoption (extent of IOIS use) was measured using a nine-item scale reflecting IOIS use for decision making support, business operations support, replacing legacy system, access to business partners internal IT system, business partners having access to internal IT system, the use of IOIS in transacting with business partners and lastly, the uses e-mail, groupware and video conferencing to communicate with business partners. These 9 items were subjected to a PCA analysis. The Bartlett's test of sphericity was significant and the KMO measure statistic was 0.818. In the first run of the rotated Varimax solution with Kaiser Normalization, email used a communication medium (EXT4) item was dropped from the analysis as it did not load with the other items and the research model. In the second run of rotated Varimax solution with Kaiser Normalization, all of the items had a significant loading (>.5) on its respective component. The results show evidence of uni-dimensionality across the dependent variables and show presence of convergent validity and each item has a significant loading (>.5). SPSS extracted one component factor solution, which accounts for 53.397% of the total variance. Refer to Table 12 below for the results of the final PCA analysis of IOIS adoption (extent of IOIS use) dependent variables.

Dependent Variable (Extent of IOIS Use)

	Component Matrix 1
EXT1	.586
EXT2	.732
EXT3	.767
EXT5	.763
EXT6	.613
DEP1	.802
DEP2	.776
DEP3	.774

Extraction Method: Principal Component Analysis.

DEP1= decision making support ; DEP2 =business operations support; DEP3= replacing legacy system; EXT1= Transacting with business partners; EXT2 = Business partners access internal IT system; EXT3= Access to business partners internal IT system; EXT5= Groupware tools used a communication medium; EXT6= Videoconferencing used as communication medium

a. Absolute values < 0.40 were suppressed.

Table 12: PCA factor structure for adoption of IOIS

For Technology factors, namely perceived relative advantage, perceived complexity and compatibility, the Bartlett's test of sphericity was significant and the KMO measure statistic was 0.751. In the first run of the rotated Varimax solution with Kaiser Normalization, the items for relative advantage (RAD6) and compatibility (COM4) were dropped from the analysis and the research model, as the wording in the questionnaire did not seem to measure relative advantage and compatibility. Complexity item (COS3) loaded onto the same component as compatibility and was dropped from the analysis and the model as the question was closely associated with organisational construct, education and training. In the second run of rotated Varimax solution with Kaiser Normalization, All the items had a significant loading (>.6) on its respective component. The results showed evidence of convergent validity (the item intended to measure a construct have converged). SPSS extracted three factor solution, which accounts for 76.972% of the total variance. All six empirically derived factors had eigenvalues greater than one. SPSS extracted a twelve factor solution, which accounts for 66.861% of the total variance. Refer to Table 13 below for the results of the final PCA analysis for technological factors.

Technology Factors

Rotated Component Matrix

	1	2	3
RAD1	.760		
RAD2	.608		
RAD3	.629		
RAD4	.854		
RAD5	.799		
COS1		.651	
COS2		.800	
COS4		.854	
COS5		.851	
COM1			.843
COM2			.858
COM3			.740

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]
COM=Compatibility; RAD=Perceived Relative Advantage; COS= Perceived Complexity;

a. Absolute values < 0.40 were suppressed.

Table 13: PCA factor structure for technological factors

For Organisational factors, namely top management support, IS technical skills, education and training, the Bartlett's test of sphericity was significant and the KMO measure statistic was 0.815. In the first run of the rotated Varimax solution with Kaiser Normalization, IS technical skills items IST2-3 loaded onto the same component as education and training constructs and had loading more than 0.500. Also, the wording for those items is closely associated with education and training construct, for this reason, IS technical skill items (IST2-3) were combined with education and training construct and justified the need to change the research model (described in greater detail in section 4.5.2 below). IST1 was dropped from further analysis as it had a very low loading. In the second run of the rotated Varimax solution with Kaiser Normalization, all the items had a significant loading (>.6 or close enough) on their respective component. The results showed evidence of convergent validity. The IS Technical Skills (IST2 -3) showed evidence of discriminate validity, despite having a cross-loadings of 0.441 and 0.429 respectively as they maintained a primary loading. SPSS extracted a two factor solution, which accounts for 73.874% of the total variance. Refer to Table 14 below for the results of the final PCA analysis.

Organisational Factors

Rotated Component Matrix

	1	2
IST2	.441	.598
IST3	.429	.712
EDT1		.879
EDT2		.810
EDT3		.771
TOP 1	.894	
TOP 2	.873	
TOP 3	.872	
TOP 4	.806	

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]
TOP=Top Management Support; IST=IS Technical Skills; EDT=Education and training

a. Absolute values < 0.40 were suppressed.

Table 14: PCA factor structure for organisational factors

For Environmental factors, namely trading partner pressure, government regulation and competition the Bartlett's test of sphericity was significant and the KMO measure statistic was 0.839. In the first run of the rotated Varimax solution with Kaiser Normalization, REG 1-3 items measuring government regulation did not show unidimensionality. REG1 loaded onto the same component as competition constructs, however, the loading for competition were higher. To ascertain the significant of the items in relation to the dependent variable, a correlation analysis was performed. The results indicated that REG 1 yielded a sample correlation coefficient of 0.320 which is statistically significant at the 0.05 level ($r=0.320$, $p<0.001$). REG 2 yielded a sample correlation coefficient of 0.266 which is statistically significant at the 0.05 level ($r=0.266$, $p<0.001$). REG3 yielded a sample correlation coefficient of 0.133 which is statistically insignificant at the 0.05 level ($r=0.133$, $p<0.001$). Government regulation items (REG 1-2) are significant however, the there is no unidimensionality. For this reason government regulation items (REG 1-3) were dropped from the analysis and research model. In addition, trading partner trust items (TPP5-9) were dropped from analysis and the research model as they were not found to converge with the other measures for trading partner pressure. Reflection on item wording suggests that TPP5-9 might reflect a trading partner trust variable that future research may wish to examine for effects on IOIS adoption. In the second run of rotated Varimax solution with Kaiser Normalization, all the items had a significant loading (>.6) on its respective component. The results showed evidence of convergent validity. SPSS extracted a two factor solution, which accounts for 86.443% of the total variance. Refer to Table 15 below for the results of the final PCA analysis of the environmental factors.

Environmental Factors

Component Matrix

	1	2
COP1		.915
COP2		.892
TPP1	.882	
TPP2	.874	
TPP3	.894	
TPP4	.893	

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.[a]
TPP= Trading Partner Pressure; REG= Government Regulation; COP =Competition

a. Absolute values < 0.40 were suppressed.

Table 15: PCA factor structure for environment factors

b. ***Cronbach alpha***

Having satisfied convergent and discriminant validity criteria, the next step was to confirm the internal consistency reliability of the scales. Cronbach's alpha calculation was applied to assess the amount of internal consistency of the measurement scale. A scale is considered to be reliable when the Cronbach's alpha is at 0.70 or higher. Item-to-total correlations were also assessed to ensure correlation coefficients were above 0.400 for each construct and all items were retained.

	Number of items	Cronbach's Alpha
Extent of IOIS use	8	.871
Competition	2	.870
Trading partner pressure	4	.942
Perceived compatibility	3	.855
Perceived relative advantage	5	.802
Perceived complexity	4	.833
Top Management Support	4	.927
IS technical skills and Education and Training	5	.870

Table 16: Reliability analysis

4.5.2 *Revised research model*

All the items of government regulation concern construct were dropped during the principal factor as the items loaded onto the same component as the competition constructs (i.e. discriminant validity could not be established between the two constructs). For this reason, Hypothesis 10: Government regulation has negative influence on the intention to adopt IOIS adoption, is dropped from the study. Furthermore, as mentioned above, based on the factor analysis the IS technical skills items loaded onto the same component as the education and training constructs. Due to similarity in measurement and significant loading, the items were combined and the model revised. The following hypotheses reflect the revised model (Figure 15):

Perceived Compatibility

Hypothesis 1: The perceived compatibility of existing information systems with IOIS has a positive influence on adoption of IOIS technologies and the extent of IOIS adoption.

Perceived Relative advantage
Hypothesis 2: The perceived relative advantage of an IOIS has a positive influence on the adoption of IOIS technologies and the extent of IOIS adoption.

Perceived Complexity
Hypothesis 3: The perceived complexity of IOIS has a negative influence on the adoption of IOIS technologies and the extent of IOIS adoption.

Top Management Support
Hypothesis 4: Top management support has a positive influence on the adoption of IOIS technologies and the extent of IOIS adoption.

IS technical Skills and Education and Training
Hypothesis 5: The existing IS technical skills and opportunity for user education and training has a positive influence on the adoption of IOIS technologies and the extent of IOIS adoption.

Size
Hypothesis 6: The size of the organisation has a positive influence on the adoption of IOIS technologies and the extent of IOIS adoption.

Trading partner Pressure
Hypothesis 7: Trading partner pressure has a positive influence on adoption of IOIS technologies and the extent of IOIS adoption.

Competition
Hypothesis 8: Competition has a positive influence on the adoption of IOIS technologies and the extent of IOIS adoption.

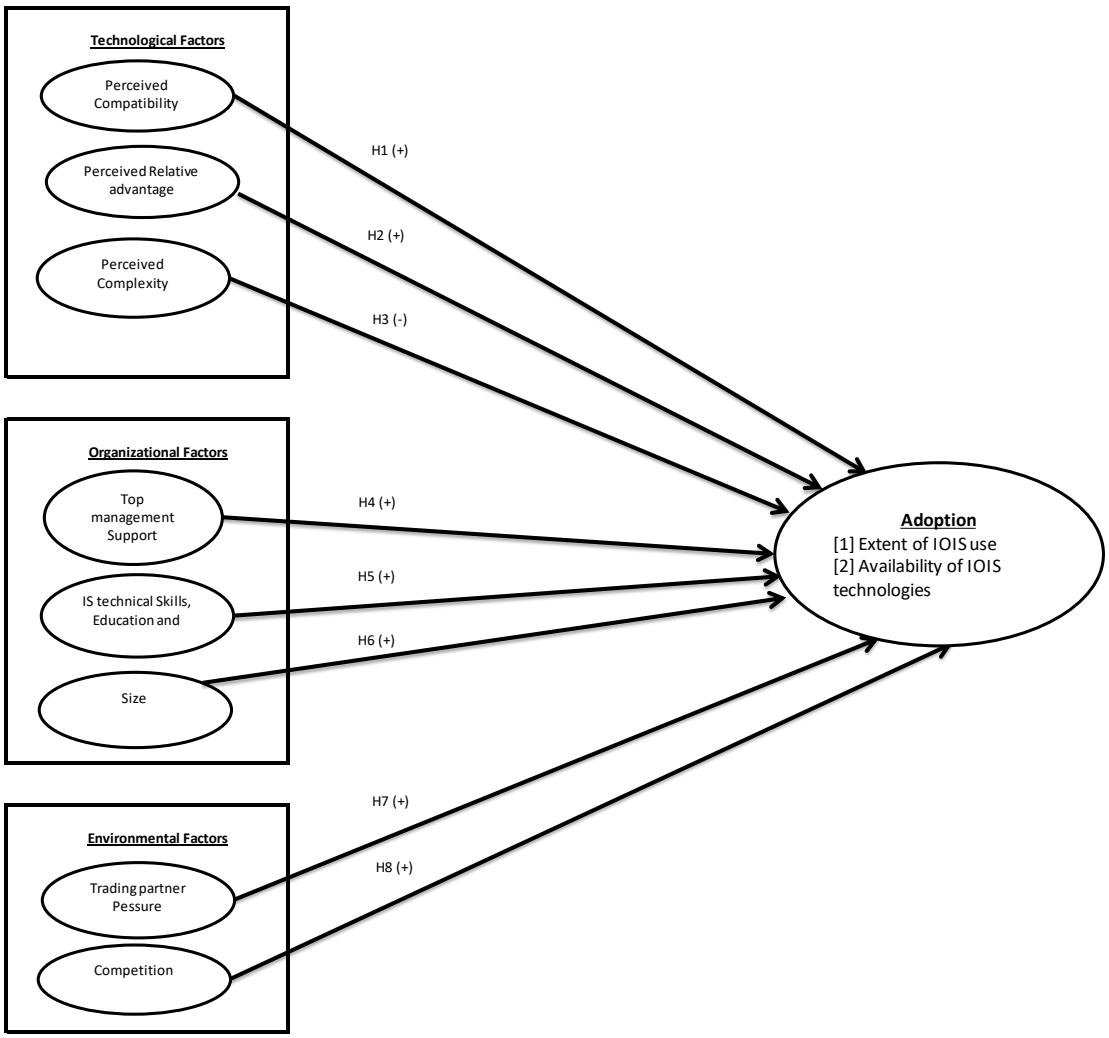


Figure 15: Revised research model

4.5.3 *Hypothesis testing*

a. *Composite Scores*

In order to perform correlation and multiple regression, multiple items needed to be reduced to a single composite (or summated) score. Composite scores were computed for the perceived relative advantage, perceived compatibility, perceived complexity, IS technical skills and education training, top management support, trading partner pressure and competition variables. Based on the variables which were retained after the factor analysis, the composite score were calculated by taking the average over a set of items weighted equally. The table below shows that all variables were normally distributed and are to be included in the model. It also shows the descriptive statistics for each of the composite variables.

Items	N	Min	Max	Mean	Std. Deviation	Variance	Skewness Statistic	Skewness Std. Deviation	Kurtosis Statistic	Kurtosis Std. Deviation
Perceived Relative Advantage	75	2.20	7.00	5.4053	1.02613	1.053	-0.893	0.277	0.773	0.548
Complexity	75	1.00	7.00	3.6733	1.35503	1.836	0.329	0.277	-0.417	0.548
Compatibility	75	1.00	7.00	5.3022	1.22189	1.493	-1.077	0.277	1.409	0.548
IS Technical Skills and Education and Training	75	1.80	7.00	4.4427	1.20373	1.449	-0.142	0.277	-0.718	0.548
Top Management Support	75	1.75	7.00	5.0200	1.26462	1.599	-0.455	0.277	-0.011	0.548
Trading Partner Pressure	75	1.00	7.00	4.4367	1.56238	2.441	-0.253	0.277	-0.525	0.548
Competition	75	2.00	7.00	5.4667	1.32882	1.766	-0.885	0.277	0.209	0.548

Table 17: Composite scores

Size

The Size variable was also normalised by taking the logarithm of the size variable and is included in the model, see table below.

Item	N	Min	Max	Mean	Std. Deviation	Variance	Skewness Statistic	Skewness Std. Deviation	Kurtosis Statistic	Kurtosis Std. Deviation
Size	75	2	5	19548.04	68540.816	469743506	5.595	0.277	34.895	0.548
TransformSize	75	0.3	5.7	3.0269	1.20912	1.462	-0.2	0.277	-0.293	0.548

Table 18: Composite score for size

Adoption

The composite scores for Adoption were also calculated. For extent of use, the composite was the average of the scale items weighted equally, and for availability it was the sum of the number of IOIS technologies adopted (median=7).

Item	N	Min	Max	Mean	Std. Deviation	Variance	Skewness Statistic	Skewness Std. Deviation	Kurtosis Statistic	Kurtosis Std. Deviation
Extent of IOIS use	75	1.25	4.88	3.4883	0.87335	0.763	-0.471	0.277	-0.33	0.548
Availability of IOIS technologies	75	0	11	6.1467	2.81258	7.911	-0.244	0.277	-0.558	0.548

Table 19: Composite score for IOIS adoption

b. *Correlation Analysis*

The bivariate correlation coefficient (usually donated as r) was used to perform hypothesis testing, which is a statistical measure of the strength of relationship between two variables. Since the data is normally distributed and ratio and interval level measures were used, the Pearson's correlation was used to assess the relationships between all independent variables. Table 20 below present 3 correlation coefficient

	Extent of IOIS use	**Availability IOIS technologies**
Perceived Relative Advantage	.406**	0.261*
Perceived Complexity	-0.032	0.153*
Perceived Compatibility	.511**	0.130*
IS Technical Skills and Education and Training	.599**	0.444***
Top Management Support	.467**	0. 205*
Trading Partner Pressure	.545**	0.433***
Competition	.572**	0.312***
Size	0.259*	0.265*
*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$;		

Table 20: Correlation analysis

Hypothesis 1

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between perceived compatibility (Mean =5.3022; Standard Deviation=1.22189) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.511 which is statistically significant at the 0.01 level ($r=0.511$, $p<0.01$). This provides support for hypothesis 1 that perceived compatibility and adoption of IOIS are positively and significantly related. Thus, the perceived compatibility of previous information system with IOIS has a positive influence on the extent of adoption of IOIS.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between perceived compatibility (Mean =5.3022; Standard Deviation=1.22189) and adoption of IOIS technology (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.130 which is statistically significant at the 0.05 level ($r=0.130$, $p<0.05$). This provides support for hypothesis 1 that perceived compatibility and adoption of IOIS are positively and significantly related. Thus, the perceived compatibility of previous information system with IOIS has a positive influence on the availability of IOIS technologies.

Hypothesis 2

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between perceived relative advantage (Mean =5.4053; Standard Deviation =1.02613) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.406 which is statistically significant at the 0.01 level ($r=0.406$, $p<0.01$). This provides support for hypothesis 2 that perceived relative advantage and adoption of IOIS are positively and significantly related. Thus, the perceived relative advantage of previous information system with IOIS has a positive influence on the extent of adoption of IOIS.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between perceived relative advantage (Mean =5.4053; Standard Deviation =1.02613) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.261 which is statistically significant at the 0.05 level ($r=0.261$, $p<0.05$). This provides support for hypothesis 2 that perceived relative advantage and adoption of IOIS are positively and significantly related. Thus, the perceived relative advantage of an IOIS has a positive influence on the availability of IOIS technologies.

Hypothesis 3

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between perceived complexity (Mean =3.6733; Standard Deviation =1.35503) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. For adoption 1 and 2, the correlation between the variables yielded a sample correlation coefficient of -0.032 which is not statistically significant at the 0.01 level ($r= -0.032$, $p>0.01$). This does not provide support for

hypothesis 3 as the relationship is not significant. Perceived complexity and adoption of IOIS are only marginally negatively associated but the effect is not statistically significant.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between perceived complexity (Mean =3.6733; Standard Deviation =1.35503) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.153 which is not statistically significant at the 0.05 level ($r= 0.153$, $p>0.05$). The hypothesis is rejected as an association between perceived complexity and use of IOIS is not in the expected direction. One possible explanation for the finding is that adoption of IOIS by nature is complex and companies who have implemented IOIS may thus have a better understanding of the unavoidable complexity of IOIS. Therefore the recognition of complexity is to some extent associated with adoption.

Hypothesis 4

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between Top management support (Mean =5.0200; Standard Deviation =1.26462) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.467 which is statistically significant at the 0.01 level ($r=0.467$, $p<0.01$). This provides support for hypothesis 4 that Top management support and adoption of IOIS are positively and significantly related. Thus, Top management support has a positive influence on the extent of adoption of IOIS.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between Top management support (Mean =5.0200; Standard Deviation =1.26462) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.205 which is statistically significant at the 0.05 level ($r=0. 205$, $p<0.05$). This provides support for hypothesis 4 that Top management support and adoption of IOIS are positively and significantly related. Thus, Top management support has a positive influence on the availability of IOIS technologies.

Hypothesis 5

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between IS technical Skills and Education and Training (Mean =4.4427; Standard Deviation =1.20373) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.599 which is statistically significant at the 0.01 level ($r=0.599$, $p<0.01$). This provides support for hypothesis 5 that existing IS technical skills and opportunity for user education and training and the adoption of IOIS are positively and significantly related. Thus, the existing IS technical skills and opportunity for user education and training has a positive association on the extent of IOIS adoption.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between IS technical Skills and Education and Training (Mean =4.4427; Standard Deviation =1.20373) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.444 which is statistically significant at the 0.001 level ($r=0.444$, $p<0.001$). This provides support for

hypothesis 5 that IS technical Skills and Education and Training and the use of IOIS are positively and significantly related. Thus, the existing IS technical skills and opportunity for user education and training has a positive association on the availability of IOIS technologies.

Hypothesis 6

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between the transformed Size variable (Mean =3.0269; Standard Deviation =1.20912) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. Size was measured as the total number of employees within an organisation. For adoption 1 and 2, the correlation between these variables yielded a sample correlation coefficient of 0.259 which is not statistically significant at the 0.05 level (r=0. 259, p>0.05). This provides support for hypothesis 6 that size and use of IOIS are positively and significantly related. Thus, size of the organisation has positive influence on the extent of IOIS adoption.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between the transformed Size variable (Mean =3.0269; Standard Deviation =1.20912) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339) was assessed. Size was measured as the total number of employees within an organisation. The correlation between these variables yielded a sample correlation coefficient of 0.265 which is statistically significant at the 0.05 level (r=0. 265, p>0.05). This provides support for hypothesis 6 that size and use of IOIS are positively and significantly related. Thus, size of the organisation has positive influence on the availability of IOIS technologies.

Hypothesis 7

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between Trading partner Pressure (Mean =4.4367; Standard Deviation =1.56238) and adoption of IOIS (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.545 which is statistically significant at the 0.01 level (r=0.545, p<0.01). This provides support for hypothesis 7 that trading partner pressure and adoption of IOIS are positively and significantly related. Thus, Trading partner Pressure has positive association on the extent of IOIS adoption.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between Trading partner Pressure (Mean =4.4367; Standard Deviation =1.56238) and adoption of IOIS (Mean =3.4293; Standard Deviation =.92339). The correlation between these variables yielded a sample correlation coefficient of 0.433 which is statistically significant at the 0.001 level (r=0.433, p<0.001). This provides support for hypothesis 7 that trading partner pressure and adoption of IOIS are positively and significantly related. Thus, Trading partner Pressure has positive influence on the availability of IOIS technologies.

Hypothesis 8

On the adoption of IOIS, where IOIS adoption is measured in terms of the extent of IOIS adoption, the relationship between Competition (Mean =5.4667; Standard Deviation =1.32882) and adoption 1&2 (Mean =3.4883; Standard Deviation =.87335) was assessed. The correlation between these

variables yielded a sample correlation coefficient of 0.572 which is statistically significant at the 0.01 level ($r=0.572$, $p<0.01$). This provides support for hypothesis 8 that competition and adoption of IOIS are positively and significantly related. Thus, Competition has positive influence on the extent of IOIS adoption.

On the adoption of IOIS, where IOIS adoption is measured in terms of availability of IOIS technologies, the relationship between Competition (Mean =5.4667; Standard Deviation =1.32882) and adoption of IOIS technology (Mean =3.4293; Standard Deviation =.92339) was assessed. The correlation between these variables yielded a sample correlation coefficient of 0.312 which is statistically significant at the 0.001 level ($r=0.312$, $p<0.001$). This provides support for hypothesis 8 that competition and adoption of IOIS are positively and significantly related. Thus, Competition has positive influence on the availability of IOIS technologies.

4.6 TOE factors that influence the extent of IOIS use

Multiple regression analysis was applied to bring further insights into the combined effects of selected independent variables on IOIS adoption.

4.6.1 *Multiple regression analysis*

Model 1 considers the effects of the technological factors on the adoption of IOIS, where IOIS Adoption is measured in terms of the extent of IOIS use. The R^2 is 0.334 suggesting that the model explains 33.4% of the variability in the adoption of IOIS. This is significant at the $p <0.001$ level. Relative advantage and perceived compatibility have a significant effect on the adoption of IOIS at the $p <0.05$ level and $p<0.001$ level respectively. Perceived compatibility has the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.488 which is significant at the $p <0.001$ level.

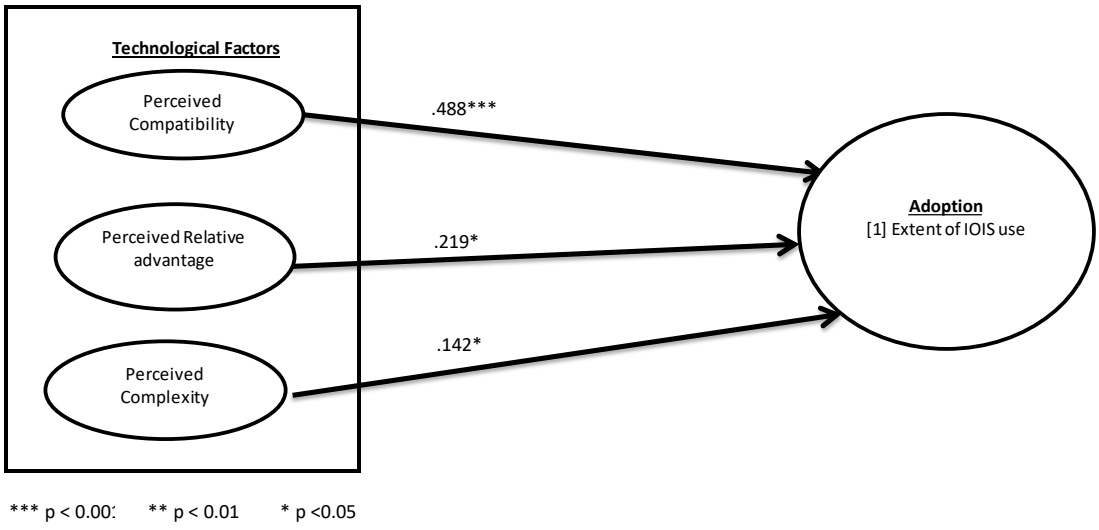


Figure 16: Model 1

Model 2 considers the effects of the organisational factors on the adoption of IOIS, where IOIS Adoption is measured in terms of the extent of IOIS use. The R^2 is 0.430 suggesting that the model explains 43.0% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. IS technical skills and education and training variable have a significant effect on the adoption of IOIS at the p<0.001 level, while size and top management support have a significant effect on the adoption of IOIS at the p<0.05 level. Combination IS technical skills and education and training have the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.439 which is significant at the p <0.001 level.

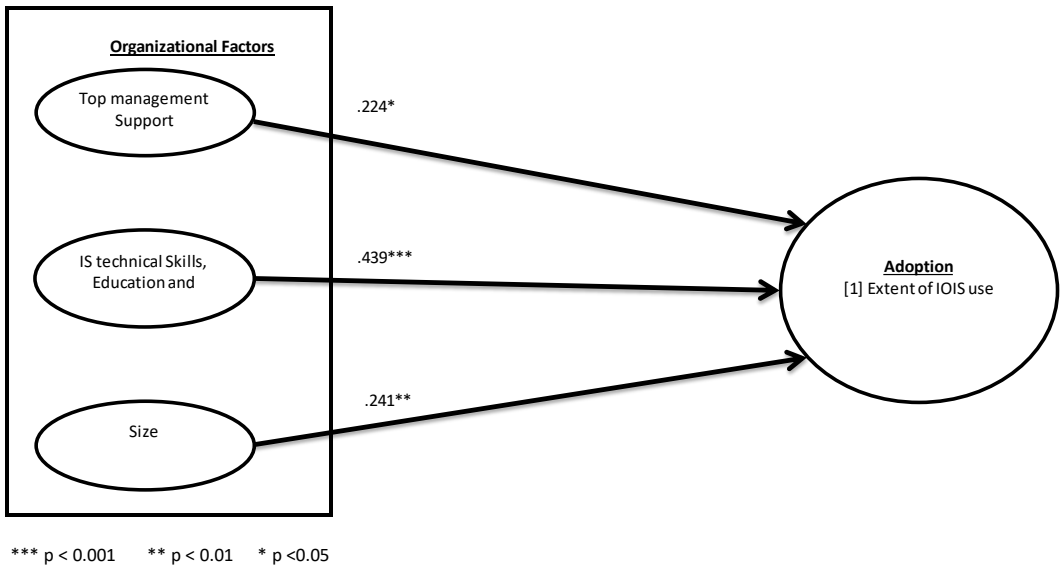


Figure 17: Model 2

Model 3 considers the effects of the environmental factors on the adoption of IOIS, where IOIS Adoption is measured in terms of the extent of IOIS use. The R^2 is 0.408 suggesting that the model explains 40.8% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. Trading partner pressure and competition have a significant effect on the adoption of IOIS (p<0.001). Competition has the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.393 which is significant at the p <0.001 level.

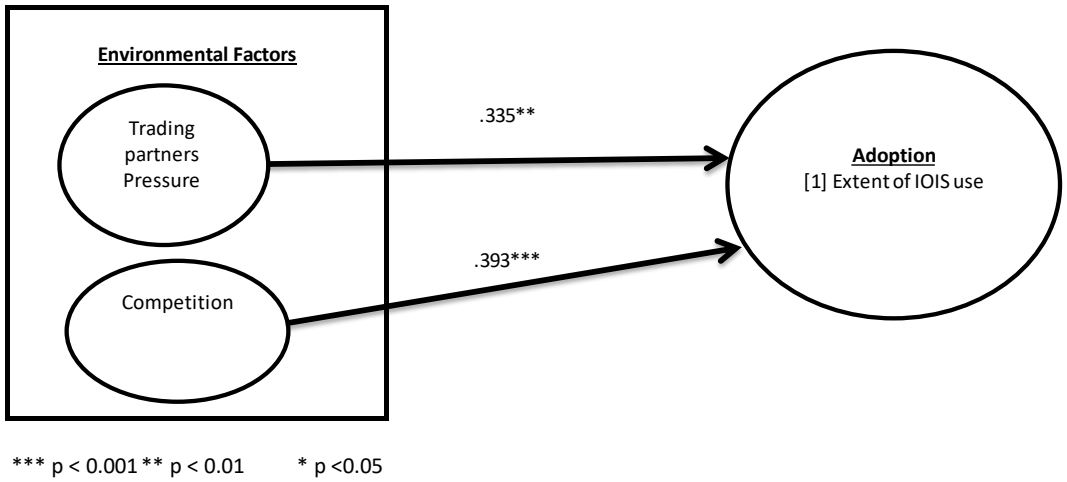


Figure 18: Model

Model 4 consider the effects the Technology, Organisation and environmental factors on the adoption of IOIS, where IOIS Adoption is measured in terms of the extent of IOIS use. The R2 is 0.451 suggesting that the model explains 45.1% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. Competition and the combination of IS technical skills and education and training have a significant effect on the adoption of IOIS (p<0.001). IS technical skill and education and training having the largest significant effect on the adoption of IOIS. It has a standardised regression coefficient (β) of 0.385 which is significant at the p <0.001 level. Followed by competition with a standardised regression coefficient (β) of 0.232 which is significant at the p <0.001 level. Perceived Compatibility pressure has the a standardised regression coefficient (β) of 0.172 at a significant level of 0.05

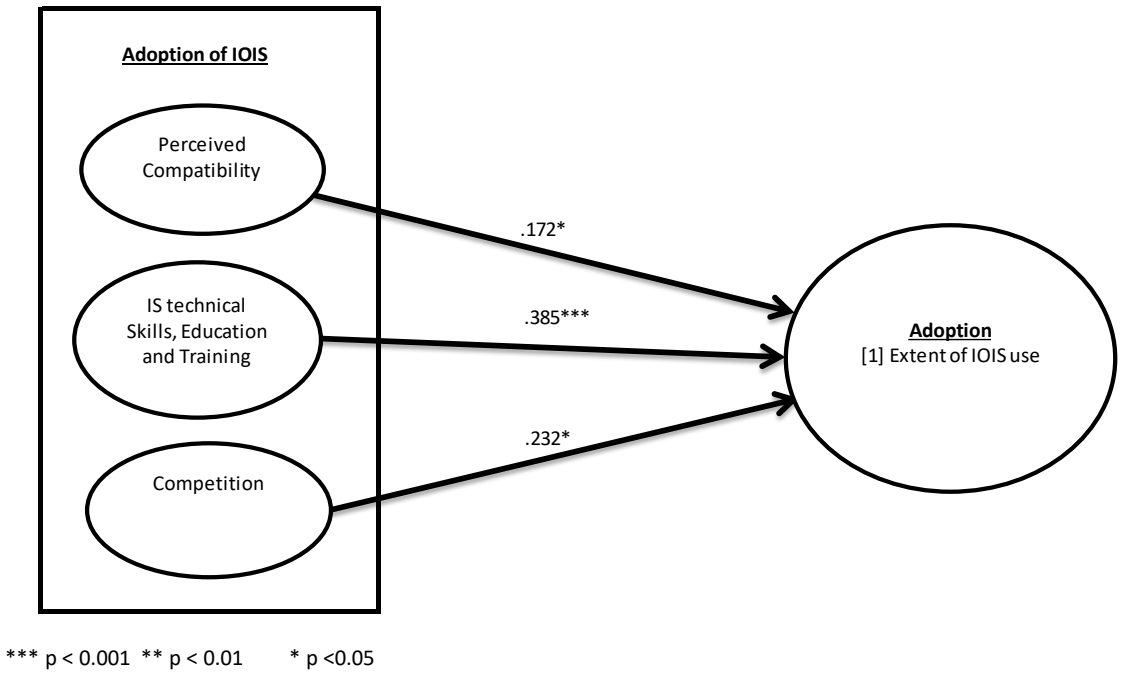


Figure 19: Model 4

4.6.2 *Assumptions*

Collinearity

Collinearity occurs when multiple independent variables in a multiple regression show a high degree of correlation. When multi-collinearity is present, regression estimates for the independent variables become unstable. Multi-collinearity was assessed by using the Tolerance parameter and its inverse the Variance Inflation Factor (VIF). According to (O'Brien, 2007), the tolerance scores should be close to 1, VIF's should be close to 0 or at least below 5. The VIF and Tolerance scores of each variable in each regression model did not show any presence of multi-collinearity and for this reason, the assumption was not violated, see the table below.

	Collinearity Statistics	
	Tolerance	**VIF**
Model 1		
Perceived Relative Advantage	0.815	1.227
Perceived Complexity	0.793	1.261
Perceived Compatibility	0.694	1.441
Model 2		
Top Management Support	0.601	1.663
IS Technical skills and education and training	0.602	1.660
Size	0.949	1.053
Model 3		
Trading Partner Pressure	0.714	1.401
Competition	0.714	1.401
Model 4		
Competition	0.441	2.269
Perceived Compatibility	0.517	1.936
IS Technical Skills and Education and Training	0.658	1.520

Table 21: Collinearity statistics for extent of IOIS adoption

Assumption of Linear Relationship

Standard multiple regression is a linear model and it cannot be fitted to data which is nonlinearly related (Bansal, 2011). Violations of this assumption can be detected by examining a scatter plot of the standardized residuals on the standardized predicted values (ZRESID as the Y variable, and ZPRED as the X variable). The resulting scatterplot should be spherical or block shaped. If the residuals follow a curved pattern, then this is a sign that nonlinearities should be considered. The scatter plots were assessed and did not show any non-linear pattern. For this reason, the assumption of linearity has not been violated.

Assumption of Heteroscedasticity

Heteroscedasticity is the assumption of constant error variance (Osborne and Waters, 2002). Using the same plot as above, standardized residuals against standardized predicted values, the assumption of heteroscedasticity was checked by assessing if the residuals were randomly distributed around 0 and were not distributed in a fan. Based on the assessment, the assumption of heteroscedasticity has not been violated.

Normality of the residual distribution

An assessment to see whether the points hug the line or rollercoaster around it has been performed (Bansal, 2011). The plots gave an indication that the residuals are approximately normally distributed. The histogram was also assessed and it displayed the shape of a normal distribution curve. For this reason, the assumption of normality has not been violated.

4.7 TOE factors that influence the availability of IOIS technologies

4.7.1 *Multiple regression analysis*

Model 5 considers the effects of the technological factors on the adoption of IOIS, where IOIS Adoption is measured in terms of availability IOIS technologies. The R2 is 0.098 suggesting that the model explains 9.8% of the variability in the adoption of IOIS. This is significant at the $p < 0.05$ level. Perceived relative advantage and perceived compatibility have a significant effect on the adoption of IOIS ($p<0.05$). Perceived relative advantage has the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.199 which is significant at the $p < 0.05$ level.

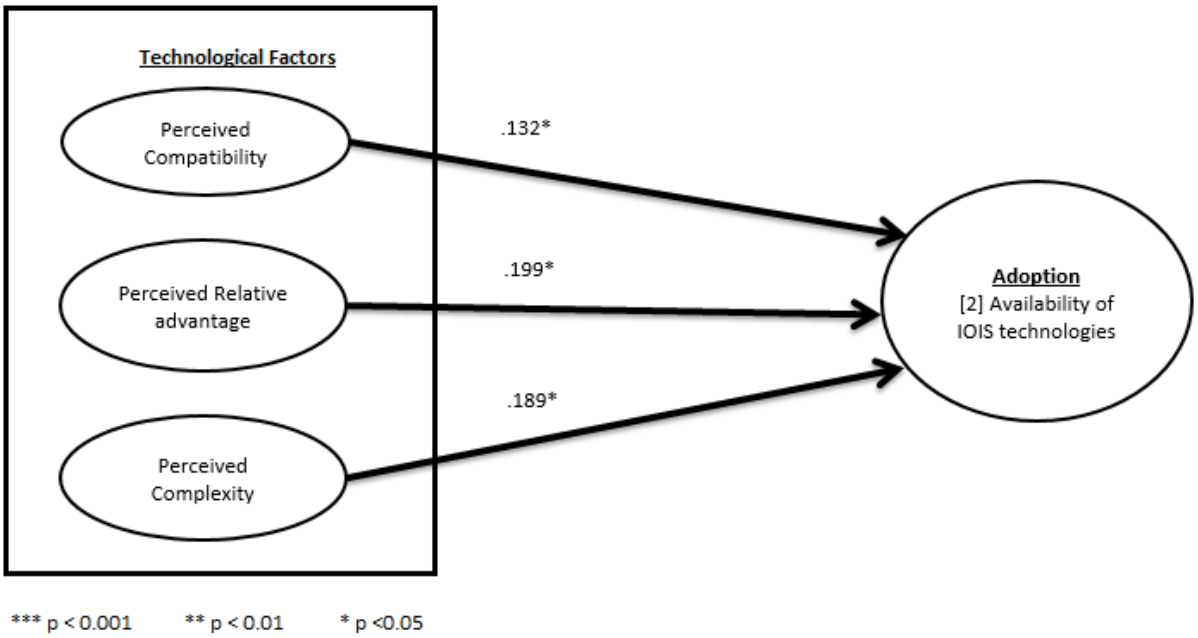


Figure 20: Model 5

Model 6 considers the effects of the organisational factors on the adoption of IOIS, where IOIS adoption is measured in terms of availability IOIS technologies. The R2 is 0.249 suggesting that the model explains 24.9% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. IS technical skills and education and training variable have a significant effect on the adoption of IOIS (p<0.001). Combination IS technical skills and education and training have the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.454 which is significant at the p <0.001 level. With these factors in place, Top management variable is not necessarily important to increasing the availability of IOIS technologies.

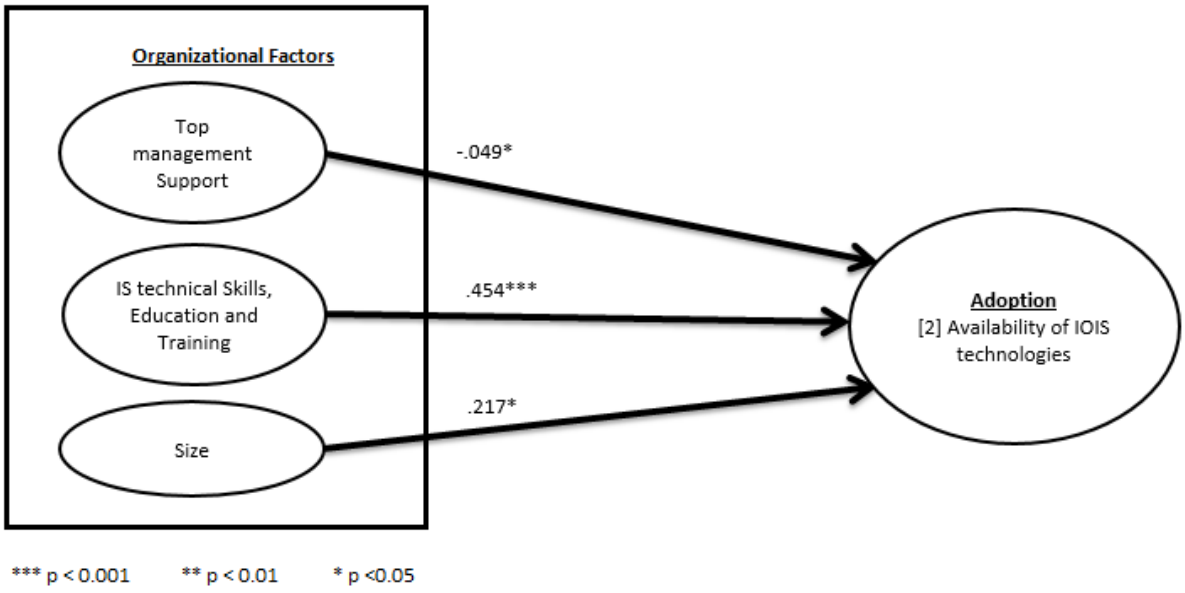


Figure 21: Model 6

Model 7 considers the effects of the environmental factors on the adoption of IOIS, where IOIS adoption is measured in terms of availability IOIS technologies. The R2 is 0.197 suggesting that the model explains 19.7% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. Trading partner pressure have a significant effect on the adoption of IOIS at the p<0.001 and competition have a significant effect on the adoption of IOIS (p<0.05). Trading partner has the largest significant effect on adoption of IOIS. It has a standardised regression coefficient (β) of 0.373 which is significant at the p <0.001 level.

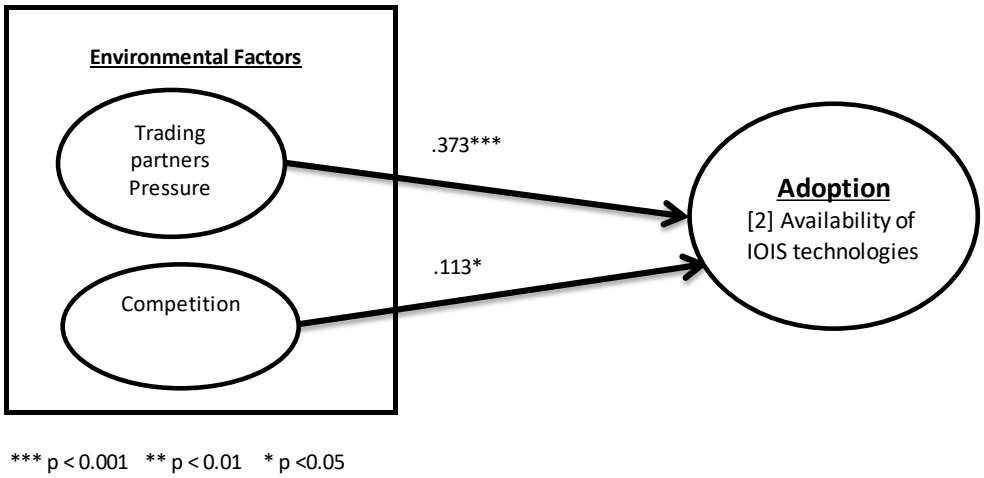


Figure 22: Model 7

Model 8 consider the effects the Technology, Organisation and environmental factors on the adoption of IOIS, where adoption of IOIS is measured in terms of availability IOIS technologies. The R2 is 0.254 suggesting that the model explains 25.4% of the variability in the adoption of IOIS. This is significant at the p <0.001 level. The combination of IS technical skills and education and training have a significant effect on the adoption of IOIS (p<0.05). IS technical skill and education and training having the largest significant effect on the adoption of IOIS. It has a standardised regression coefficient (β) of 0.298 which is significant at the p <0.05 level. Followed by trading partner pressure with a standardised regression coefficient (β) of 0.257 which is significant at the p <0.05 level. Perceived relative advantage pressure has the a standardised regression coefficient (β) of 0.040 at a significant level of 0.10

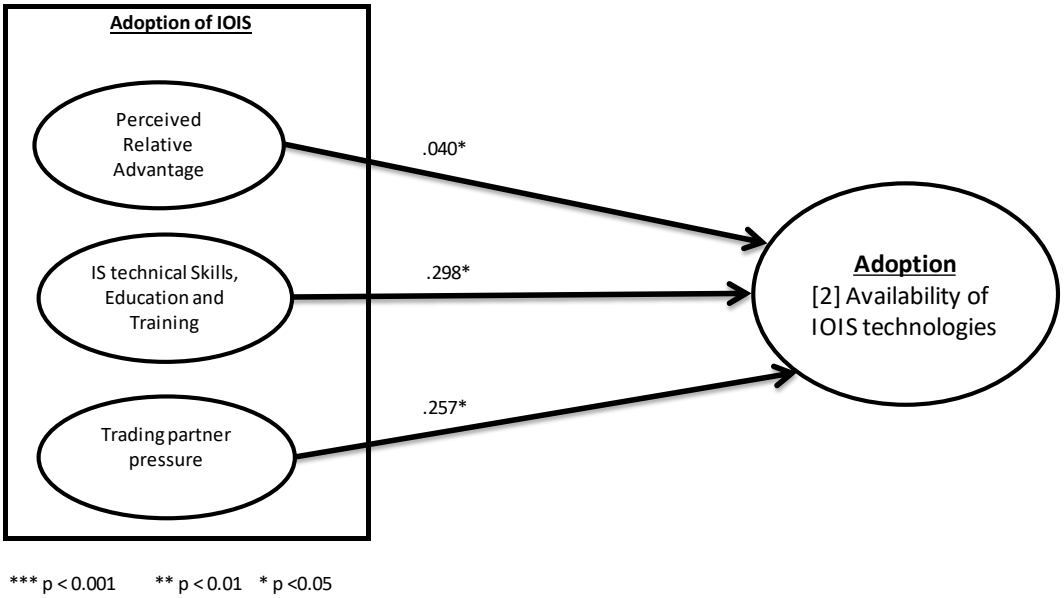


Figure 23: Model 8

4.7.2 *Assumptions*

Collinearity

Collinearity occurs when two or more independent variables in a multiple regression are highly correlated with one another. When multi-collinearity is present, regression estimates for the independent variables become unstable. Multi-collinearity was assessed by using the Tolerance parameter and its inverse the Variance Inflation Factor (VIF). According to (O'Brien, 2007), the tolerance scores should be close to 1, VIF's should be close to 0 or at least below 5. The VIF and Tolerance scores of each variable in each regression model did not show any presence of multi-collinearity and for this reason, the assumption was not violated, see the table below.

	Collinearity Statistics	
	Tolerance	**VIF**
Model 1		
Perceived Relative Advantage	0.815	1.227
Perceived Complexity	0.793	1.261
Perceived Compatibility	0.694	1.441
Model 2		
Top Management Support	0.602	1.660
IS Technical skills and education and training	0.601	1.663
Size	0.949	1.053

Model 3		
Trading Partner Pressure	0.714	1.401
Competition	0.714	1.401
Model 4		
Trading Partner Pressure	0.585	1.709
Perceived Relative advantage	0.735	1.361
IS Technical Skills and Education and Training	0.724	1.380

Table 22: Collinearity statistics for adoption of IOIS technologies

Assumption of Linear Relationship

Standard multiple regression is a linear model and it cannot be fitted to data which is nonlinearly related (Bansal, 2011). Violations of this assumption can be detected by examining a scatter plot of the standardized residuals on the standardized predicted values (ZRESID as the Y variable, and ZPRED as the X variable). The resulting scatterplot should be spherical or block shaped. If the residuals follow a curved pattern, then this is a sign that nonlinearities should be considered. The scatter plots were assessed and did not show any non-linear pattern. For this reason, the assumption of linearity has not been violated.

Assumption of Heteroscedasticity

Heteroscedasticity is the assumption of constant error variance (Osborne and Waters, 2002). Using the same plot as above, standardized residuals against standardized predicted values, the assumption of heteroscedasticity was checked by assessing if the residuals were randomly distributed around 0 and were not distributed in a fan. Based on the assessment, the assumption of heteroscedasticity has not been violated.

Normality of the residual distribution

An assessment to see whether the points hug the line or rollercoaster around it has been performed (Bansal, 2011). The plots gave an indication that the residuals are approximately normally distributed. The histogram was also assessed and it displayed the shape of a normal distribution curve. For this reason, the assumption of normality has not been violated.

Chapter Conclusion

This chapter presents results of this study. Firstly, the chapter reports the results of the data screening and reverse scoring process, the results of missing data and outlier analyses. Secondly, a sample profile analysis of organisation is presented. Thirdly, the chapter answers the first and second research question. Followed by an assessment of that the validity and reliability of the measures and the research model and hypotheses tested. The next chapter will discuss these findings further and relate the outcomes to existing literature.

CHAPTER 5. Discussion

This chapter discusses the findings and relate them back to the TOE studies found in the literature to determine whether the findings confirm or differ from expectation. The first section discusses the IOIS technologies and types of IOIS used in South African context. Followed by a discussion on the effects of TOE factors on the adoption of IOIS.

5.1 IOIS Technologies and the type of IOIS

The first research question aimed to describe the extent of adoption of different types of inter-organisational information systems in South African firms. To identify the types of IOIS and the enabling technologies, a literature review was performed. Eleven enabling technologies were identified for inclusion based on the work of Zhu et al. (2003), Solimanz and Janz (2004) and Lee and Kim (2007). They were Electronic Data Interchange (e.g. Order Management System), Electronic Payment System and Online Banking, Groupware (e.g. SharePoint, Shared calendars, email folder, address books) , Extranet, Online shopping, Reservation system, Supply Chain Management System, eProcurement, Inventory Management System, Freight Tracking System, Videoconferencing. These IOIS technologies can be classified into different types of IOIS, namely dyadic, hub and spoke, and multilateral as identified from studies by Choudhury (1997) and Lyytinen and Damsgaard (2011). Although a fourth community type IOIS does exist, such systems are more typical within public institutions and were not the focus of this study.

From the survey of 96 firms providing data on IOIS adoption, it was found that groupware technologies, video conferencing, electronic payment system/online banking, EDI and supply chain management system were the most used IOIS technologies among financial services and consulting firms. This is similar to others (Kuan and Chau, 2001; Soliman and Janz, 2004; Lee and Kim, 2007) who have found that EDI, online selling and shopping system, and electronic payment system to be the most used technologies. The least used IOIS technology was found to be freight tacking and reservation systems. This is surprising given that these system can be used by organisations as a way to achieve competitive advantages (Johnston and Vitale, 1998). It may be worthwhile for future studies to continue to track the adoption of such systems within South African firms within different industries.

Moreover, the study found that all types of IOIS, namely dyadic, hub and spoke, and multilateral have diffused within the South African context. Multilateral IOIS such as online banking and electronic payment systems were the most used type of IOIS. This types of IOIS acts as an intermediary between firm and its trading partners/ customers and has the advantage of reducing the buyer's search cost by making the information required by the buyer to be easily accessible (Choudhury, 1997). This makes sense for the firms studied given that these system are used by organisation to enable clients and customers to transact.

Furthermore, an almost similar number of dyadic type of IOIS are in use. Choudhury (1997), describes dyadic as a bilateral exchanges between a selected numbers of partners. The enabling technologies (groupware, video-conferencing, freight tracking system, and electronic data interchange) for this types of IOIS can either be constructed to create an electronic partnership for virtual business integration or enable trading partners to seek dominant position in the market which require trading partners to have a highly integrated business processes.

In addition, technologies such as supply chain management and inventory management systems, which are hub and spoke type IOIS, are the least used type of IOIS. They are described by Lyytinen and Damsgaard (2011) to allow multiple organisations or departments to use one central hub which is configured with key technological capabilities that allows it to control business relations. Hub and spoke IOIS can improve virtual business integration for competitive advantage (Lyytinen and Damsgaard, 2011). This makes sense for the firms studied given that these system are used for inventory updates and to exchange business information with business partners. It would be worthwhile for future studies to continue to track the adoption of such systems within South African firms within different industries.

There was also some variation found within different industries sampled. Most respondents were from the financial services sectors. Here, groupware technologies had the largest frequency count in terms of use, followed by electronic payment system/online banking. Numerous responses were also received from the consulting industry, showing a similar pattern as financial services in terms of technology usage. The high level of adoption is not surprising given the need among such firms to communicate with their business partners. In addition, the data indicated that supply chain management system and electronic data interchange system are less used in comparison to industries such as retail, mining, oil and gas and manufacturing firms. Different types of IOIS may thus be more appropriate or less appropriate to adopt by different types of firms operating within different types of industries.

5.2 The effects of technological, organisational and environmental factors on IOIS adoption.

This study's second research question (RQ2) was: What are the technological, organisational and environmental factors influencing the adoption state of IOIS in South Africa? IOIS adoption was examined in two ways. First it was measured in terms of the extent IOIS is used as a communication medium with business partners and used to support an organisation in decision making, business operation and replaces legacy technologies. Second, it was measured in terms of availability of IOIS technologies. The effects of each of the factors on IOIS adoption will be discussed next.

5.2.1 *Effects of technological factors on IOIS adoption*

a. *Perceived relative advantage*

This study hypothesized that the perceived relative advantage of an IOIS has a positive influence on the adoption of an IOIS, where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. This hypothesis was justified by the idea that an organisation adopts an IOIS based on the likelihood that existing problems may be solved through innovative solutions,

coupled with the perception that the implementation of a new system will ultimately yield better results than one that is in existence (Lee and Kim, 2007). In support of the above, other studies mentioned that an organisations adopt an IOIS in order to improve its business processes, to establish economic gains and improve its status (Teo et al., 2003). In this study it was found based on correlation and subsequent regression analysis of technological factors that South African organisation are more likely to adopt a new system based on these relative advantage attributes; an IOIS could potentially improve communication with customers, IOIS could potential help increase sales and help reduce cost, IOIS is likely to help improve data accuracy and data security. When taking into account the technological factors, the result of this study showed that perceived relative advantage was the main reason for adoption of an IOIS, where adoption is measured as the availability of IOIS technologies.

However, it was unanticipated that perceived relative advantage is not the main reason for adoption of an IOIS, where IOIS adoption is measured in terms of extent of use, as previous studies (Teo et al., 2003; Lee and Kim, 2007) have shown that organisations are willing to adopt an IOIS, if they can see the advantages of doing so.

b. *Perceived complexity*

This study hypothesized that perceived complexity of IOIS has a negative influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The result of this study showed that this hypothesis was not supported for IOIS adoption, where IOIS adoption include variables that support management decisions, support business operations and the extent that IOIS replaces legacy technologies. South African organisations may be unwilling to adopt an IOIS if they make out that the system is difficult to use, requires IS employees to have complex skills, implementation of IOIS is a complex process and maintaining of an IOIS in the current work practices is complex. This finding is marginally consistent with the findings in previous studies (Kim and Lee, 2007; Thong, 1999) which highlighted that when more technical understanding is required to use an IOIS and if the IS resources lack the technically capability to use the system then it becomes a barrier to adopt the IOIS (Kim and Lee, 2007). A study by Thong (1999) further support this view and highlights that if an IOIS has been adopted but the employees finds the system difficult to use, it discourages the employee to use the system.

The findings suggest that the inverse of the above implies that if an IOIS is perceived to be less complex then an organisation would use the adopted IOIS. In addition, the skills required in implementing an IOIS ought to not be too complex and the integration process ought to be efficient. As demonstrated in this study, less complicated IOIS allows organisation to implement the system.

In contrast to the above, the result of this study showed that this hypothesis was rejected when IOIS adoption was measured in terms of implemented IOIS technologies. This finding is not consistent with finding from previous studies mentioned above, this study suggest that complexity of IOIS implementation may be unavoidable and may be more apparent to adopters.

c. *Perceived compatibility*

This study hypothesized that perceived compatibility of IOIS has a positive influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The hypothesis was supported for both IOIS adoption measures. When taking into account the technological factors, the result of this study showed that compatibility was the main reason for adoption of an IOIS, where adoption is measured as the extent of use. This is consistent with findings from previous studies (Thong, 1999; Teo et al., 2003; Lee and Kim, 2007) which showed that organisations are willing to adopt an IOIS if they perceive the system to be consistent with the current organisation's system and organisational procedure and values. System and organisational consistency allows seamless integration and minimal business process adjustment.

The findings suggest that when making decisions associated with adopting an IOIS, South African organisation choose to adopt IOIS if it is, firstly, compatible with their existing business processes. This could be valid as adoption of new technological innovation could lead to significant changes in work practices and procedures (Kim and Lee, 2007). Secondly, South African organisation choose to adopt an IOIS if the system is well-suited with the beliefs and the values existing in the firm. According to a study by Kim and Lee, this affects user attitude towards the system and allows usage and acceptance of the system. Lastly, South African organisation choose to adopt an IOIS if it is compatible with the firm's IT infrastructure. Meaning, organisation want to be less hampered by compatibility issues which could prevent them from processing transactions and pose difficulty with internal business process. This is supported by previous studies (Teo et al., 2003; Lee and Kim, 2007), which have suggested that if an organisation's internal application require minimal adjustments, in terms of rules and procedures and allows for expansion of electronic links and services then the organisation can adopt an IOIS more efficiently and with less risk. Taking into consideration the technological factors, this implies that when South African organisations are making decision on the adoption of IOIS, where adoption is measured in terms of the extent of use, they are driven more by the perception that technological innovation is well aligned with current value systems rather than the advantages of the system.

5.2.2 *Effects of organisational factors on IOIS adoption*

a. *IS Technical skills and education and training*

This study hypothesized that a combination of existing IS technical skills and opportunity for user education and training have a positive influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The hypothesis was supported for both IOIS adoption measures. In addition, this study showed that combination of the exiting IS technical skills and education and training had the highest significant effect on the adoption of IOIS. Previous studies (Thong, 1999; Lee and Kim, 2007; Kim and Lee, 2008) have demonstrated that an organisation with employees who have the technical skills to develop or implement a system, they are more likely to adopt the system. Likewise exiting Information System technical skills supplemented by and education and training create better chances of succeeding in adopting an innovation.

The findings suggest that the motivation for deciding to adopt an IOIS in South African organisations is influenced by numerous factors. Firstly, organisations considers whether an organisation's Information System employees are well trained in IOIS technology along with the experts with advanced IT skills or knowledge associated with IOIS existing in the organisation. Previous studies (lee and Kim, 2007; Kim and lee, 2008; Thong, 1999) found that oorganisation's tend to delay adoption of a new system, if they do not have IS expertise. The study by Lee and Kim (2007), suggest that innovativeness is enabled by wide variety of expertise capable of proposing and arguing for more innovative ideas. In addition to this, the study indicate that an organisation with less IS technical skills experience difficulty with experimenting with the new system. Therefore, if an organisation has IS technical experts it could mitigate difficulties or problems as they occur during IOIS implementation, as such organisations tend to have the necessary technical knowledge required to facilitate the development of new technical ideas. The second factor, considers whether education and training on IOIS is offered to the staff sufficiently and continuously. The study by lee and Kim (2007) found that education and training reduces resistance of user to change and increase adoption of a new innovation. The third factors considers whether the content and structure of the education and training in IOIS systems are fitting. Reason being, education and training material is essential in promoting system understanding and simplifying implementation success. Lastly, South African organisation consider if there exist a number of education and training opportunities in IOIS for all staff members. This lowers knowledge barrier in understanding and using the IS. Thus, combination of IS technical skills and education and training lowers technical difficulty in implementation and encourages adoption of IOIS.

b. ***Size***

This study hypothesized that the size of the organisation has positive influence on the adoption of IOIS. The hypothesis was supported where IOIS adoption was measured in terms of availability of IOIS technologies. Previous studies highlighted that larger firms have several advantages over smaller organisations. Larger firms tend to have greater flexibility and absorb more risk, they are more likely to achieve economies of scale as IOIS implementation requires large amounts of capital, have capability to urge trading partners to adopt technology with network externalities (Kim and Lee, 2008; Pan and Jang, 2008; Zhu et al., 2003). Benefits of IOIS vary across small and large firms, SME have better chance to compete in ebusiness and larger firms are better able to enhance IOIS. Sample size of this study did not provide sufficient indication of whether larger organisation had better advantages over smaller organisations. Where adoption is measured in terms of extent of use, the hypothesis was not supported. Thus, finding were consistent with other studies (Rajaguru and Matanda, 2009; Pan and Jan, 2000; Zhu et al., 2003) which indicated that there is no significant relationship between adoption and firm size. Even smaller firms may consider adoption of IOIS technologies such as EDI, supply chain management system, extranets, and inventory management system especially where such technologies might be compatible with the organisation and if sufficient technical skills and training are available.

c. ***Top management support***

This study hypothesized that top management support has a positive influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The hypothesis was supported for both IOIS adoption measures. The role of top management as previous studies (Li & Lin, 2006; Hartono et al.,2010; Rajaguru and Matanda, 2012) have mentioned is to suggest a long-term vision of the specific benefits of IOIS integration and reducing divergence of interests within and across the partnering organisations. Therefore, the lack of top management support could negatively impact the required communication and coordination with business partners causing conflict and misalignment in the implementation of IOIS. It could also lead to poor resources allocation required for implementation of an IOIS (Hartonoa et al.,2010; Rajaguru and Matanda, 2012).

It can be inferred from the results of this studied that within the sampled South African organisation, adoption of a new system is based on whether top management support exists. Such support includes top management investing funds in IOIS, being highly interested in using IOIS, being aware of the benefits of IOIS technologies and considering IOIS as strategically important. This finding is consistent with findings from previous studies. For instance, the study by Thong (1999), states that IOIS are complex innovations which require large outlays of financial resource, therefore, requires senior executives to be willing to take such risks. In addition, previous studies (Rajaguru and Matanda 2012; Hartonoa et al.2010, and Lee and Kim, 2007) have noted that when top management is interested in using IOIS, it is essential that they leverage the necessary resources, ensure alignment between the firms' long-term strategy, encourage active support throughout all organisation, and convince the Information System department to prioritize IOIS development and communicate with the supply chain partners that are involved in IOS implementation. Thus, previous studies (Hartonoa et al., 2010, and Lee and Kim, 2007) mentioned that top management support can require functions from different disciplines besides that of IT for example, the marketing and sales function could introduce a new system or make a few changes on existing system as strategic benefit for business continuity. The implementation of IOIS in this regard, may require support from top management.

5.2.3 *Effects of environmental factors on IOIS adoption*

a. ***Trading partner pressure***

This study hypothesized that trading partner pressure has positive influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The hypothesis was supported for both IOIS adoption measures. Previous studies (Lee et al., 2005; Zhu et al., 2003; Kim and Lee, 2008) indicated that IOIS establishes linkages between trading partners and enables business information to be shared beyond firm borders instantly. IOIS links are crucial in maintaining competitive position and improving strategic objectives (Soliman and Janz, 2004). For instance, if a firm has dominant business partner or the firm's major customers prefer to use an innovation, the firm may follow its customers or the business partner and adopt the system as an indication that it is fit to be a business partner and it has the capacity to utilize the system (Ortega et al., 2014). In addition, a firm's decision to adopt IOIS may be influenced by the adoption state of its trading partners pressure to adopt from trading partners, since for information sharing to take place, it is necessary that trading partners adopt compatible trading systems (Zhu et al.,2003;

Premkumar et al., 1997; Ramamurthy et al., 1999). Furthermore, other studies (Lin, 2006; Kim and Lee, 2008) pointed out that in a situations where mutual dependence between firms and their trading partners exist, the firm that is recommending the use of IOIS offers the trading partner expertise for implementing IOIS linkages, which enables the firms to obtain long term benefits. Moreover, trading partner pressure encourages for an improved understanding of trading partner's needs, external opportunities and threats (Kim and Lee, 2008). For instance, when partners are actively involved in the process of implementing an IOIS, requirements obtained during this phase, fit both partners and increase user satisfaction and reduces system configuration (Kim and Lee, 2008). When taking into account the environmental factors, the result of this study showed that trading partner pressure was the main reason for adoption of an IOIS, where adoption is measured as the availability of IOIS technologies. The findings of the study are aligned with previous studies, indicating that South African organisations adoption of IOIS are influenced by business partners request or recommendation to transact using IOIS.

b. ***Competition***

This study hypothesized that competition has positive influence on the adoption of IOIS where adoption is measured as (1) the extent of IOIS use and (2) the availability of IOIS technologies. The hypothesis was supported for both IOIS adoption measures. The study by Thong (1999) suggest rivalry pushes business to be innovative and that there are three ways to compete; (1) change the industry structure, (2) create competitive advantage by giving business new ways to outperform their rivals; and (3) IS can create opportunities for new business. Similarly, the study by Zhu et al. (2003) supports the study above, suggesting that a company is affected by competitors in the market. The study noted that firms that are in a competitive environment need necessary skills which could be acquired by learning using process as they are driven by competitive pressure that drives them to change from one technology to the next. The contrast between the two studies Thong (1999) found that competition had an insignificant effect on the adoption of IT, as opposed to Zhu et al. (2003) study, which found that firms that face strong competition tend to adopt ebusiness. The results of this study found that South African organisation consider whether their competitors use or are soon to be using IOIS for communication and the trends in the industry that drive them to utilize IOIS for business related activities. In addition, when taking into account the environmental factors, the result of this study showed that competition was the main reason for adoption of an IOIS, where adoption is measured as the extent of IOIS use. Therefore, the findings of this study are aligned with findings from study by Zhu et al. (2003), implying that intense competition stimulates the adoption of innovation

Chapter conclusion

This chapter discussed the findings and related them back to the TOE studies found in the literature to determine whether the findings confirm or differ from expectation. The first section discusses the IOIS technologies and types of IOIS used in South African context. It was shown that groupware technologies, electronic payment system/online banking and video conferencing and Electronic data interchange were the most used IOIS technologies within the sampled organisations. The least used IOIS technology was found to be freight tacking system and reservation system. Multilateral IOIS such as online banking and electronic payment systems were the most used IOIS. Followed by Hub and spoke IOIS such as EDI, supply chain management system, extranets, and inventory management system. The least used type of IOIS was dyadic. The effects of TOE factors on the adoption of IOIS were discussed. The next chapter discusses the implications of these findings and concludes the study.

CHAPTER 6. Conclusion

This chapter presents a summary of the research findings. It presents the implications of these findings for practice and academia. The chapter concludes with a discussion on the study's limitations and offers some directions for future research.

6.1 Summary of findings

The objective of this study was to investigate the different types of interorganisational information systems used in South African firms, and to identify the factors impacting the adoption of IOIS. The TOE framework was employed as a theoretical lens. A literature review was carried out, which surfaced the different types of IOIS which had been studied in past research and past studies into the adoption of IOIS by firms. Research gaps were identified, namely that the state of IOIS adoption with South African firms was not well understood and that the TOE framework could be used to better understand the factors influencing IOIS adoption in the South African context.

An online mail survey method was then carried out to examine the types of IOIS which have diffused in the South African context and the factors influencing their adoption. A total of 469 firms were selected for inclusion and a key informant from each firm was invited to take part. Responses were received from 119 firms across different industry sectors in South Africa.

The first research objective of this study was to identify the types of IOIS which are available in South Africa. Results showed that dyadic, hub and spoke, and multilateral IOIS had all diffused with South African context with multilateral and dyadic being the most popular. The results further showed that groupware, electronic payment system/online banking, video conferencing and electronic data interchange were the most used in contexts such as financial services and consulting.

The second research objective for this study was to identify the factors impacting the adoption of IOIS in the South African firms, using the TOE framework as a theoretical lens. A model was developing hypothesizing the effects of technology compatibility, relative advantage and complexity, along with top management support, IS skills and training and firm size, as well as environmental pressure from trading partners and competitors. Adoption was measured both as the availability of IOIS technologies and the extent of IOIS use. Correlation results showed that perceived compatibility, perceived relative advantage, top management support, IS technical skills and education and training, trading partner pressure and competition all had positive influence on the adoption of IOIS, while perceived complexity was negatively associated. Firm size had an insignificant effect on the adoption of IOIS. Regression results showed that perceived relative advantage, trading partner pressure and IS technical skills, education and training were most important for availability of IOIS. Regression results also showed that perceived compatibility, competition, and IS technical skills, education and training were most important for the extent of IOIS use in the firms studied.

6.2 Implications for practice

The results of this study have implications for IS practitioners. First, the results from the study can be used to provide practitioners insights into the types of IOIS available for adoption, and which have been most popular already as a means to link trading partners. Results inform practice on which IOIS technologies are mostly used across different industries. Firms can thus benchmark themselves against these results, especially those in the financial services or consulting sectors.

Second, this study provides guidance for organisations seeking to understand the factors influencing other organisations decisions to adopt IOIS. For example, it was found that internal technical skills and perceived relative advantage were factors strongly impacting the number of IOIS technologies implemented within firms. Without internal skills and training it is unlikely that firms will succeed to implement numerous IOIS. Moreover, the motivation to adopt seems to be driven more by perceived relative advantage than by concerns for compatibility of complexity. Similarly, when it comes to the extent of use of IOIS within a firm, competitive pressure is a strong influence, while skills and training are also needed to support the ongoing integration of IOIS into business operations. The results also give insights into factors needed to succeed with IOIS adoption in certain organisational contexts. For instance, if the adopting organisation has multilateral type of IOIS, it would need to ensure that the trading partners systems are compatible to allow data exchange to take place.

Organisations planning to adopt an IOIS should thus assess whether their existing IS technical skills, education and training are available in the organisation as this will help to boost firm understanding of the new technology quicker. In addition, the organisation should also consider if the technology would potentially improve communication with customers, has the potential to help increase sales and help reduce cost. Thus, when a system is being implemented understanding of system relative advantage attributes and technical assistance would be made available. Moreover, when deciding to adopt an IOIS, managers would need to consider whether their competitors use or are soon to be using IOIS for communication and verify if there are trends in the industry that drive them to utilize IOIS for business related activities.

6.3 Implications for academia

This study conceptualized IOIS adoption by drawing on the diffusion model (Rogers, 1995). This allowed for adoption to be conceptualized in two stages. The first as making IOIS technology available for use and the second as the extent to which IOIS is used in operations. To explain adoption, the study drew on the technology organisation-environment framework (Tornatzky and Fleisher, 1990). The specific technological, organisational and environmental factors that were used to explain the adoption of IOIS were identified from the literature review. The results of this study showed that adoption of IOIS in South Africa is highly influenced by organisational factors i.e. combination of IS technical skills and education and training. This is surprising as previous studies (Kim and Lee, 2008; Zhu et al.,2006) found technological factors to be the main contributor of IOIS adoption where IOIS adoption is measured as the extent of use and the availability of IOIS technologies. When evaluating the technological factors, the results suggest that perceived relative advantage has more influence on availability of IOIS technologies and perceived compatibility has much influence on the extent of IOIS use. These technological factors could be considered in future research. In addition, when evaluating the environmental factors, the results suggest that trading partner pressure has more influence on availability of IOIS technologies and competition has more

influence on the extent of IOIS use. These factors should also be considered in future research. This study has thus contributed by showing that different dimensions of adoption (availability versus use) are differentially impacted by different TOE factors with some factors important to both stages. Future research should consider which dimension of adoption they wish to focus and to theorize about adoption factors accordingly.

Competition and trading partner pressure were found important in this study. Future researchers may however consider drawing on other theories such as institutional theory as a basis for examining environmental factors that impact on IOIS adoption at the organisational level.

6.4 Limitations and future research

The majority of respondents for this study were from financial services and consulting sectors. A few respondents from other sectors were represented but not proportionately to their representation in the population. Thus results do not adequately reflect the adoption behaviour of firms in these other sectors. In addition, the surveys were self-completed and thus subject to respondent bias. For example, the questions might have been misinterpreted, some responses might be subject to an acquiescence bias or a social desirability bias, e.g. to paint their organisations in a better light in terms of their state of IOIS adoption. In addition, the participants could be non-IS senior business manager with some knowledge of IOIS and their views could differ from IS senior managers. Furthermore, a web based survey was used to collect data and this excludes individuals who preferred hand delivered or paper based surveys. The format of the survey may have introduced a non-response bias.

Moreover, the questionnaire's structure and content might have not covered other additional decision influencing factors of adoption. In other words, the questionnaires covers the types of IOIS studied and factors influencing adoption based on the TOE framework only. In addition, the types of IOIS and the enabling technologies were extracted from the literature review and only eleven technologies were identified and four types of IOIS. Furthermore, a cross-sectional study was conducted, which does not establish temporal precedence and thus causal direction should not be inferred. All taken together, these issues introduce limitations to the internal validity and generalisability of this study's findings.

Future researchers may consider a longitudinal design to improve our understanding of how IOIS technologies continue to be adopted. In addition, other studies could include other independent variables to examine the factors impacting on adoption of IOIS. Future research may consider the variables applied in this study on smaller organisations specifically. Also, the government regulation item were excluded from the model as the loadings were not uni-dimensional, however future research should explore other governmental related variable in future research. Different types and examples of IOIS might be considered by future researchers.

6.5 Conclusion

This study has contributed to existing IOIS literature through identifying the types of IOIS and assessing the state of adoption with South African organisations. Through the use of quantitative empirical methods, the study showed that perceived compatibility, perceived relative advantage, IS technical skills and education and training, trading partner pressure and competition positively influenced the adoption of IOIS. While perceived complexity had negatively influenced the adoption of IOIS. Based on the findings of this study, South African organisation would be in a position to evaluate and make informed decisions regarding their adoption of IOIS

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APPENDIX A: Cover Letter

Good day,

I am completing my Master of Commerce degree in Information Systems at the University of the Witwatersrand, Johannesburg (Wits). For the purpose of my degree, I will be conducting a study of technological, organisational and environmental factors influencing the decision by firms in South Africa to adopt inter-organisational information systems (IOIS). Understanding these factors would allow us to identify barriers or enablers of inter-organisational information systems. IOIS refers to information systems which are used jointly by business partners or a group of companies with shared or common IT capabilities.

With this letter, I would like to invite your firm to participate in this study, please note that participation is entirely voluntary.

Your anonymity is assured as you are not required to provide any identifying information such as your name or that of your company's in your response. Confidentiality will be observed throughout the research process, the final report and this questionnaire will be for academic purposes only, data will not be shared with any third parties and results will only be reported in the aggregate. You have the right to withdraw your participation at any stage. Choosing to proceed with the survey will be taken as your consent and that you have permission from your organisation to participate in the survey. If you choose to participate, the survey should take approximately 10-15 minutes to complete.

If you consent to participate please proceed to access the online survey via this link
https://www.surveymonkey.com/r/WITS_IOIS

If you prefer, a mailed or hand-delivered questionnaire can be made available to you.

This study was approved by the research ethics committee of the School of Economic and Business Sciences, protocol number: CINFO/1105.

I understand you are extremely busy your agreement to contribute to my research would greatly be appreciated. I will be available to meet with you at a location and time of your convenience.
Thank you for your kind assistance. For any questions or queries, please contact me during the day at email 0606317k@students.wits.ac.za

Kind regards,
Zamambo Mkhize
MCom Information System Student
School of Economic and Business Sciences
University of the Witwatersrand, Johannesburg

Supervisor: Prof Jason Cohen on email: Jason.Cohen@wits.ac.za

APPENDIX B: Research Instrument

This questionnaire consists of five sets of questions and should take approximately 10-15 minutes to complete.

I agree to my responses being used for education and research on condition that my privacy is respected, subject to the following:

- I understand that my response will be treated confidentially and that I will not be personally identified
- I understand that I am under no obligation to take part in this survey.
- I understand I have the right to withdraw from this survey at any stage.
- I confirm that as I am a senior member of staff, I am able to respond on behalf of my organisation

I agree to participate in this research project.

Section A: Demographic Information

Job Title	**Please specify Job title**	
Size	**Please indicate the total number of employees within your organisation**	
Industry	**Please indicate the industry you work in**	Financial service Retail Public services Manufacturing Transport and Logistics Telecommunication Consulting Mining, Oil and Gas Other (please specify):

Section B: Use of Interorganisational System and IOIS technologies

IOIS: Interorganisational information systems are automated systems which allow one or more firms to connect to their business partners in order to send each other business information across common information technology (IT).

Please specify which of the following IOIS technologies your firm is using or plans to use in the near future (select all that apply):

	Using	Plan To Use
Electronic Data Interchange (e.g. Order Management System)		
Electronic Payment System and Online Banking		
Groupware (e.g. SharePoint, Shared calendars, e-mail folder, address books)		
Extranet		
Online shopping		
Reservation system		
Supply Chain Management System		
e-Procurement		
Inventory Management System		
Video-Conferencing		
Freight Tracking System		
Other (please specify)		

Please indicate how extensively your firm makes use of the following

	Not at all	Very little	Somewhat	Much	Very Much
1. The extent to which our firm uses IOIS in transacting with business partners					
2. The extent to which business partners have access to our internal IT systems for exchange of information					
3. The extent to which we have access to internal IT systems of our business partners for exchange of information					
4. The extent to which our firm uses e-mail to communicate with business partners					
5. The extent to which our firm uses groupware tools to communicate with business partners					
6. The extent to which our firm uses video-conferencing to communicate with business partners					

Section C: Dependent Variable

Please rate the extent to which your interorganisational systems are supporting your organisation:

	Not at all	Very little	Somewhat	Much	Very Much
1. To what extent does IOIS provide support to management decision making within your organisation					
2. To what extent does IOIS provide support to business operations within your organisation					
3. To what extent are IOIS replacing legacy technologies within your organisation					

Section D: Independent Variable – Environmental Factor

Please indicate the extent to which you agree with each of the following statements relating to the environment in which your organisation operates:

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
1. There is a trend in my industry to utilize IOIS for business related activities and business communication							
2. Important competitors using or soon to be using IOIS for communication would put pressure on my firm to do the same							
3. We are aware of applicable laws that support our use of IOIS							
4. Incentives provided by government are important to our adoption of IOIS							
5. There are effective regulation which protect sharing of business and consumer data							
6. Our most important partners have requested that we transact with them using an IOIS							
7. The use of IOIS is recommended by our most important business partners							
8. The majority of our business partners have requested that we transact with them using an IOIS							
9. The use of IOIS is recommended by a majority of our business partners							

Section E: Independent Variable – Technological Factors

Please indicate the extent to which you agree with each of the following statements relating to IOIS technology:

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
1. IOIS implementation would be compatible with existing business processes							
2. IOIS implementation would be compatible with the beliefs and values existing in our firm.							
3. The adoption of IOIS would be compatible with firm's IT infrastructure.							
4. IOIS is likely to improve communication with our customers.							
5. IOIS is likely to help increase sales.							
6. IOIS is likely to help reduce cost.							
7. The skills required to develop IOIS are too complex for our IS employees.							
8. It will be very difficult to maintain IOIS in our current work practices.							
9. All of our IS team staff are well versed about development methodologies for IOIS.							
10. Data exchanged over IOIS between our firm and business partners requires a secured communication medium							
11. Our company believes that IOIS implementation is a complex process							
12. Our company believes that using IOIS is difficult							
13. IOIS is likely to help improve data accuracy							
14. IOIS is likely to help improve data security							

15. IOIS performance is sensitive to system errors and failures

Section F: Independent Variable – Organisational Factors

Please rate the degree to which you agree with the following statements:

	Strongly Agree	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	Strongly Disagree
1. Top management invest funds in IOIS							
2. Top management is highly interested in using IOIS.							
3. Top management is aware of the benefits of IOIS technologies.							
4. Top management consider IOIS as strategically important							
5. Our IS employees are generally aware of advanced IT systems such as IOIS							
6. We have many experts on advanced IT systems such as IOIS.							
7. Our IS employees are well trained in IOIS technology.							
8. Education and training on IOIS is offered to our staff sufficiently and continuously							
9. The content and structure of the education and training in IOIS systems are appropriate							
10. There exist a number of education and training opportunities in IOIS for all staff members							
11. Relationships with our business partners are characterized by high levels of trust							
12. Our firm and our partners generally trust that each will stay within the terms of our agreements							
13. We and our partners are generally sceptical of the information provided to each other							

14. We can count on our partners to meet their obligations
15. It is worthwhile to maintain close collaboration with our partners

Thank you for completing this questionnaire. For any questions and queries related to the research, please email me at 0606317K@students.wits.ac.za

Appendix C: Assumptions

Assumptions for Factors that influence extent of IOIS use

Assumption of Linear Relationship

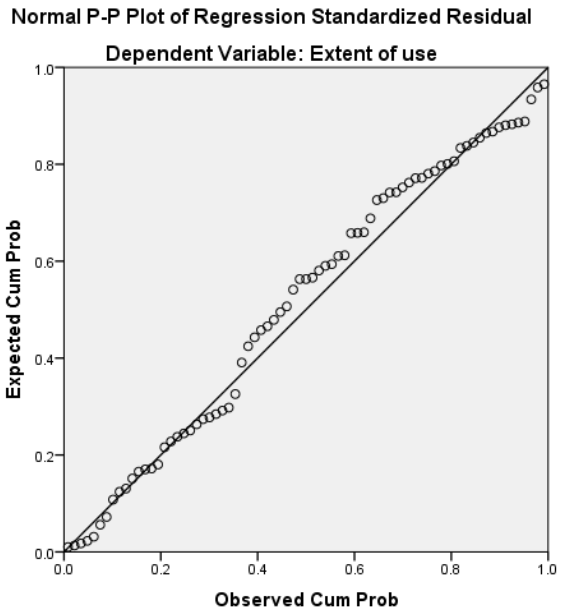


Figure 24: Technological - Linear relationship (Extent of use)

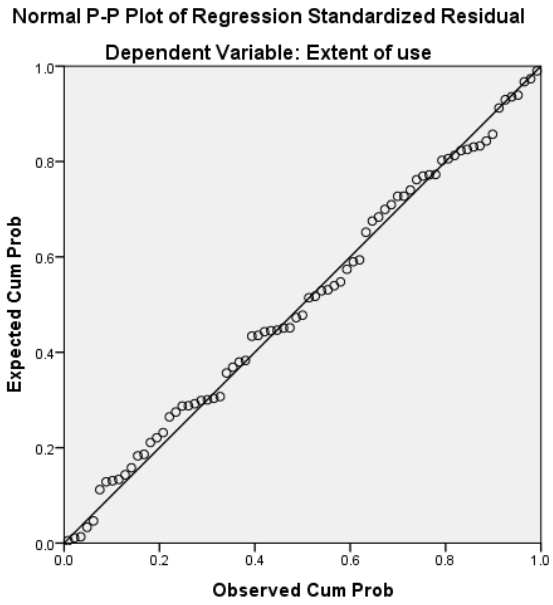


Figure 25: Organisational - Linear relationship (Extent of use)

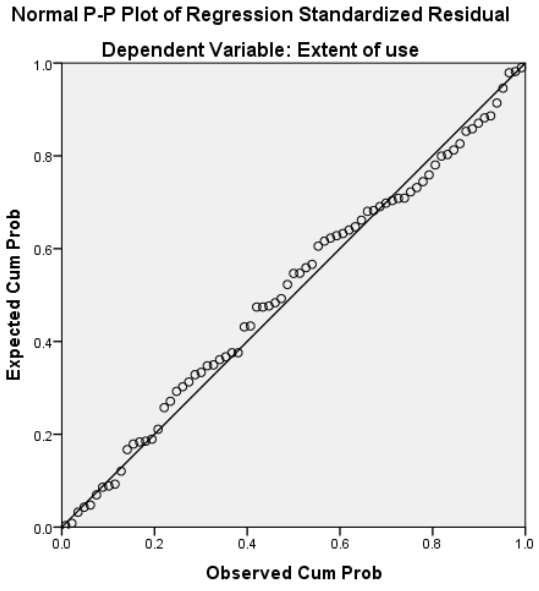


Figure 26: Environmental - Linear relationship (Extent of use)

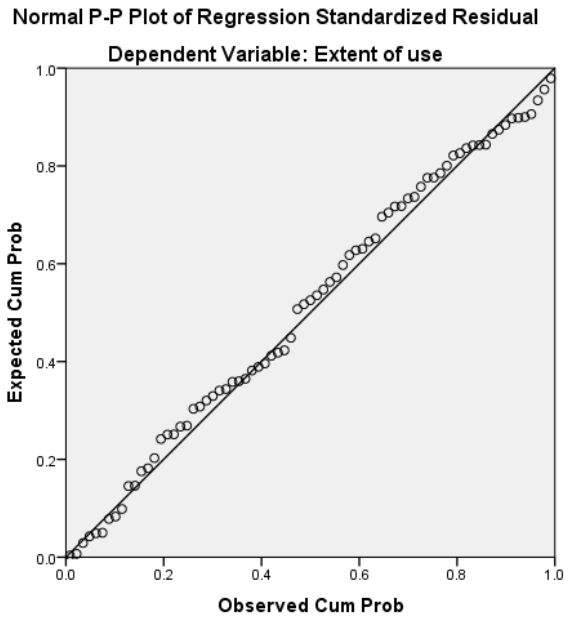


Figure 27: Dependent variable - Linear relationship (Extent of use)

Assumption of Heteroscedasticity

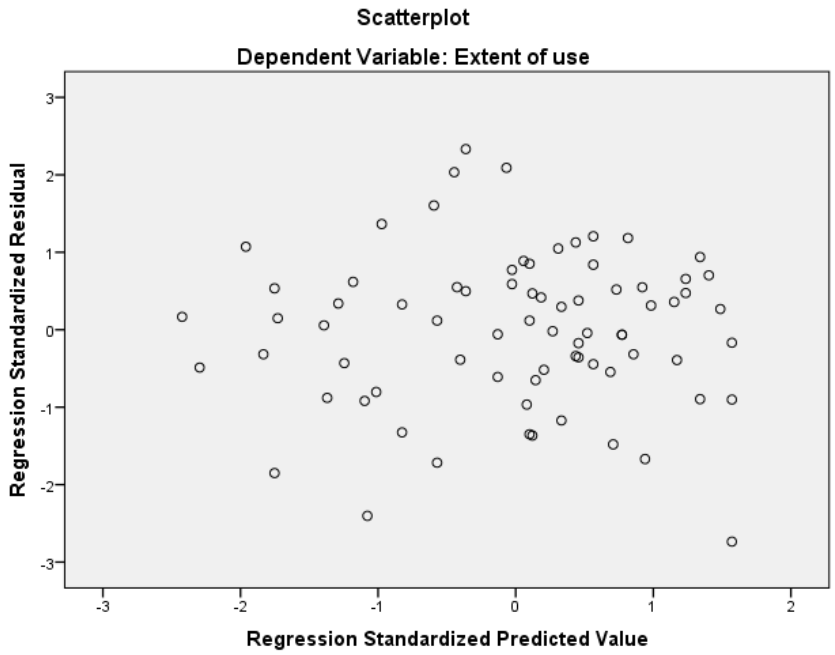


Figure 28: Technological – Heteroscedasticity (Extent of use)

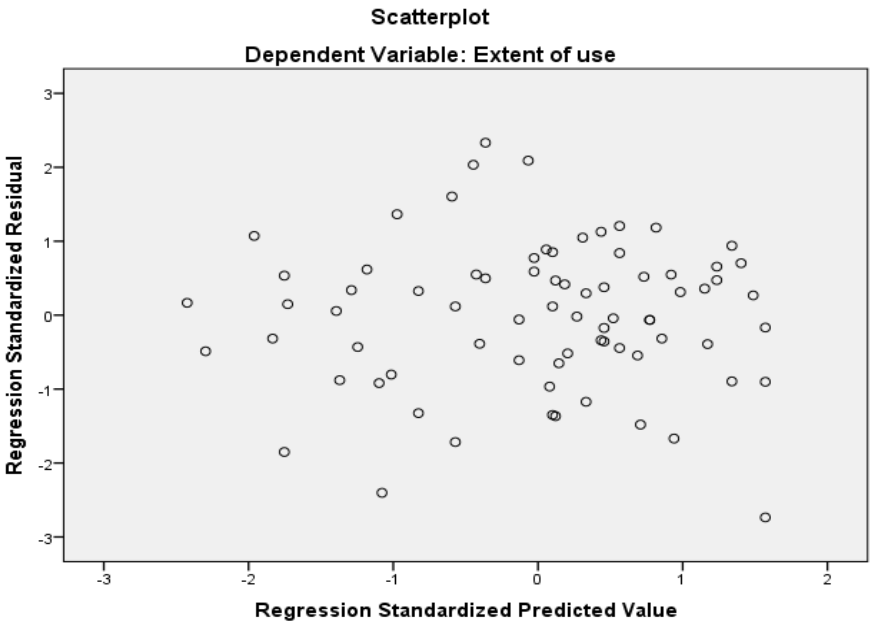


Figure 29: Organisational – Heteroscedasticity (Extent of use)

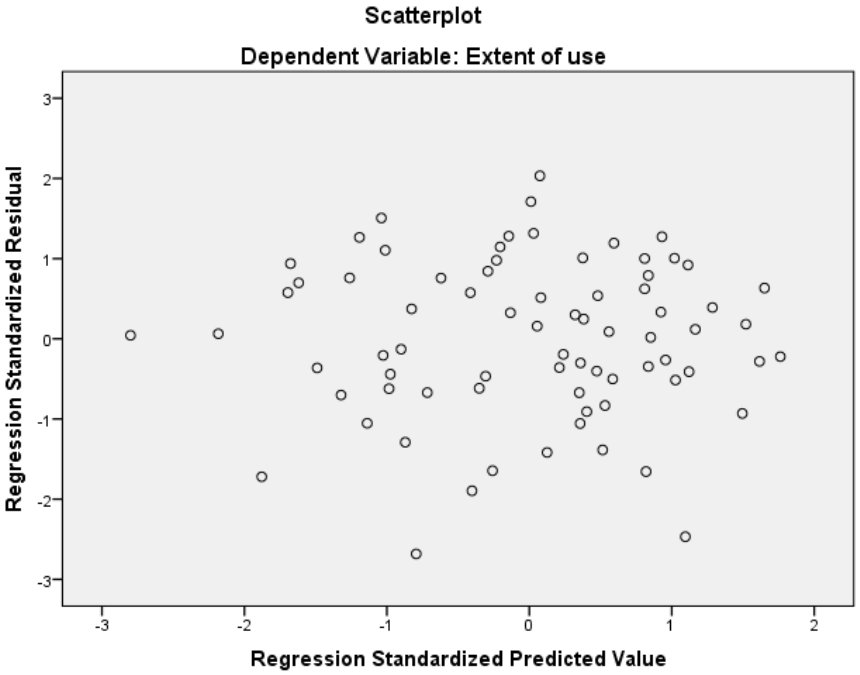


Figure 30: Environmental – Heteroscedasticity (Extent of use)

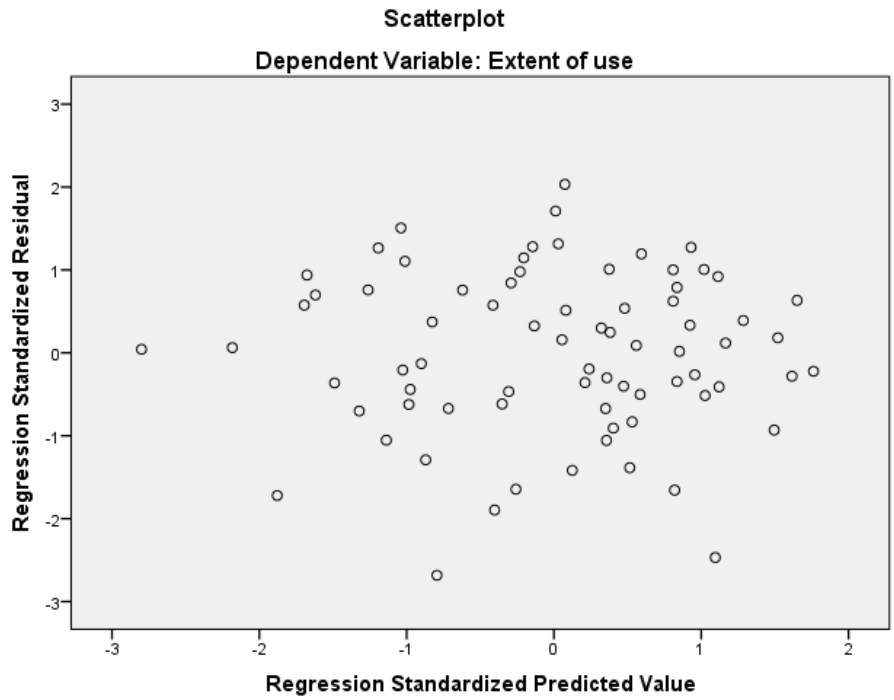


Figure 31: Dependent Variable – Heteroscedasticity (Extent of use)

Normality of the residual distribution

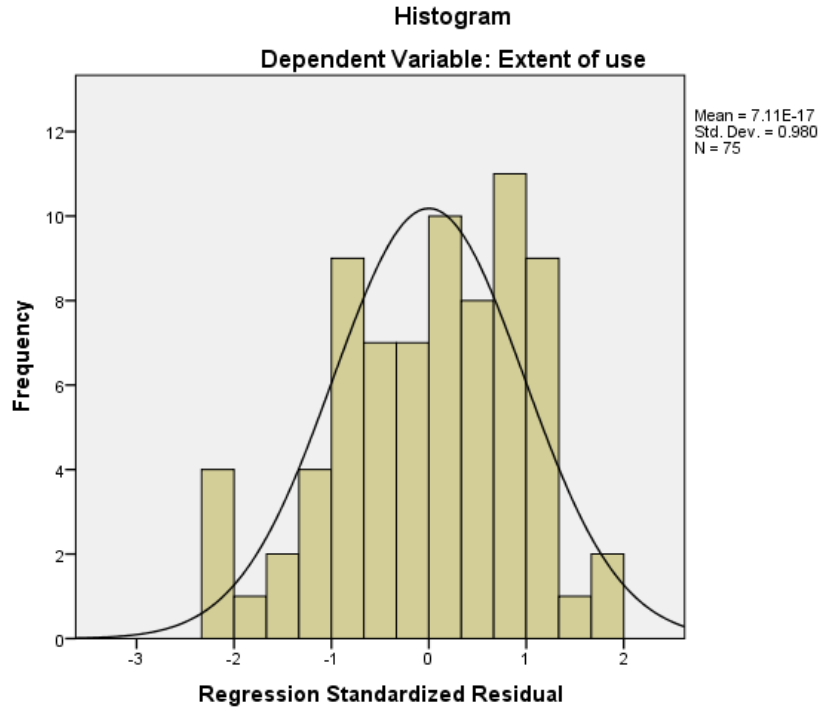


Figure 32: Technological - Residual distribution (Extent of use)

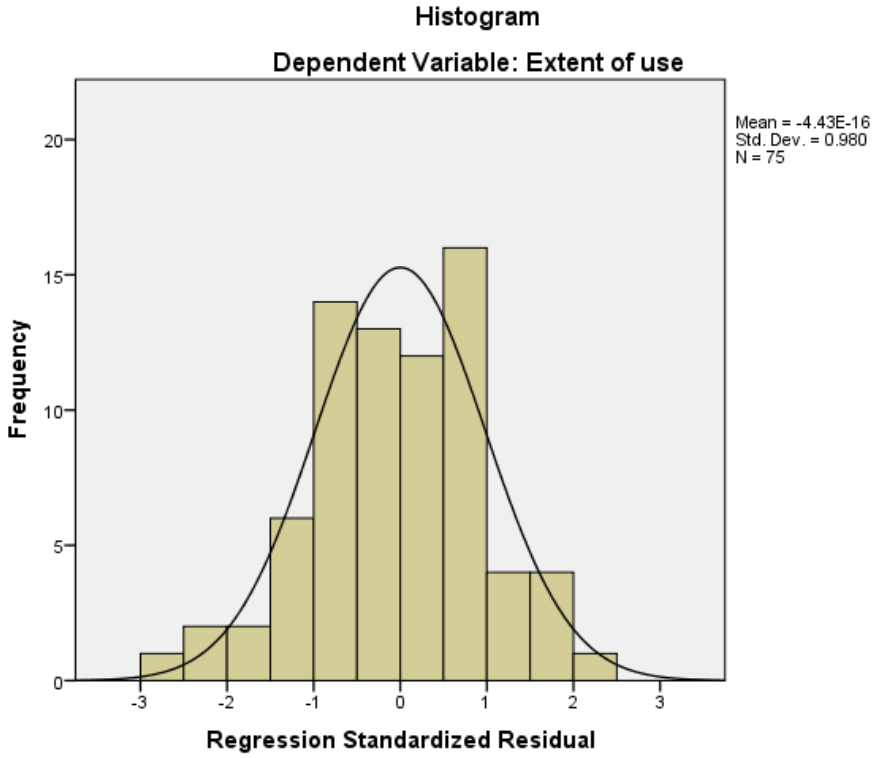


Figure 33: Organisational - Residual distribution (Extent of use)

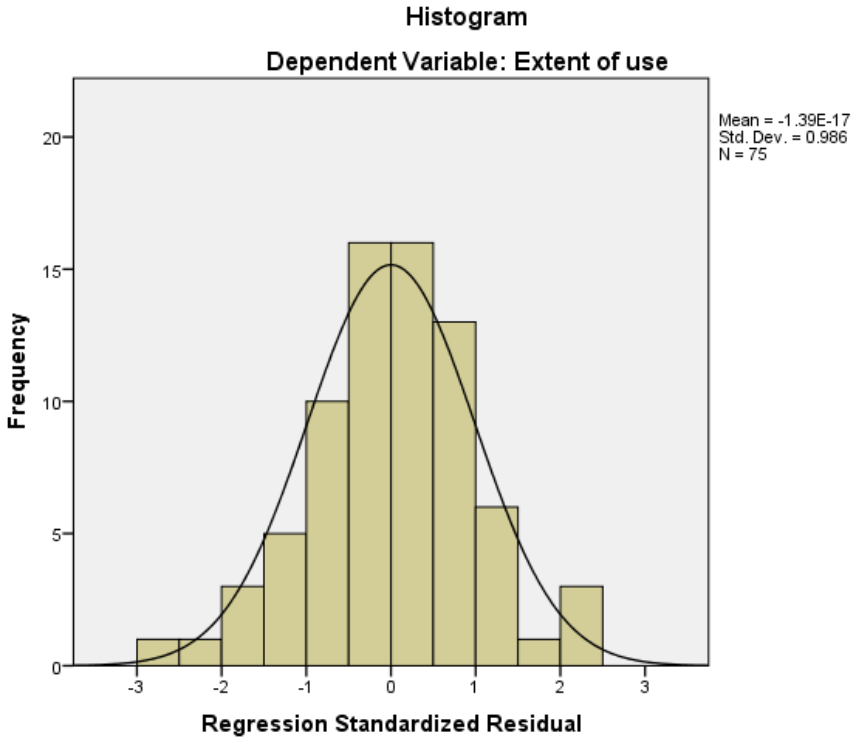


Figure 34: Environmental - Residual distribution (Extent of use)

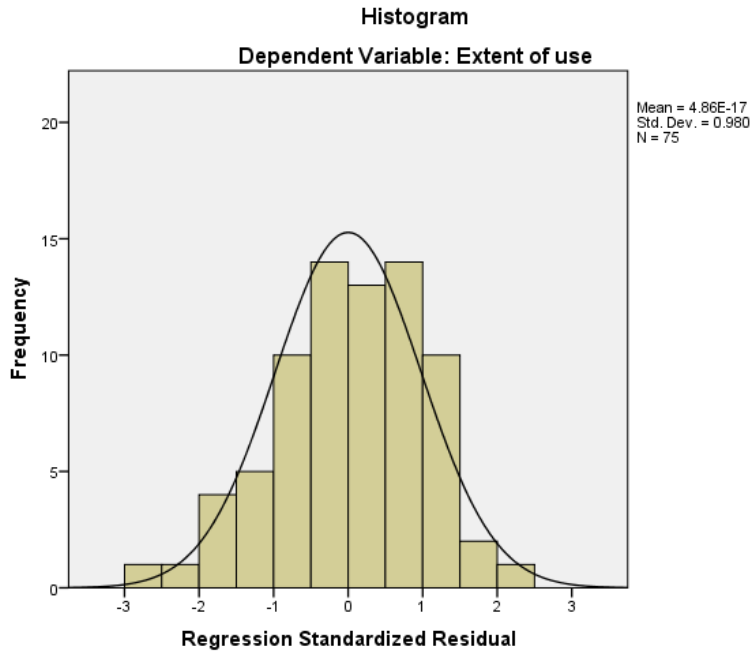


Figure 35: Dependent variable - Residual distribution (Extent of use)

Assumptions for TOE factors that influence the availability of IOIS technologies

Assumption of Linear Relationship

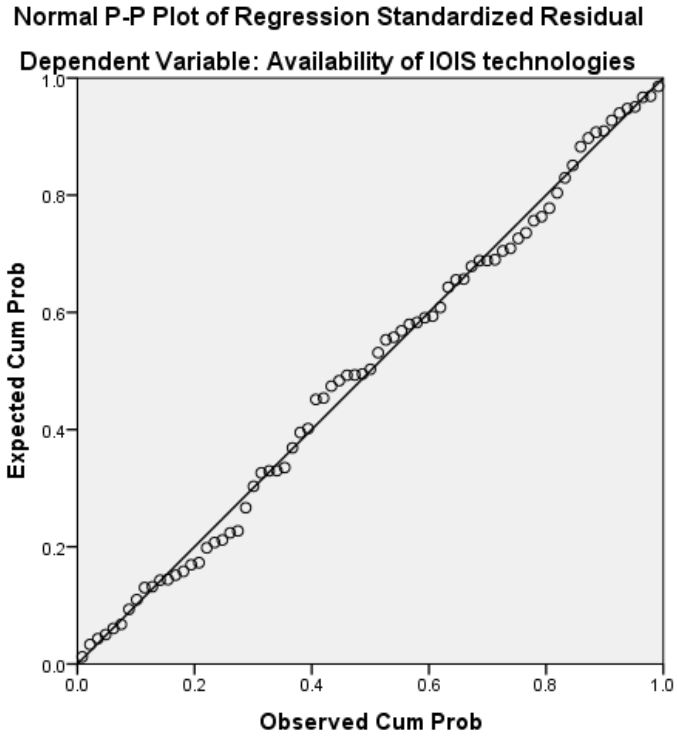


Figure 36: Technological - Linear relationship (Availability of IOIS technologies)

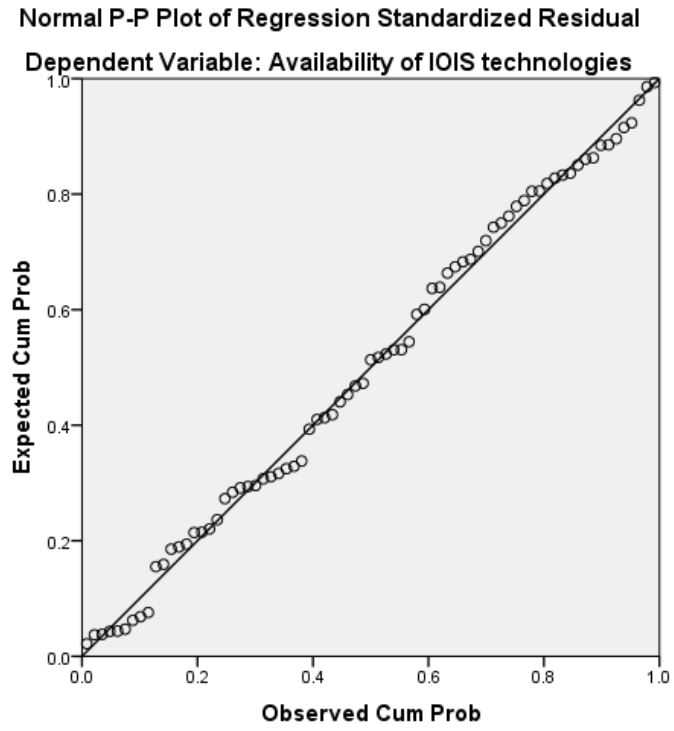


Figure 37: Organisational - Linear relationship (Availability of IOIS technologies)

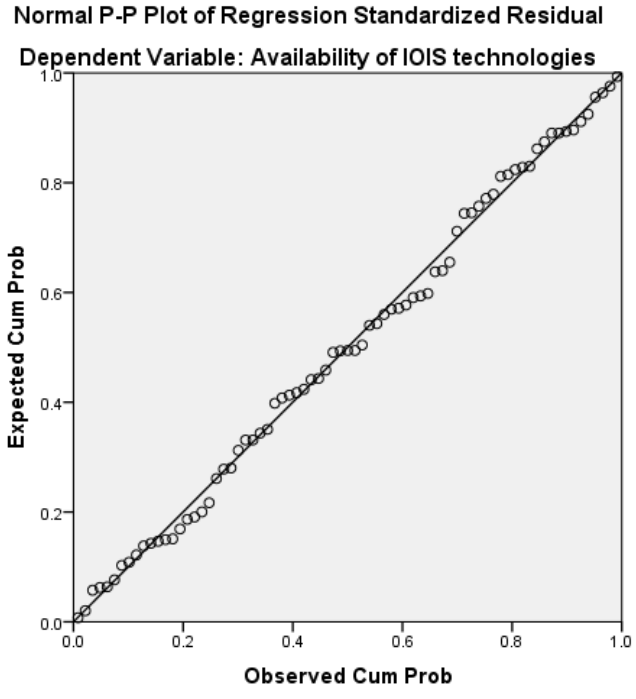


Figure 38: Environmental - Linear relationship (Availability of IOIS technologies)

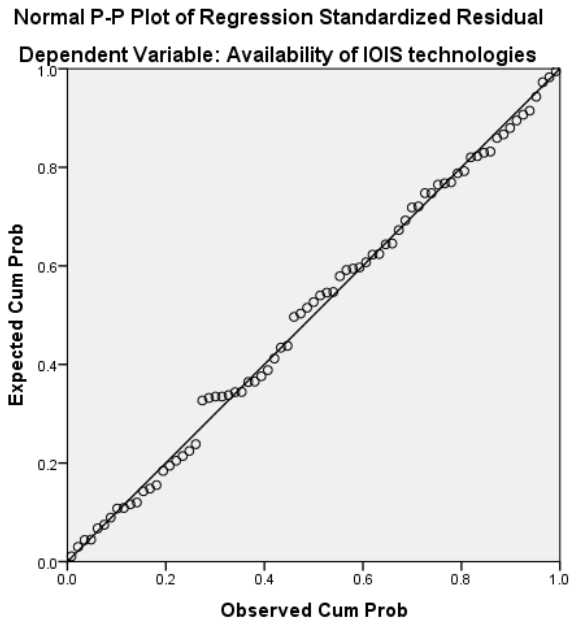


Figure 39: Dependent variable - Linear relationship (Availability of IOIS technologies)

Assumption of Heteroscedasticity

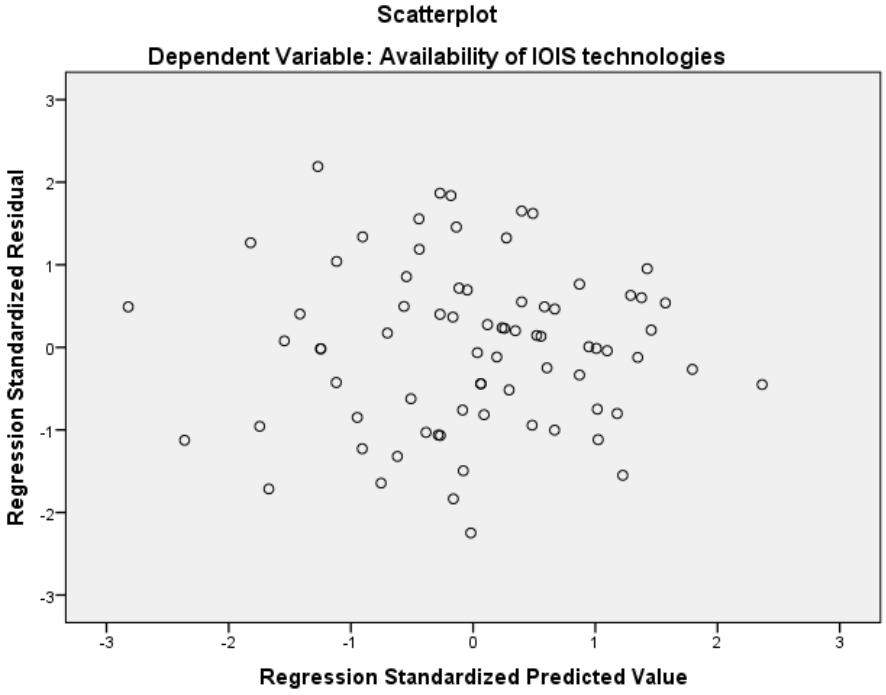


Figure 40: Technological – Heteroscedasticity (Availability of IOIS technologies)

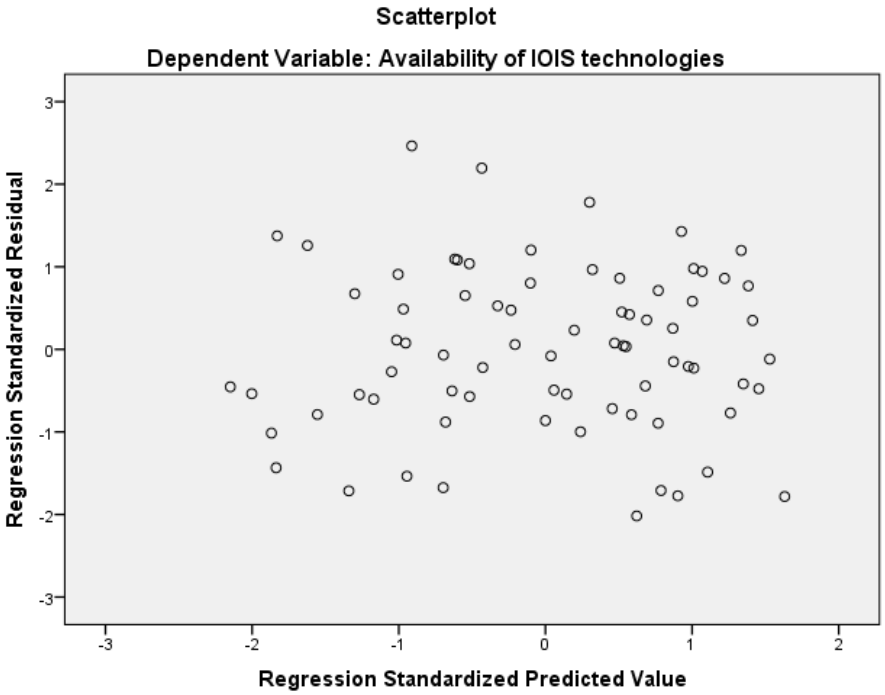


Figure 41: Organisational – Heteroscedasticity (Availability of IOIS technologies)

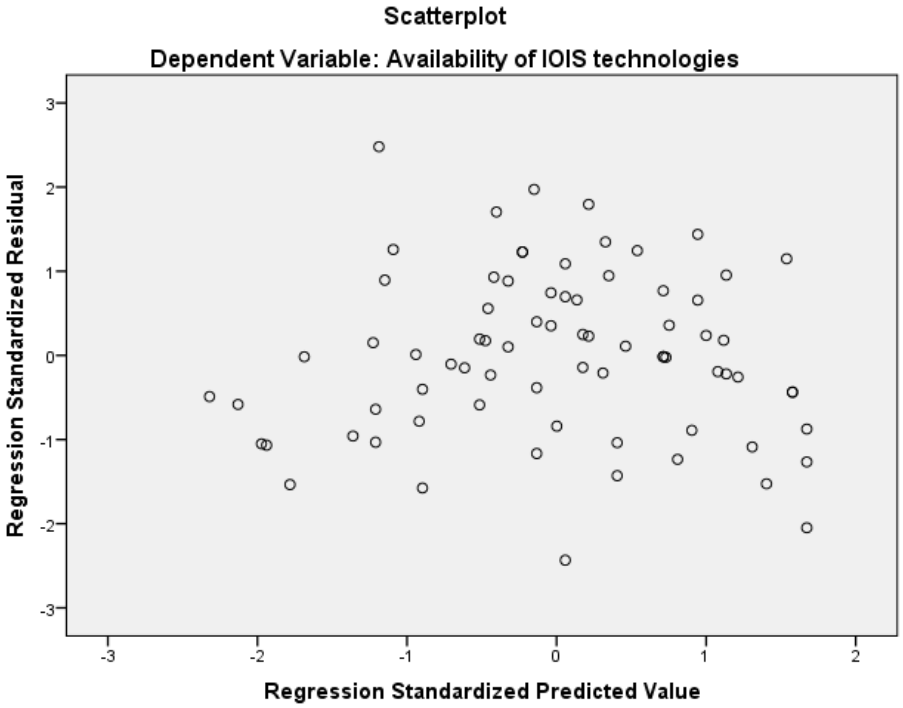


Figure 42: Environmental – Heteroscedasticity (Availability of IOIS technologies)

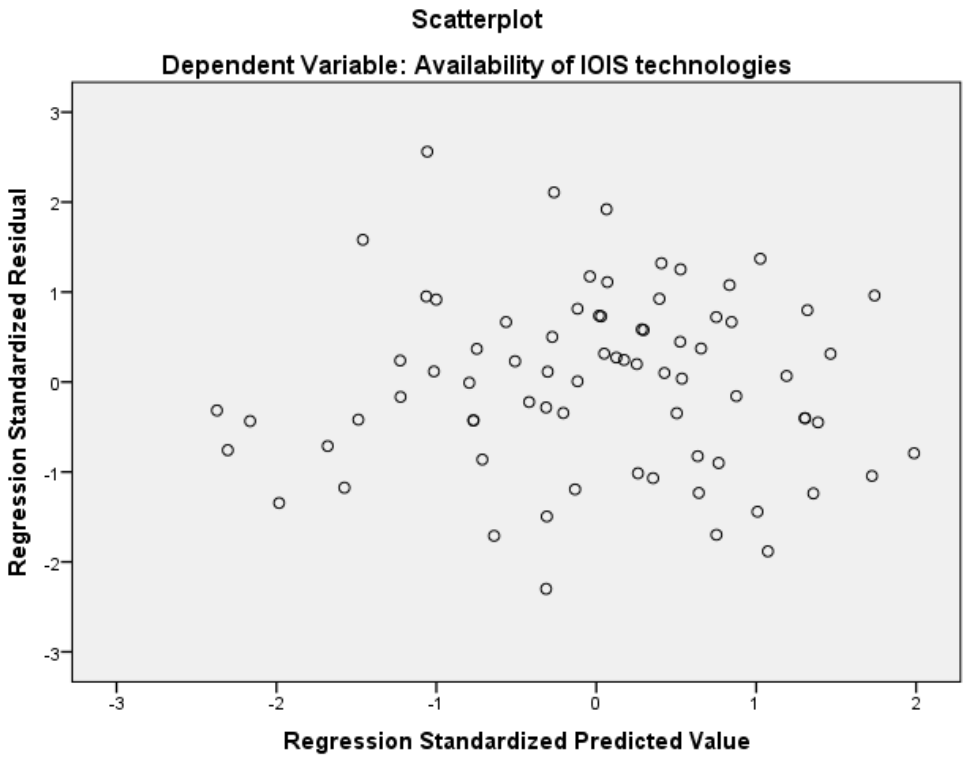


Figure 43: Dependent variable – Heteroscedasticity (Availability of IOIS technologies)

Normality of the residual distribution

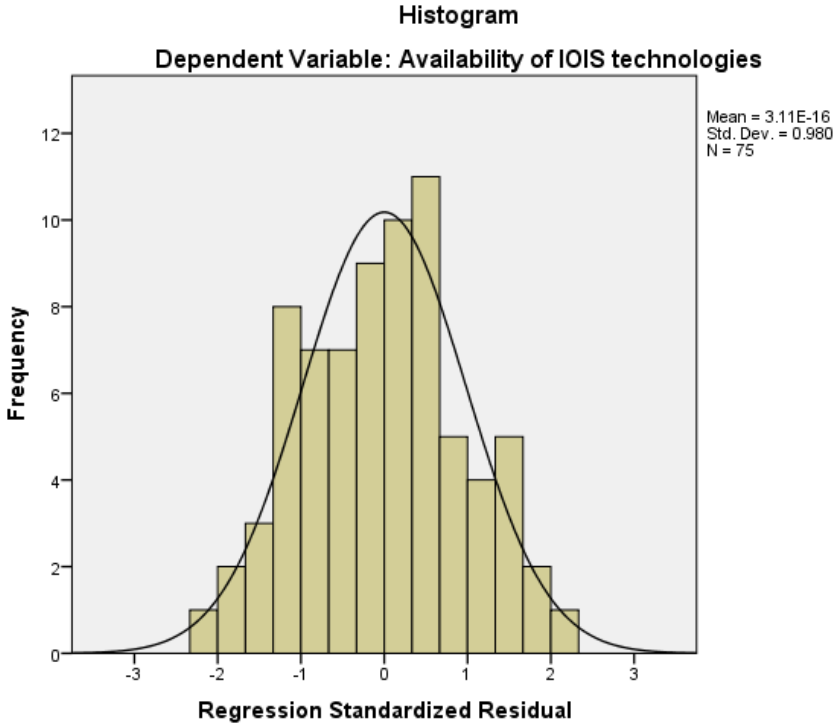


Figure 44: Technological - Residual distribution (Availability of IOIS technologies)

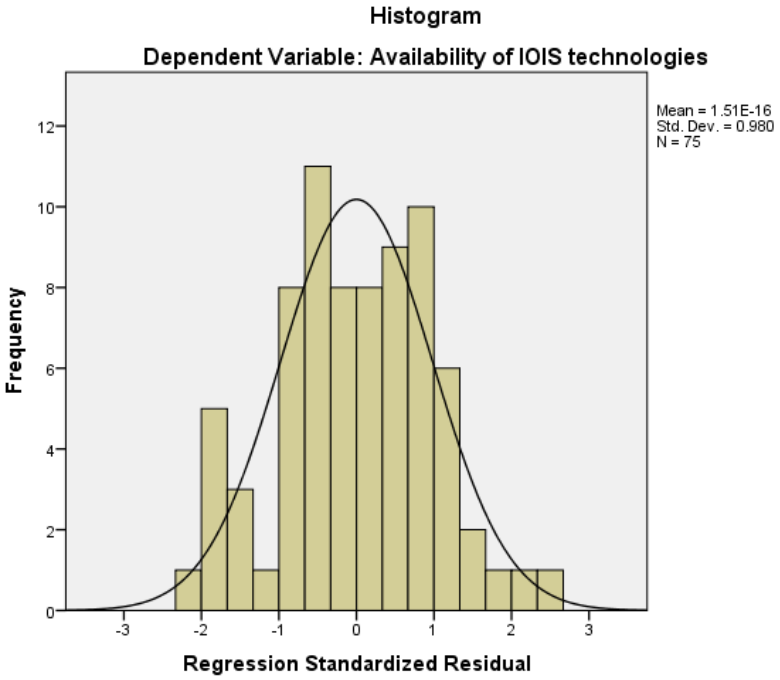


Figure 45: Organisational - Residual distribution (Availability of IOIS technologies)

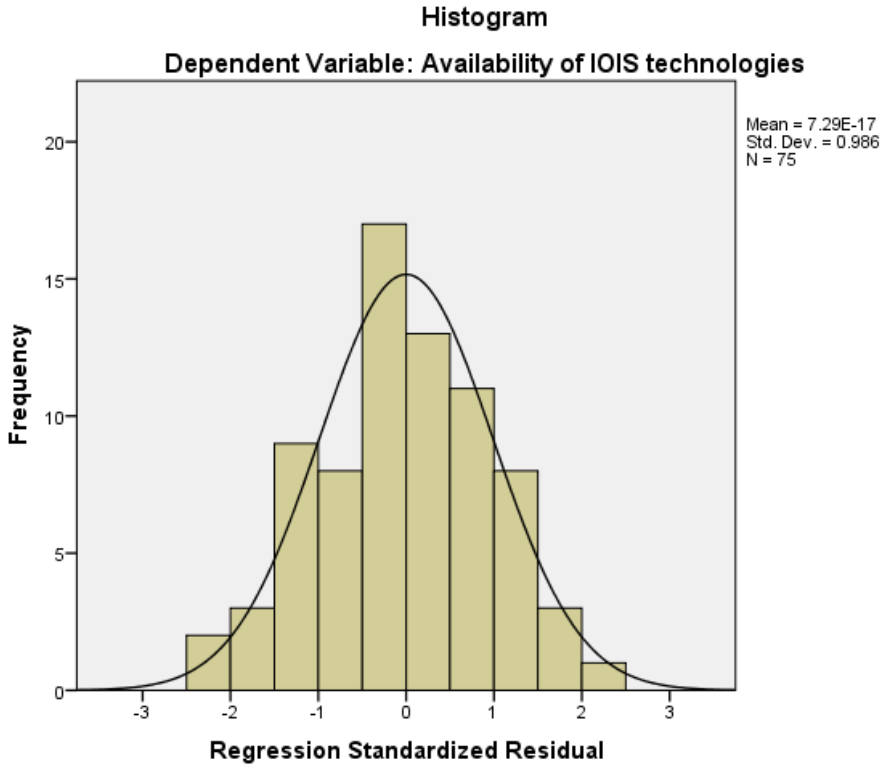


Figure 46: Environmental - Residual distribution (Availability of IOIS technologies)

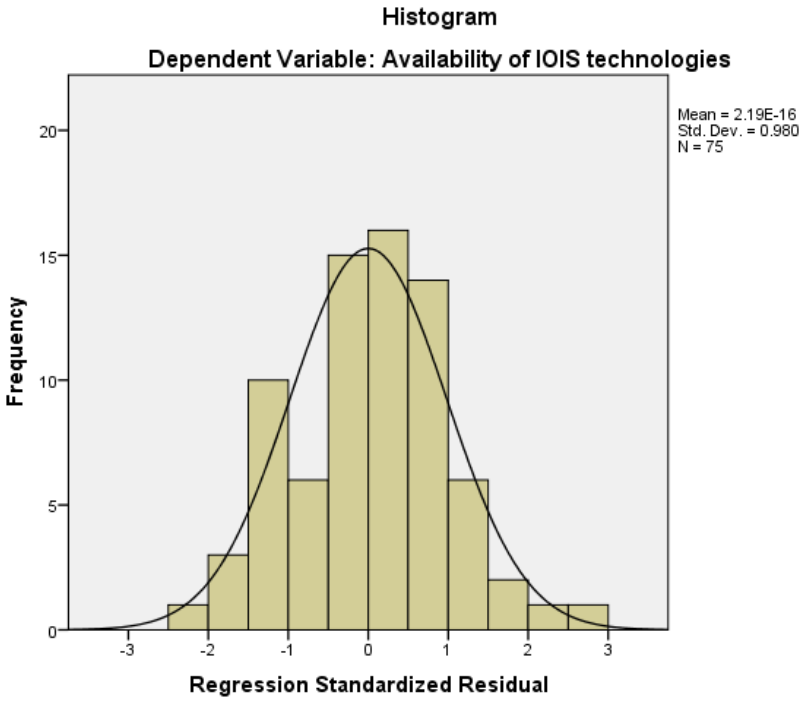
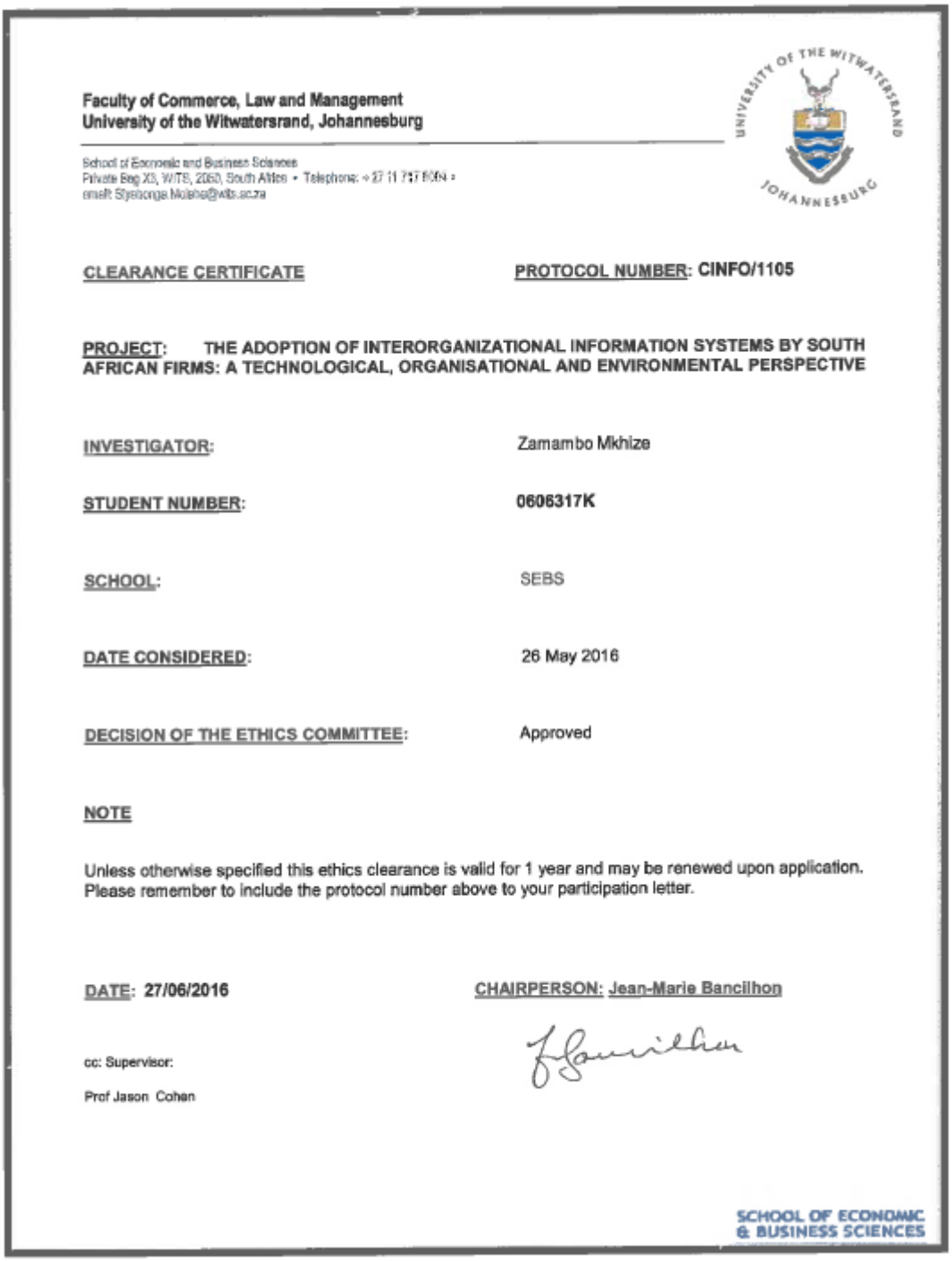


Figure 47: Dependent variable - Residual distribution (Availability of IOIS technologies)

Appendix D: Ethics Clearance Form



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CLEARANCE CERTIFICATE **PROTOCOL NUMBER: CINFO/1105**

PROJECT: THE ADOPTION OF INTERORGANIZATIONAL INFORMATION SYSTEMS BY SOUTH AFRICAN FIRMS: A TECHNOLOGICAL, ORGANISATIONAL AND ENVIRONMENTAL PERSPECTIVE

INVESTIGATOR: Zamambo Mkhize

STUDENT NUMBER: 0606317K

SCHOOL: SEBS

DATE CONSIDERED: 26 May 2016

DECISION OF THE ETHICS COMMITTEE: Approved

NOTE

Unless otherwise specified this ethics clearance is valid for 1 year and may be renewed upon application.
Please remember to include the protocol number above to your participation letter.

DATE: 27/06/2016 **CHAIRPERSON: Jean-Marie Bancilhon**

cc: Supervisor:

Prof Jason Cohen

SCHOOL OF ECONOMIC & BUSINESS SCIENCES