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**DEVELOPMENT AND ASSESSMENT OF AN ORGANISATIONAL  
READINESS FRAMEWORK FOR EMERGING TECHNOLOGIES: AN  
INVESTIGATION OF ANTECEDENTS FOR SOUTH AFRICAN  
ORGANISATIONS' READINESS FOR SERVER VIRTUALISATION**

A DISSERTATION PRESENTED TO  
THE DEPARTMENT OF INFORMATION SYSTEMS  
UNIVERSITY OF CAPE TOWN



IN PARTIAL FULFILMENT OF THE  
REQUIREMENTS FOR THE  
**MASTERS OF COMMERCE DEGREE**

IN  
INFORMATION SYSTEMS

By  
**ABIODUN AFOLAYAN OGUNYEMI**

22 AUGUST 2011

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## **ABSTRACT**

The lack of unifying frameworks to investigate emerging technologies and changing practices in organisations remains a major challenge to the Information Systems body of knowledge. To determine, holistically, factors that contribute to organisational readiness for these emerging technologies on one part, and the factors that influence organisational preparedness on its own on the other part, raises another concern.

This study developed a new conceptual readiness framework NOIIE (an acronym for National e-readiness, Organisational preparedness, Industrial relationships, Internal resistance and External influence), for assessing organisations' readiness for emerging technologies and applications. Server virtualisation was used as a pilot technology to investigate the antecedents for the readiness of South African organisations for emerging technologies in order to be able to validate the NOIIE framework.

Server virtualisation is one of the most important technologies that organisations are considering for the achievement of cost reductions and improvement of business productivity. More so as economic recession and globalisation remain top challenges for business organisations, due to funding constraints and the rapid release of emerging technologies. Information Technology (IT) executives in recent surveys indicate cost reduction and business productivity as major concerns and are in need of solutions to help address these concerns. Server virtualisation was rated the second most helpful technology to achieve cost reduction and improve business productivity. Server virtualisation is being widely used in developed countries, and very little is known about server virtualisation adoption in organisations in developing countries.

Organisations that prepare adequately through their people, governance and technology in addition to the e-readiness of the country in which such an organisation is operating in, and a good relationship in terms of support with the technology provider are able to derive full benefits from technology advantage. Using a quantitative approach and an online survey, this study investigated antecedents for the readiness of 83 South African organisations for server virtualisation.

The readiness of South African organisations for server virtualisation is impressive, as 73% of organisations surveyed have implemented server virtualisation to one extent or another. The NOIIE framework was validated, as national e-readiness, organisational preparedness, and industrial relationships were found to be highly significant and positive contributors to organisational readiness for adopting server virtualisation in South African organisations. Internal resistance has a weak negative influence on organisational preparedness. External influence however, has a weak positive influence on organisational preparedness. The NOIIE framework could be further developed and used to investigate other emerging technologies in organisations in developing countries. Server virtualisation adoption has certain inhibiting factors such as software and license costs, network complexity, license complexity, bandwidth and high broadband affordability which should be considered.

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## **CHAPTER ONE INTRODUCTION**

This study developed a readiness framework (NOIIE) for investigating antecedents for organisations' readiness for emerging technologies, and sought to validate the framework by using it to determine the antecedents for the readiness of South African organisations for server virtualisation.

### **1.1. BACKGROUND TO STUDY**

The world was hit with what would be another round of economic recession in the early 2000s, and in 2008 the downturn reached its peak (El Sawy & Pavlou, 2008; Latham, 2009). Organisations embarked on mass staff retrenchment (Raghuram, 2009), and IT budgets were drastically reduced (Luftman & Ben-Zvi, 2010a). Information technology (IT) departments were mandated to provide cost efficient solutions that enhanced productivity (El Sawy & Pavlou, 2008; Luftman & Ben-Zvi, 2010a). Thus, IT executives busied themselves looking for these solutions (Luftman & Ben-Zvi, 2010b).

In 2009, a Society for Information Management survey of 243 IT executives in the United States of America (USA) considered server virtualisation (a technology that allows a physical server computer to host two or more virtual servers) the second most important technology in this recession (Luftman & Ben-Zvi, 2010a). However, the rapid development of new and emerging technologies and applications due to globalisation has made the adoption of emerging technologies and applications a challenge (El Sawy & Pavlou, 2008; Luftman & Ben-Zvi, 2010a).

The environments in which organisations operate are most times not enabling due to poor e-readiness of the country (Dada, 2006; Ifinedo, 2005). This suggests an evaluation of countries' e-readiness. This study adopted the definition of e-readiness offered by the

Economist Intelligence Unit (EIU), as it provides a holistic view of national e-readiness assessment areas. EIU defines e-readiness as “a measure of the quality of a country’s information and communications technology (ICT) infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit” (EIU, 2008, p. 2).

The terms readiness and e-readiness have been used interchangeably by some scholars. For example, Ram and Pattinson (2009), adopted an e-readiness definition offered by Fathian et al. (2008), to define organisational readiness as “the ability of a firm to successfully adopt, use, and benefit from information technologies” (p. 8). Ram and Pattinson’s (2009), definition is also similar to the contribution of Choucri, et al. (2003) which defined e-readiness as the “ability to pursue value creation opportunities facilitated by the use of internet” (p. 4). In other words, readiness and e-readiness strive to achieve a common purpose. This study adopted this stance in understanding the factors (antecedents) that contribute to organisational readiness for emerging technologies, and other influencing factors.

Organisations are often unaware of emerging technologies or applications, and their potential benefits (Jensen, 2007). For instance, emerging technologies such as server virtualisation have potential economic and environmental benefits (Luftman & Ben-Zvi, 2010a). Organisations in a difficult economic situation can evaluate emerging technologies in order to take adoption and implementation decisions. However, when organisations are adequately prepared, adoption and implementation decisions are easier to take.

The Information Technology (IT) industry appears not to be providing the required support such as product awareness, software cost affordability, and flexible licensing to organisations (Molla & Licker, 2005). This suggests an evaluation of the relationship which exists between organisations and the IT industry.

Meanwhile, organisational preparedness for adopting an emerging technology may be influenced by internal resistance to technological change within such an organisation, and influences to accept or reject the technology from external bodies such as peer organisations, and business associates. For example, server virtualisation adoption decision has the potential to be resisted by IT staff when they lack appropriate skills to support the technology (Info-Tech, 2008). Secondly, application owners and users in the organisation may resist the adoption decision due to perceived security risk associated with server virtualisation (Uddin & Rahman, 2011). Lastly, internal resistance may be due to perceived risk associated with virtualising mission-critical servers (Ray & Schultz, 2009). External bodies however, often influence organisations to accept an innovation than reject the innovation, because other organisations may be using such an innovation (Kurnia, et al., 2009). Finally, the academic body does not appear to be fully researching emerging and new technologies (Dada, 2006).

## **1.2. PROBLEM STATEMENT**

In recent surveys of IT executives, server virtualisation has been identified as an important technology to help organisations improve business productivity, achieve cost reductions, and as a means of mitigating global economic recession effects (Luftman & Ben-Zvi, 2010a; Luftman & Ben-Zvi, 2010b; McGee, 2010). Server virtualisation is offering organisations huge benefits, and virtually nothing is known about its adoption in organisations in developing countries (CDW, 2010; Strategic Counsel, 2007).

There are no appropriate tools to investigate antecedents for organisations' readiness for emerging technologies in the context of developing countries. This study sought to address this major gap by developing a new readiness framework (NOIIE), and using it to investigate the antecedents for South African organisations' readiness for server virtualisation. Server virtualisation was selected as the emerging technology based on its economic and

environmental benefits, as indicated in recent IT executives' surveys (Luftman & Ben-Zvi, 2010a; Luftman & Ben-Zvi, 2010b).

### 1.3 RESEARCH QUESTIONS

The main research question is: What are the antecedents for South African organisations' readiness to adopt server virtualisation as an emerging technology? In order to answer this question, two other exploratory questions were asked:

1. What factors contribute to organisational readiness for server virtualization adoption?
2. What factors influence organisational preparedness for server virtualization adoption?

A conceptual framework was therefore created, using these two exploratory questions:

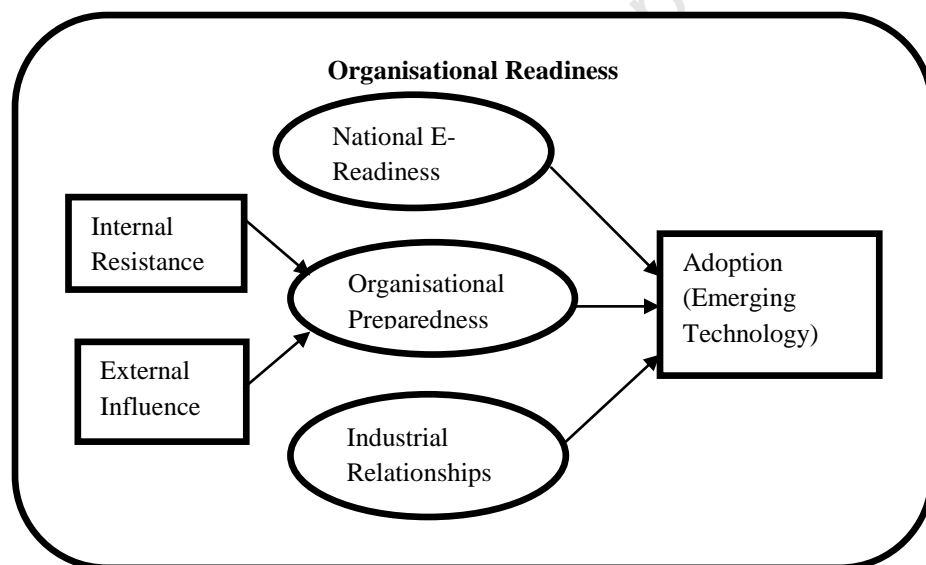


Figure 1: Conceptual framework

### 1.4 RESEARCH OBJECTIVES

South Africa remains the highest ranked e-ready country in Africa (EIU, 2009; Ifinedo, 2005). However, the extent of adoption of server virtualisation in organisations in African countries remains unknown. Thus the objectives of this research are as follows:

1. To develop and validate a conceptual readiness framework (NOIIE) based on literature.
2. To use the framework to determine the antecedents for South African organisations' readiness for server virtualisation.
3. To determine the factors that enable and, or inhibit server virtualisation in organisations in developing countries.
4. To identify the benefits and drawbacks of server virtualisation to the organisations in developing countries using the technology.

## **1.5 RESEARCH BENEFITS**

There are few readiness studies on antecedents for organisational adoption of emerging technologies or applications. This study sought to determine the readiness indicators of organisations for server virtualisation, as an example of emerging technology. The outcome of the study will be beneficial to the Information Systems (IS) research community because it highlights readiness indicators for emerging technologies. The study will also broaden knowledge in e-readiness and readiness studies and provide a further shift of focus from the environment to the users, which most previous e-readiness and readiness studies have failed to address. This study will augment the few relevant academic articles available on server virtualisation adoption, and is one of the motivations for this study.

Finally, the study proposes a new framework (NOIIE), which will be useful for further investigation into readiness of other emerging technologies and applications, and to organisations hoping to adopt server virtualisation in their environments.

## **1.6 RESEARCH SCOPE AND LIMITATIONS**

E-readiness and readiness studies have been more inclined to assess how countries and organisations exploit the potential of e-commerce, e-business, and advanced applications such as Enterprise Resource Planning (ERP), and Customer Relationship Management (CRM) (Molla & Licker, 2005; Ram & Pattinson, 2009). This study in order to provide a shift of focus developed and used a new readiness framework to determine the antecedents for South African organisations' readiness for server virtualisation.

Furthermore, since very little is known about the adoption of server virtualisation in organisations in developing countries, IT Departments in South African organisations were surveyed. The possibility exists that medium to large organisations may be adopting server virtualisation because “start-up organizations are much more inclined to pursue revenue-generating strategies as a means to weathering recession rather than cost reductions, which tended to be the preferred strategy of larger firms” (Latham, 2009, p. 180). The e-readiness status of South Africa also suggests an enabling environment to enhance organisational readiness.

## **1.7 STRUCTURE OF THE RESEARCH REPORT**

The research is organised as follows:

Chapter two provides the review of the literature. The chapter discusses the antecedents for organisational readiness for innovations adoption, e-readiness and readiness models, ICT adoption enablers and inhibitors, and an overview of server virtualisation, and the benefits and drawbacks of server virtualisation. Finally, the chapter provides a summary of emerging research questions, and identifies notable gaps.

Chapter three provides the proposed research framework, and details of the conceptual model's (NOIIE) readiness assessment areas.

Chapter four provides the research methodology which was used to conduct the research. The underlying research philosophy, research purpose, time frame, research strategy, data type, research population, data collection and data coding and analysis, are discussed.

Chapter five provides an analysis of the research results, reliability and validity tests results, research framework test, demographic and qualitative data analysis, discussions and implications of research results.

Chapter six concludes the research with a summary, discussions, and recommendations for future research.

University of Cape Town

## **CHAPTER TWO THE LITERATURE SURVEY**

### **2.1 INTRODUCTION**

The chapter discusses the antecedents for organisational readiness for innovations adoption, e-readiness and readiness models, ICT adoption enablers and inhibitors, and overview of server virtualisation. The purpose is to understand innovation adoptions in organisations and factors that contribute to, or influence adoption of innovation such as server virtualisation in organisations. Finally, the chapter provides the summary of emerging research questions and identifies notable gaps.

### **2.2 ANTECEDENTS FOR ORGANISATIONAL READINESS FOR INNOVATIONS ADOPTION**

The world is now immersed in an information age where ICTs have become the “major driving forces for productivity, competitiveness, collaboration, and superposition of resources on both national and international level” (Hanafizadeh, Hanafizadeh, & Khodabakhshi, 2009, p. 189). However, the advent of ICT also brought a digital separation between the developed and developing countries (Al-Solbi & Mayhew, 2005; Javadi & Gharakani, 2008). What this implies is that a nation or organisation that is not making extensive use of ICTs for competitive advantage is left behind (Mutula & van Brakel, 2006b).

The adoption of technologies by organisations is premised on their status of readiness (Fathian, Akhavan, & Hoorali, 2008; Uzoka, Shemi, & Seleka, 2007). Assessment of the current status of ICT adoption in organisations helps to understand if ICT policies and implementation are working and how to address failing issues (Uzoka, et al., 2007).

This rest of this section discusses antecedents for organisational readiness for emerging technologies such as server virtualisation.

### 2.2.1 National E-Readiness

The context of assessment of readiness of an organisation for adoption of emerging technologies is important to the output of such assessment. The society is expected to provide an enabling environment for its people and organisations to be ready to adopt innovations for their economic benefits (Al-Solbi & Mayhew, 2005; Kurnia, et al, 2009, Molla & Licker, 2005; Mutula & van Brakel, 2006b). Government formulates policies, provides ICT infrastructures, enters into collaborations and seeks partnerships in order to enhance the lives of its people (Javadi & Gharakani, 2008; Kurnia, et al, 2009). The context of this study is South Africa, and this section shall briefly review South Africa's e-readiness over a period of five years between 2005 and 2009 using the results provided by the EIU.

South Africa has consistently maintained its African leadership in terms of e-readiness rankings. The country has consistently strove to make basic ICT infrastructures such as internet, telecommunications, among others, available to its people and organisations (EIU, 2009). One of South Africa's initiatives is to deploy a new network infrastructure in 2011, in order to break the monopoly of Telkom, which has been the country's sole ICT provider (Business Monitor International, 2009).

Table 1 shows South Africa's e-readiness results between 2005 and 2009. The overall score was based on 10 and each category can be multiplied by 10 to arrive at 100%. This is necessary in order to understand how each category improves or otherwise. The percentages indicated below each category were set by the EIU, and were to show the breakdown of countries' e-readiness assessment areas.

**Table 1: South Africa's five-year e-readiness results (Source: EIU (2005, 2006, 2007, 2008, 2009))**

Year	Overall Score	Category					
		Connectivity (20%)	Business Environment (15%)	Social & Cultural Environment (15%)	Legal Environment (10%)	Govt. Policy & Vision (15%)	Consumer & Business Adoption (25%)
2005	5.53	2.10	6.94	6.10	7.48	6.10	7.50
2006	5.74	2.70	6.85	6.00	7.48	7.50	6.50
2007	6.10	4.30	6.84	5.00	6.80	7.05	7.00
2008	5.95	4.55	6.83	5.27	7.10	6.20	6.35
2009	5.68	4.30	5.94	5.57	7.20	5.95	5.93

Table 1 reveals that South Africa has been steadily creating an environment suitable for competitive advantage in the global market. Internet provisioning and connectivity for example, rose steadily from 21% in 2005 to 45.5% in 2008 and dropped slightly to 43% in 2009. This suggests that government has been consistent in its efforts to improve internet connectivity.

Business environment was steady between 2006 and 2008; social and cultural environment dropped sharply in 2007 and began to rise from 2008 through to 2009. Similarly, legal environment ratings dropped in 2007 and rose from 2008 through 2009. Government policy and vision ratings rose in 2006 and began to drop from 2007. Consumer and business adoption ratings have been on steady decline since 2007. These results suggest that 2007 was perhaps the best "e-ready year". The 2007 EIU survey focused on the rate of ICT adoptions in countries and the results suggest that South Africa took a giant leap that year in providing necessary ICT infrastructures for its people and organisations (EIU, 2007). Furthermore, the focus of EIU in 2008 was on the countries' ability to maintain their ICT spending or improve on it (EIU, 2008). Coincidentally, 2008 was characterised with severe negative impacts of the

global economic depression, which may account for various low spending on ICT infrastructure (Vincent, et al, 2010), which may also be the case with South Africa. In 2009, EIU focused on ICT usage in countries. It argued that the availability of ICT infrastructures within the society was not sufficient but its usage was more imperative (EIU, 2009).

The results in Table 1 suggest that South Africa has an enabling environment in terms of its commitment to e-readiness. One of the aims of this study is to identify antecedents for organisational readiness for adoption of emerging technologies. The question that arises is: Does South Africa's e-readiness (national e-readiness) contribute significantly and positively to South African organisations' readiness for server virtualisation?

### **2.2.2 Organisational Preparedness**

Rogers' (2003) theory of diffusion of innovations provides holistic insight into organisational adoption of innovations (new ideas, concepts, or objects) and is appropriate to understand issues around adoption of emerging technologies such as server virtualisation.

Innovation diffusion has five processes: knowledge is the first process where there is awareness of the innovation, and intended users undergo learning of the innovation, and eventually understand how to use it; persuasion follows, where users consider the consequences of using the innovation, and then form attitudes towards such innovation. Attitudes may be favourable or otherwise. After this process, a decision is made whether to adopt or reject the innovation. Adoption of innovations leads to implementation where innovations are put into use. Finally adopters seek to reinforce their earlier decisions. This is the confirmation stage.

In addition to these processes, there are five characteristics of an innovation which tend to influence its adoption (Rogers, 2003).

- Relative advantage seeks to understand the extent to which an innovation is perceived to be a better alternative to the current practice. Adoption increases when innovation is perceived as better than the current ideas (Ashley, 2009; Premkumar, 2003).
- Compatibility is the extent to which innovations are perceived to be consistent with previous practices, existing values, and adopters' needs. The more compatible an innovation is, the higher the chance of its adoption (Ashley, 2009; Mustonen-Ollila & Lyytinen, 2003).
- Complexity is the extent to which an innovation can be understood and used. The less complex an innovation is, the more such an innovation is likely to be adopted (Ashley, 2009; Enfield, Myers, Lara , & Frick, 2011).
- Trial ability is the degree to which an innovation can be experimented before its full adoption. This ensures potential adopters have a feel of the innovation and are able to make adoption or rejection decision (Ashley, 2009; Lapointe & Rivard, 2005).
- Observability refers to the extent to which the use and benefits of an innovation are apparent to others. Adoption increases when the benefits of an innovation are achieved and are visible to future adopters (Ashley, 2009; Cotteleer & Bendoly, 2006).

By looking at the process and characteristics of innovations adoption of Rogers (2003), it is plausible that adopters of server virtualisation are aware of the technology or are prepared to learn how to use the technology. Moreover, such adopters form an attitude to accept or reject the use of server virtualisation in their environment, and establish their decisions. Acceptance decision is possible provided that server virtualisation's use offers better value than, and is consistent with the current practice; users understand how to use the technology; users can

use it in a test environment before actual deployment in a production environment; and future adopters can be motivated by the success story of existing adopters.

This analysis suggests that Rogers' (2003) Theory of Diffusion of Innovation is quite relevant to understanding the adoption of server virtualisation in South African (a developing country) organisations because it is very unclear if these organisations are aware of the technology in the first place. Secondly, server virtualisation like other emerging technologies has its learning curve. Finally, there is a perceived 'single point of failure' with server virtualisation that can make adopters sceptical.

Adoption of emerging technologies such as server virtualisation has been known to be associated with certain problems (Lucas, Jr., et al., 2007). Kwon and Zmud (1987) identified these problems and their resolutions as factor, process, and political research. These categories are closely related to the adoption of server virtualisation as they consider people, governance, and technological factors which are imperative to achieve IT adoption success (Info-Tech, 2008; Lapointe & Rivard, 2005). Factor research considers individual, organisation, and technology; process research fosters change management; and political research considers diversity of IT stakeholders' interest (Cooper & Zmud, 1990; Info-Tech, 2008).

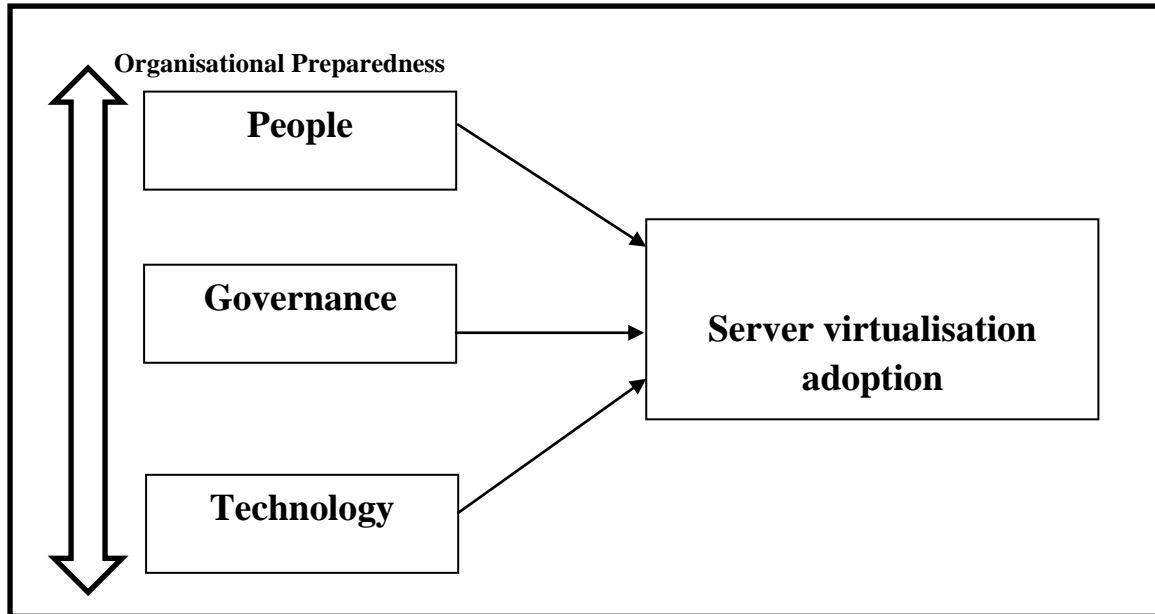
Employees (people) in an organisation often exhibit resistance to adoption of new technologies (Lapointe & Rivard, 2005). For example, server virtualisation adoption often fails because top executives, application owners and IT staff may not buy into the technology (Daniels, 2009). For example servers that have good virtualisation candidatures may be "poison pills" as a result of political landmine (Info-Tech, 2008). In another instance, there may be lack of change readiness as a result of fear of loss of control (Kwahk & Lee, 2008; Peansupap & Walker, 2005). Trial ability of a technology or product (an innovation) occurs

when such technology or product is introduced and intended users try their hands on it (Rogers, 2003). If there is a perception of loss of control as result of adoption of such technology, these users often resist (Lapointe & Rivard, 2005). Lack of expertise to manage these new technologies and poor knowledge management and practice are other instances (Alavi & Leidner, 2001; Cetindamar, et al., 2009; King & Marks Jr., 2008).

Governance is another consideration for adopting emerging technologies because of the enormous challenge associated with getting the right technologies to enhance business value (Hoving, 2007). In some instances, organisations often fail to consider the future of their businesses when adopting emerging technologies in terms of commoditisation (interoperability and cost performance), integration and management of these technologies and achieving business value (Goodhue, et al., 2009). Another reason is that innovators are often somewhat venturesome and make rash decisions when they are adopting an innovation, despite a high degree of uncertainty often associated with adopting new innovations, and most often they encounter setbacks (Enfield, et al., 2011). In other instance, innovations have inviting benefits that must be carefully weighed with business requirements (El Sawy & Pavlou, 2008; Ifinedo, 2005).

The existing IT infrastructure (technology) determines, in addition to the people and governance, the success of adoption of emerging technologies (Goodhue, et al., 2009; Luftman & Ben-Zvi, 2010a). Before adopting server virtualisation, organisations must assess their existing servers, platform integration, IT infrastructure, bandwidth, candidature, resource demand, and hardware requirement (Daniels, 2009; Uddin & Rahman, 2011). Server virtualisation may provide for a single point failure if an organisation consolidates all its applications on a server and fails to deploy failover service such as clustering or provide for

redundancy (Uddin & Rahman, 2011). These three major factors can be depicted as shown in Figure 2.



**Figure 2: People, governance, and technology in organisational preparedness for server virtualisation adoption**

Server virtualisation adoption was discussed and three major factors namely; people, governance and technology were identified to form the bulk of organisational preparedness for server virtualisation. This implies that an organisation will be prepared for adopting emerging technologies (such as server virtualisation) if such an organisation takes its people, governance and existing IT infrastructure (technology) into consideration when adopting these emerging technologies. The question that arises is: Does organisational preparedness (covering people, governance and technology) contribute significantly and positively to the overall organisational readiness for server virtualisation in South Africa?

It may be interesting to also understand if people, governance and, or technology contribute positively to organisational preparedness as depicted in Figure 2?

### **2.2.3 Industrial Relationships**

The relationship between an organisation and the technology provider (vendor) is one of the important factors in organisational readiness. Tornatzky and Fleischer (1990), in the Technology Organisation Environment Model identified the industry (a component of the environment) to which an organisation belongs, as a factor shaping organisational adoption of innovation. The term industrial readiness has been sparsely used to depict a significant relationship between adopting organisations and innovation providers (vendor) (Kurnia, et al., 2009; Molla & Licker, 2005). Organisational readiness for innovations such as server virtualisation may be influenced negatively if technology providers fail to support adopting organisations (Azadegan & Teich, 2010). This is because server virtualisation as an emerging technology requires certain supports such as flexible licence cost and general technical support (Colivet, 2008). The IT industry is thus expected to make its service available and affordable for organisations requiring such service (Molla & Licker, 2005).

This study aimed at determining if industrial relationship is an antecedent for South African organisations' readiness for server virtualisation. The question that arises is: Does industrial relationship contribute significantly and positively to South African organisations' readiness for server virtualisation?

### **2.2.4 Internal Resistance**

A resistance within an organisation often leads to non-adoption (Lapointe & Rivard, 2005). Resistance takes place if the adoption of an innovation is perceived to cause a change of users' behaviour, systems behaviour, or loss of users' control (Kwahk & Lee, 2008; Peansupap & Walker, 2005). A meta-analysis of 43 articles published in 20 top IT journals between 1980 and 2005 revealed varying understanding of the concepts of resistance and

why it occurs (Lapointe & Rivard, 2005). Some of these studies suggested that resistance is a means through which users show their discomfort with an innovation (Lapointe & Rivard, 2005). Other authors felt that resistance is simply an inhibitor that should be removed (Lapointe & Rivard, 2005).

Server virtualisation adoption may likely be hindered considering the attitude that stakeholders such as top executives, IT staff, application owners and users within the organisation may form towards the technology (Info-Tech, 2008). For example, application owners and users may be unwilling to support the adoption decision because of perceived security risk associated with server virtualisation (Brasol, 2009). Similarly, top executives may not buy into adoption of server virtualisation because of mission-critical servers such as ERP and CRM (Info-Tech, 2008).

The question arising is: Does internal resistance within South African organisations influence South African organisational preparedness for server virtualisation?

### **2.2.5 External Influence**

The external influence factor has been included in major IS adoption research because of its roles in shaping organisational adoption decision of innovations (Premkumar, 2003). The Environmental factor of the TOE Framework offers valuable contributions on how competition from external organisations shapes organisational decision to adopt an innovation in order to remain competitive (Tornatzky & Fleischer, 1990). Drawing upon the TOE framework, Kuan and Chau (2001) and Xu, Zhu and Gibbs (2004) discovered that the desire to be competitive often mounts strong pressure on organisations to adopt innovations, especially with rapid challenges in innovations due to globalisation.

Similarly, business associates (trading partners) exert pressure on organisations to adopt an innovation especially if the organisation is being supported technically by these associates (Low, Chen, & Wu, 2011).

The question that arises is: Does external influence on South African organisations influence their preparedness for server virtualisation?

Five antecedents to organisational readiness for adoption of innovations (such as server virtualisation) were identified and discussed in section 2.2. The next section discusses two models that were drawn based on Theory of Diffusion of Innovation and largely the antecedents discussed in section 2.2.

### **2.3. E-readiness and Readiness Models**

Most studies on e-readiness focus on the environment, and thus demonstrate the need to focus on the organisation (Dada, 2006). E-readiness of most developing countries is still poor when compared to the developed countries (Ifinedo, 2005). The poor e-readiness status of a country affects the effective participation of its organisations in the networked economy (Mutula & van Brakel, 2006b).

2.3.1 Perceived Organisational E-Readiness (POER) and Perceived Environmental E-Readiness (PEER) Model Molla and Licker (2005) proposed a model on perceived organisational e-readiness (POER) and perceived environmental e-readiness (PEER), and carried out a quantitative study of 150 organisations in South Africa. The objective was to determine the factors that affect e-commerce adoption in a developing country. Molla and Licker (2005) discovered that POER (organisational e-readiness) explains adoption of e-commerce better than PEER. In Figure 3, organisational e-readiness is determined by factors tagged A, B, C, D, E, and F, and environmental e-readiness by factors tagged G, H, and I.

Each factor in the perceived organisational e-readiness and perceived environmental e-readiness variables were hypothesised to contribute significantly and positively related to initial adoption. Institutionalisation was determined on organisations that have made full adoption.

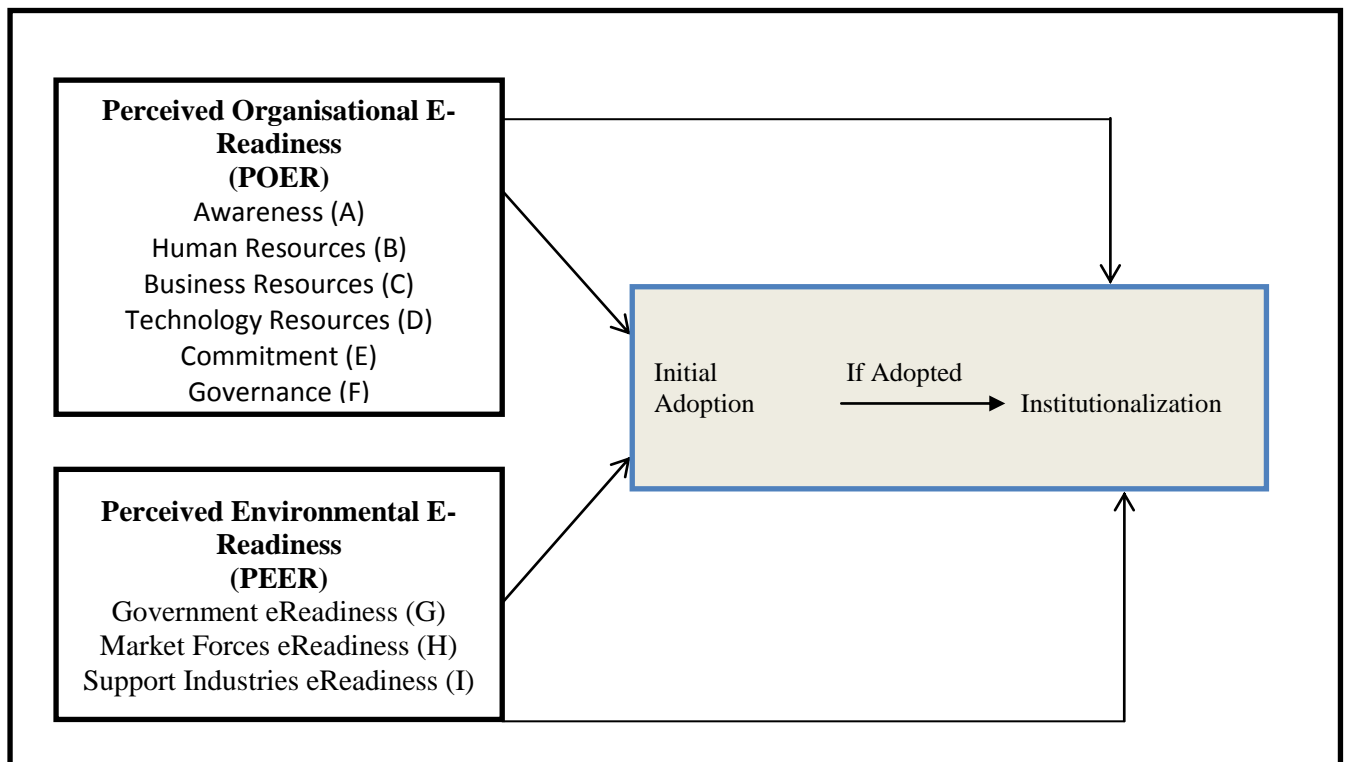


Figure 3: E-commerce adoption model (Molla & Licker, 2005)

Molla and Licker (2005) suggested that organisations in developing countries should take cognisance of organisational factors such as awareness, human resources, business resources, technology resources, commitment, and governance, and environmental factors such as government e-readiness, market forces e-readiness, and support industries e-readiness, when making e-commerce adoption decisions.

### 2.3.2 Electronic Commerce Readiness

Kurnia et al (2009) carried out a quantitative study of 180 Malaysian SMEs and discovered that readiness variables such as organisational readiness, industrial readiness, national e-readiness, and external influence, have different correlations with different e-commerce technologies such as e-mail, internet, intranet, barcode, and so on. This suggests that an assessment of organisational readiness of individual technologies (such as server virtualisation) is better, in order to establish the significance of readiness variables (Mutula & van Brakel, 2006a).

In Figure 4, five factors were hypothesised to support adoption decisions for e-commerce technologies. Organisational Readiness was measured by determining how top managers perceived e-commerce technologies to provide benefits to their business, and human and technological resources within the organisation, and organisational governance. Industrial Readiness entailed “industry structure and standards, and readiness of trading partners that promotes adoption of EC technologies” (Kurnia, et al. 2009, p. 4). National Readiness referred to support (enabling environment through economic and socio-political stabilities, ICT infrastructures, research and development, and foreign investments) from governmental and non-governmental bodies. Perceived Environmental Pressure was added to the E-Commerce Adoption Model, and referred to influences exerted by peer organisations and business associates on organisations to adopt a technology. The need to remain competitive was another reason for perceived environmental pressure on organisations.

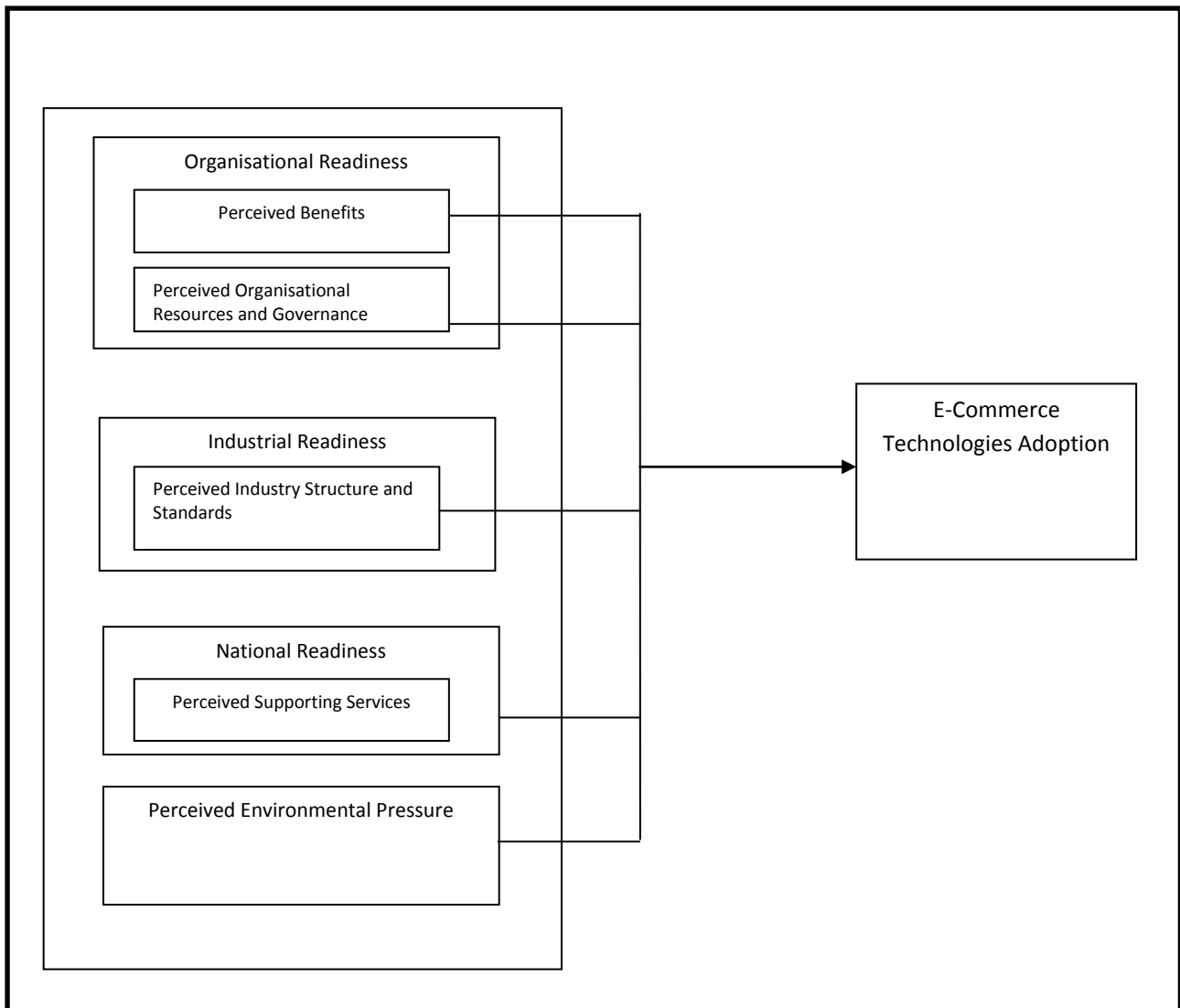


Figure 4: Kurnia, et al (2009) EC Technologies Adoption Framework for SMEs in Developing Countries

Kurnia et al. (2009) observed that organisational readiness factors, that is perceived benefits, perceived organisation resources, and governance play prominent roles in organisational readiness, and suggests that SMEs need continuous support from the government or any relevant bodies, and the industry in order to be ready to adopt e-commerce technologies.

Section 2.3 reveals that there is no single framework to provide a unifying model to understand adoption of innovations (emerging technologies) in the context of organisations in developing countries. Furthermore, there has been a recent call to “provide a stable theoretical

frame with which to understand new technologies and changing practices” (Lucas, Jr., Swanson, & Zmud, 2007, p. 209).

This research aims to understand factors that contribute to, or influence South African organisations' readiness for server virtualisation (an emerging technology). This is to develop a readiness model that provides for a holistic understanding of antecedents for adopting emerging technologies in organisations in developing countries and to offer contributions to the current discourse on antecedents for organisational readiness.

From the contributions of Molla and Licker (2005) and Kurnia et al. (2009), it appears that organisational readiness is an antecedent for the overall organisational readiness to adopt an innovation. Furthermore, organisations in developing countries appear to require the contributions from the countries in which they operate (national e-readiness), and the industry (industrial relationships), to be ready.

## **2.4 ICT ADOPTION ENABLERS AND INHIBITORS**

This section discusses common enablers and inhibitors to the implementation of ICTs in organisations. These factors are related to organisations. The section serves to determine if factors that enable and, or inhibit generic ICTs adoption in organisations apply to server virtualisation in South African organisations.

### **2.4.1 Enablers**

Reviewing literature, the following enablers to generic ICT adoption appeared.

#### ***2.4.1.1 Stakeholders' Support***

Stakeholders in organisations include top executives such as CEO, IT manager, IT staff, IT users, and the customers (Cotteleer & Bendoly, 2006). These stakeholders' decision and

support are crucial to successful adoption of ICTs in any organisation (Sanad, Fidler, & McBride, 2010). The top executives take decisions on adoption of technologies in their organisations; the IT department handles the technical operation and support of these technologies; users utilise the technology for their routine business tasks; and the customers subscribe to the output service of the overall process (Caetano & Amaral, 2011; Premkumar, 2003).

#### ***2.4.1.2 Training***

Provision for staff training by top management is one of the factors that enable adoption of ICTs in organisations (Bruque & Moyano, 2007; Cetindamar, et al., 2009). In addition, knowledge sharing is facilitated when staff exhibit good working relationship and socialise, which makes such staff prepared for technological changes (Alavi & Leidner, 2001). This suggests that training can take a form of informal knowledge sharing among employees, or some more formal training offered by technical groups or product vendors (King & Marks Jr., 2008).

#### ***2.4.1.3 IT and Business Integration***

Although IT and business alignment has been a conundrum for a long time, leveraging IT and business enhances strategic relationship between IT and business, and helps organisations to achieve proven success (Bhatt, et.al. 2010; Luftman & Ben-Zvi, 2010b). Organisations which make IT an integral part of business requirements often facilitate adoption of technologies in their environments (Kunneke, Groenewegen, & Menard, 2010). In this case, IT is seen as inclusive of business and business as part of IT (Luftman & Ben-Zvi, 2010b). However, adequate planning of technologies is required for organisations to effectively integrate technology into business (Caetano & Amaral, 2011). This enhances organisational IT

investments where such investments lead to greater autonomies in form of “decentralised decision authority, use of self-managed teams, and cross-functional units” (Ramirez, et al., 2010, p. 418). For instance, teams are more efficient when they form a synergy as a result of using technologies, because IT capabilities enhance knowledge sharing and management among team members (Caetano & Amaral, 2011).

#### ***2.4.1.4 Strategic IT Planning Capability***

IT Strategic planning has continued to be among the top ten priorities of IT executives as it helps to deliver business improvements rapidly (Luftman & Ben-Zvi, 2010a). Since the commencement of economic downturn, IT executives have been working hard to discover strategic opportunities for using IT to achieve cost reductions and enhanced productivity (Uddin & Rahman, 2011). It is common now that some organisations consolidate their IT infrastructures using such technologies as virtualisation (Daniels, 2009). Other organisations are negotiating new contracts with their vendors (Luftman & Ben-Zvi, 2010b). Thus, organisations that have strong strategic IT planning capabilities are able to adopt new technologies faster than those who do not (Bajgoric, 2006).

#### ***2.4.1.5 Flexible IT Infrastructure***

Flexible IT infrastructure relates to the extent “to which the IT infrastructure is scalable, compatible, modular, and can handle multiple business applications” (Bhatt, et al. 2010, p. 342). Organisations are able to react to change faster when they have flexible IT infrastructure (Peansupap & Walker, 2005). However, organisations must have standard IT policies which will enhance adoption, and upgrading into new systems to meet changing business needs (Cetindamar, et al., 2009).

#### ***2.4.1.6 Effective Technical Support***

Technical support is crucial to adoption of ICTs. Technical support includes in-house support provided by the IT department and external support from vendors (Debreceeny, 2006). The vendor support covers online assistance, product updates and upgrades, user training, and occasional maintenance especially during emergencies (Wang, et al., 2008).

### **2.4.2 Inhibitors**

In addition to the enablers identified in sub section 2.4.1, the following inhibitors also emerged.

#### ***2.4.2.1 Lack of Technology Awareness***

Lack of technology awareness remains one of the inhibitors to adoption of ICTs in organisations (Molla & Licker, 2005; Mutula & van Brakel, 2006b). As a result of this, organisations often fail to seek opportunities which can be achieved with adoption of ICTs (Stewart & Mohamed, 2002). In most cases, the decision to invest in, and adopt these ICTs is very difficult to arrive at when organisations are unaware of the potential benefits they can derive from adoption of ICTs (Peansupap & Walker, 2006).

#### ***2.4.2.2 Fear of Job Loss and Insecurity***

Implementation of new technologies often requires changes in users' behaviours (Peansupap & Walker, 2005). Most often, users exhibit fear of losing jobs, responsibilities or other certain controls (Bruque & Moyano, 2007).

#### ***2.4.2.3 Lack of Skilled Staff***

The expert skills required to adopt and support IT infrastructures and applications are motivated by provisions for IT training courses in organisations, and adequate IT staff with

requisite experience (Stewart & Mohamed, 2002). Thus, lack of skilled personnel to implement, use and support IT is one of the biggest inhibitors to ICT adoption in organisations (Bruque & Moyano, 2007; Gilham & Van Belle, 2005).

#### ***2.4.2.4 ICT Adoption Policy***

The trial ability characteristic of an innovation helps to understand why some organisations are early adopters of an innovation (a new technology), and others are late adopters (Rogers, 2003). Trial ability has been found in recent studies to have significant influence on adoption of ICTs (Gilham & Van Belle, 2005; Peansupap & Walker, 2006). Adoption policy specifies when an innovation should be adopted and why such an innovation should be adopted (Ashley, 2009). Generally, organisations appear to adopt an innovation early, when the organisations are fully aware of the innovation, and such an innovation proves to a better replacement of the existing practice (Lapointe & Rivard, 2005).

#### ***2.4.2.5 Cost***

Cost of software and license affects adoption of ICTs in organisations (Bruque & Moyano, 2007). High costs associated with initial setup and maintenance is responsible for low level of ICT adoption in organisations in most cases (Stewart & Mohamed, 2002). For example, many virtualisation vendors often offer “cost per instance” licensing instead of “cost per processor”, thus making cost of virtualisation license huge and unaffordable for many organisations hoping to adopt the technology (Daniels, 2009).

Common factors enabling and inhibiting ICT adoption in organisations were identified. Server virtualisation is an emerging technology and very little is known about its adoption in organisations in developing countries. In line with the third objective in section 1.4, the

question that arises is: What are the factors that enable and, or inhibit server virtualisation in South African organisations?

The next section discusses the history of virtualisation and provides an overview of server virtualisation.

## **2.5 OVERVIEW OF SERVER VIRTUALISATION**

Virtualisation concept began decades ago with IBM's hardware partitioning of its mainframe computers (Banica, Rosca, & Stefan, 2009; Gay, 2007). Virtualisation is a technique which allows multiple virtual machines on a physical computer in such a way that the resources, such as CPU, memory, hard disk space and network interface card(s) of the host (physical computer) can be shared across multiple environments (Healey, Anderson, & Humphreys, 2008; VMware, 2010). A virtual machine is a tightly isolated software container that is capable of running its own operating systems and applications as though it were a physical computer (Ogunyemi & Johnston, 2010; Uddin & Rahman, 2011).

Virtualisation technologies became popular on x86 servers (Healey, Anderson, & Humphreys, 2008). In 1997, Microsoft released Virtual PC virtualisation software (Prieto, et al., 2008), and in 1998 VMware Incorporation released VMware Workstation (Banica, et al., 2009; Prieto, et al, 2008). This marked the transition to software virtualisation which is the main architecture of today's virtualisation technologies (Daniels, 2009; Ray & Schultz, 2009). Hardware vendors such as Intel, AMD and IBM provide hardware platform support for virtualisation software (Ritsuko, 2009; Strom, 2008).

Meanwhile, the current economic recession has caused IT departments in organisations to be more interested in solutions that help the improvement of business productivity and achieve cost reduction (Luftman & Ben-Zvi, 2010a). Business productivity and cost reduction

continue to be concerns for IT executives as revealed in a mid 2010 survey of the Society for Information Management of 172 US organisations (Luftman & Ben-Zvi, 2010b). Brocade (2009) posited:

“The organizations that can leverage high-performing, highly available, highly scalable, and highly efficient technology solutions will be able to broaden their customer base and expand their products and services. As a result, they will be in a position to use the economic downturn as a competitive advantage rather than an inhibitor to growth” (p. 3)

Data centre owners and managers are also concerned about proliferation of physical servers in data centres, and the costs associated with the running and maintenance of these servers and other data centre infrastructures (Rao, Kiran, & Reddy, 2010; Uddin & Rahman, 2011). As a result, server consolidation has remained one means through which organisations reduce costs of maintenance, provision of cooling devices and power consumption (Ritsuko, 2009; Uddin & Rahman, 2011). Server virtualisation is a consolidation technology (Ogunyemi & Johnston, 2011). Server virtualisation has the potential to help organisations reduce the number of their physical servers to a manageable number (Murphy & McClelland, 2009).

Server virtualisation helps to achieve higher utilisation of server resources (Colivet, 2008; Luftman & Ben-Zvi, 2010a). For instance, in a non-virtualised environment, a typical server is estimated to run at 15-20% utilisation (Kamoun, 2009; Luftman & Ben-Zvi, 2010a), while this is increased to a level of 70% in a virtualised environment (Brasol, 2009; Colivet, 2008; Luftman & Ben-Zvi, 2010a). There is no significant difference in the amount of energy consumed by a server when it is running as a stand-alone, and when it is virtualised (Luftman & Ben-Zvi, 2010a; Rasmussen, 2009). A stand-alone server is estimated to use 50% of its cost of purchase to meet power and cooling demands (Healey, et al., 2008). Thus, server

virtualisation offers higher utilisation and sharing of hardware resources while reducing power consumption (Uddin & Rahman, 2011).

Figure 5 shows that a physical server which has been virtualised can host 2 or more virtual servers (VS 1-n), each running several applications (App 1-n) and operating systems (OS 1-n). The hypervisor (a virtual machine software programme) or virtual machine monitor inserts a thin layer of abstraction between the physical server (host) and the virtual machines (guest) (Banica, et al., 2009; Colivet, 2008). The architecture of server virtualisation follows hardware virtualisation, in which the virtual machine operates at a layer below the host computer operating systems (Colivet, 2008; Shields, 2008).

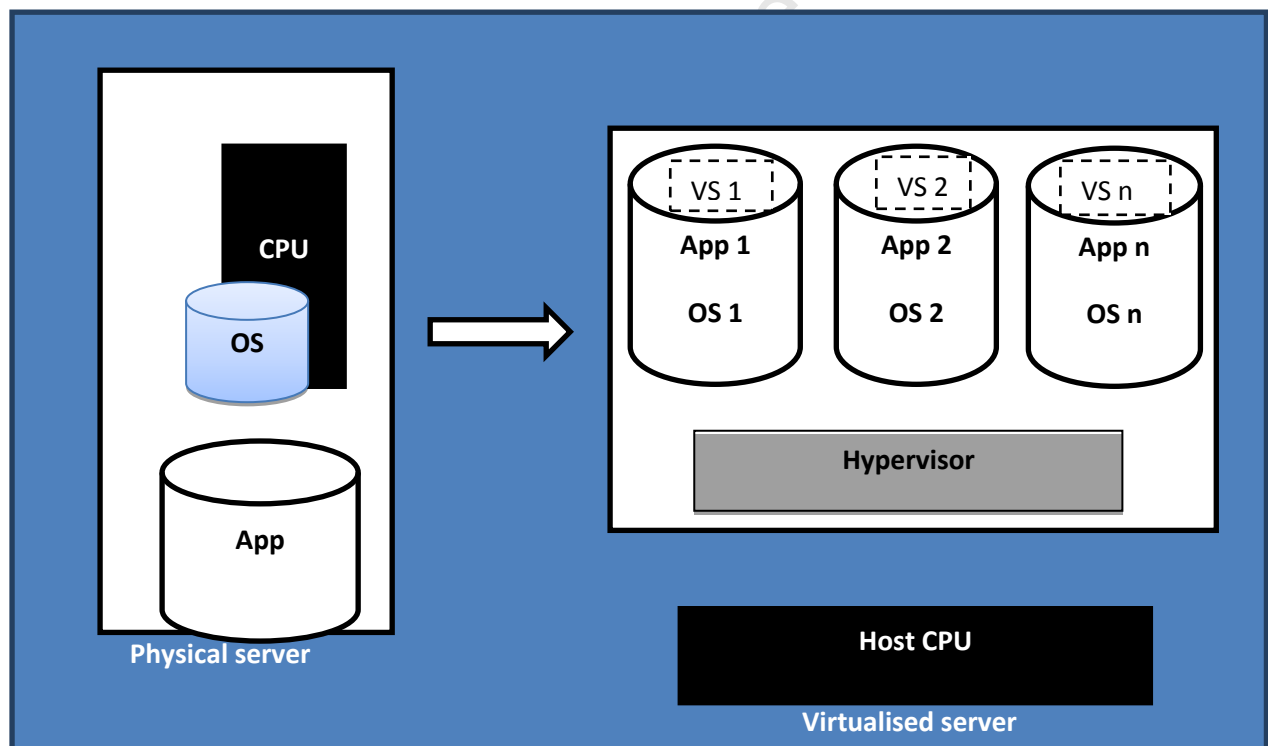


Figure 5: A typical virtualised server environment (HP, 2009)

## **2.5.1 Benefits**

Server virtualisation offers many benefits revolving around cost reduction and improved business productivity. This section discusses the benefits achieved from server virtualisation implementation in organisations.

### ***2.5.1.1 Cost Reductions***

Implementation of server virtualisation in organisations' data centres results in reduced total cost of ownership (TCO), and enhanced return on investment (ROI) (Spears, 2009). In other words, organisations achieve more with fewer resources (Colivet, 2008; Daniels, 2009). In this regard, server virtualisation may be a suitable technology for organisations looking for solutions to help mitigate the current economic recession (El Sawy & Pavlou, 2008; Luftman & Ben-Zvi, 2010a). Table 2 shows representative savings from server virtualisation. The savings range from the cost of data centres, and power demands from servers and other IT infrastructures, through to the cost of cooling.

**Table 2: Savings from server virtualisation implementation (Spears 2009, p. 6)**

The ROI of Virtualization	Before Virtualization	After Virtualization
Data centre size	240 servers	82 servers
Server power draws	240 @ 200W	30 @ 200W, 52 @ 270W
Total power required	48 kW	20.04 kW
Cooling	13.6 tons	5.7 tons
UPS/electrical loss	7.2 kW	3.0 kW
Electrical cost	\$.08 per kW	\$.08 per kW
Yearly electrical cost (IT only)	\$33,638.40	\$14,016.00
Additional costs (UPS/electrical)	\$5,045.76	\$2,102.40
Additional costs (cooling)	\$27,078.91	\$11,282.88
Total yearly electrical spend	\$65,763.07	\$27,401.28
Total savings per year		<b>\$38,361.79</b>
Power cost improvement		<b>58 per cent</b>
Reduction in Cooling		<b>7.9 tons</b>
Reduction in UPS/electrical loss		<b>4.194 kW</b>

### **2.5.1.2 Sustainable Environment**

One of the major foci of the United Nations' (UN) millennium development goals (MDGs) is to achieve a more sustainable environment, as global warming is responsible for climate change (United Nations 2010). Energy consumption in data centres is a contributor to carbon emission which triggers climate change (Francis & Richardson 2008). There is constant power demand for cooling and the running of IT infrastructures in data centres (Rao, et al., 2010). Eighty seven per cent of all carbon-related emissions generated in data centres are due to power consumption (Francis & Richardson, 2008). Server virtualisation helps to reduce energy demands for cooling as a result of consolidating data centres servers (Rao, et al., 2010). In this regard, organisations are able to reduce their carbon footprints by implementing server virtualisation and also enhance the drive for sustainable environment.

### **2.5.1.3 High Availability**

Organisations achieve high availability because virtual machines are quicker to package and deploy, thereby reducing downtime in the event of major failures (Luftman & Ben-Zvi 2010a). Server uptimes and high availability are crucial to organisations' mission-critical servers such as email, CRM, ERP, and databases (Bourne, 2010). In 2007, about \$140 billion was lost globally in productivity due to server downtimes (Brasol, 2009). High availability helps organisations fulfil service level agreements with their customers (SLAs) (Shields, 2008; Uddin & Rahman, 2011).

### **2.5.1.4 Disaster Recovery**

Disaster recovery “identifies critical business processes, services, and systems, and determines action plans for restoring mission-critical services in the event of an outage” (Luftman & Ben-Zvi, 2010b, p. 269). Disaster recovery plans are critical to organisations because huge financial loss may be experienced in the event of downtimes (Wood, Cecchet & Ramakrishnan, 2010). Disaster recovery enhances business continuity (Saleem, et al. 2008). This is why many organisations deploy disaster recovery solutions to mitigate unexpected system failures (Gay 2007; Maitra, Shanker, & Mudholkar, 2011). Because server virtualisation offers the benefit of consolidation of physical servers, it is possible for organisations to design their disaster recovery solution (Gay 2007). Such disaster recovery solutions can be configured to run in both replication and failover mode (Wood, et al., 2010). When a major failure occurs, the system switches from replication mode to failover mode (Saleem, et al. 2008). Thus, consideration for disaster recovery should be made extensively when deploying several virtual servers on physical servers.

### ***2.5.1.5 Floor Space***

Floor space is another major issue confronting organisations due to proliferation of IT infrastructures such as servers (Tomory, 2010). In most cases, server sprawl arises (Luftman & Ben-Zvi 2010a). Server virtualisation helps organisations to consolidate their physical servers into few, thereby freeing up floor space in the data centre (Edison, 2006). Such space can be converted to real estate (Tomory, 2010).

### ***2.5.1.6 Agility***

Server virtualisation increases business agility because virtual machines can be moved quickly and easily within virtual environments (Luftman & Ben-Zvi, 2010a). Agility is one of the strong requisites to fulfil service level agreements in business operations (Uddin & Rahman, 2011).

The benefits of server virtualisation implementation were discussed. In line with the fourth objective of this research stated in section 1.4, the question that partly arises is: What are the benefits of server virtualisation to the South African organisations using the technology?

## **2.5.2 Drawbacks**

This section discusses various drawbacks to server virtualisation implementation in organisations.

### ***2.5.2.1 Management***

Management is one of the major drawbacks to implementation of server virtualisation in organisations (Bigelow, Vancouver, & Posey, 2010; Caudill, 2009). Failure to consider the overall effect of server virtualisation on other IT equipment such as storage, and network in the data centre, can result in unwanted consequences such as management complexity (Brocade 2009). This is because every new technology is associated with a learning curve

(Colivet 2008), and server virtualisation may require considerations of expert skills and IT infrastructure management before its implementation (Colivet 2008; Gay 2007).

#### ***2.5.2.2 Virtual Sprawl***

Server virtualisation's consolidation advantages could tempt enterprises to implement a higher ratio of virtual to physical servers (Brasol 2009). In some situations, organisations are tempted to host more virtual machines on their physical servers, thereby overstressing the workload for the physical servers and overstressing human administrative capacity (Bigelow, et al., 2010). Such situations can result in virtual sprawl – a condition in which there are more virtual servers than an organisation can manage (Bigelow, et al., 2010). In some cases, virtual sprawl can lead to license complexity (Brasol 2009). It is therefore important that organisations assess the workload and capacity of their physical servers before implementing server virtualisation (Gay 2007).

#### ***2.5.2.3 Licensing***

Virtual machines are quicker to design and deploy, and transfer virtual image from one host to another, in the event of major failures (Luftman & Ben-Zvi 2010). However, there is a license implication each time a virtual machine is moved (Bigelow, et al., 2010). It is imperative therefore for organisations to discuss license costs and implications with their potential vendors before implementing server virtualisation (Colivet, 2008).

#### ***2.5.2.4 Security***

Data security policies and data protection maintenance of organisations using server virtualisation is imperative, especially as data centre infrastructures grow (Brocade, 2009). In most cases, organisations fail to review their policies, thereby increasing their risks (Ray & Schultz, 2009). Another issue is the type of hypervisor (virtual machine monitor) being

installed (Bigelow, et al., 2010). There are two types: type 1 hypervisor is installed on top of the hardware of the server, and type 2 is installed on top of the operating system (Bigelow, et al., 2010). Type 2 hypervisor is more vulnerable to malicious attack, even though it has the advantage of better server maintenance (Bigelow, et al., 2010).

Considering the benefits and drawbacks of server virtualisation implementation discussed in subsections 2.5.1, and 2.5.2, this is the question that arises: What are the benefits and drawbacks of server virtualisation to the South African organisations using the technology?

## **2.6 IDENTIFIED GAPS**

Considering the importance of readiness of organisations, it is amazing that national e-readiness is not playing a major role in enhancing organisational readiness to adopt innovations. This study seeks to conduct an empirical investigation into this gap by investigating antecedents for South African organisations' readiness for server virtualisation.

Secondly, so little studies have holistically addressed organisational preparedness to adopt innovation in terms of the people, governance and technology of organisations. This research drawing upon the contribution of Kwon and Zmud (1987), aims to conduct an empirical investigation to know if people, governance and technology contribute to organisational preparedness for server virtualisation in South African organisations.

Thirdly, very few existing studies have looked at the contribution of supporting industries to organisations adopting innovations. Adapting the contributions of Kurnia et al. (2009) and Tornatzky and Fleischer (1990), this study aims to determine if industrial relationship contributes positively to South African organisations' readiness for server virtualisation.

Fourthly, this study will extend existing knowledge on internal resistance within organisations to adoption of innovations especially emerging technologies (such as server virtualisation).

Finally, this study will also extend empirical investigation on the impact of external influence on organisations adopting innovations.

University of Cape Town

## **CHAPTER THREE RESEARCH FRAMEWORK**

This section discusses the research framework. It provides a detailed discussion of the conceptual readiness assessment framework (NOIIE) for organisations in developing countries.

### **3.1 RESEARCH FRAMEWORK DETAILS**

There has yet to be a unifying framework to investigate organisations' readiness for emerging technologies such as server virtualisation. It has been argued that it is challenging to provide a unifying theory to fit adoption of innovations, and that frameworks should be built to fit the context of the innovation being investigated (Molla & Licker, 2005).

This research develops a new conceptual readiness framework (NOIIE), which will be beneficial to undertake studies on emerging technologies in the context of organisations in developing countries (Lucas, Jr., et al., 2007). The proposed conceptual readiness framework (NOIIE) is shown in Figure 6.

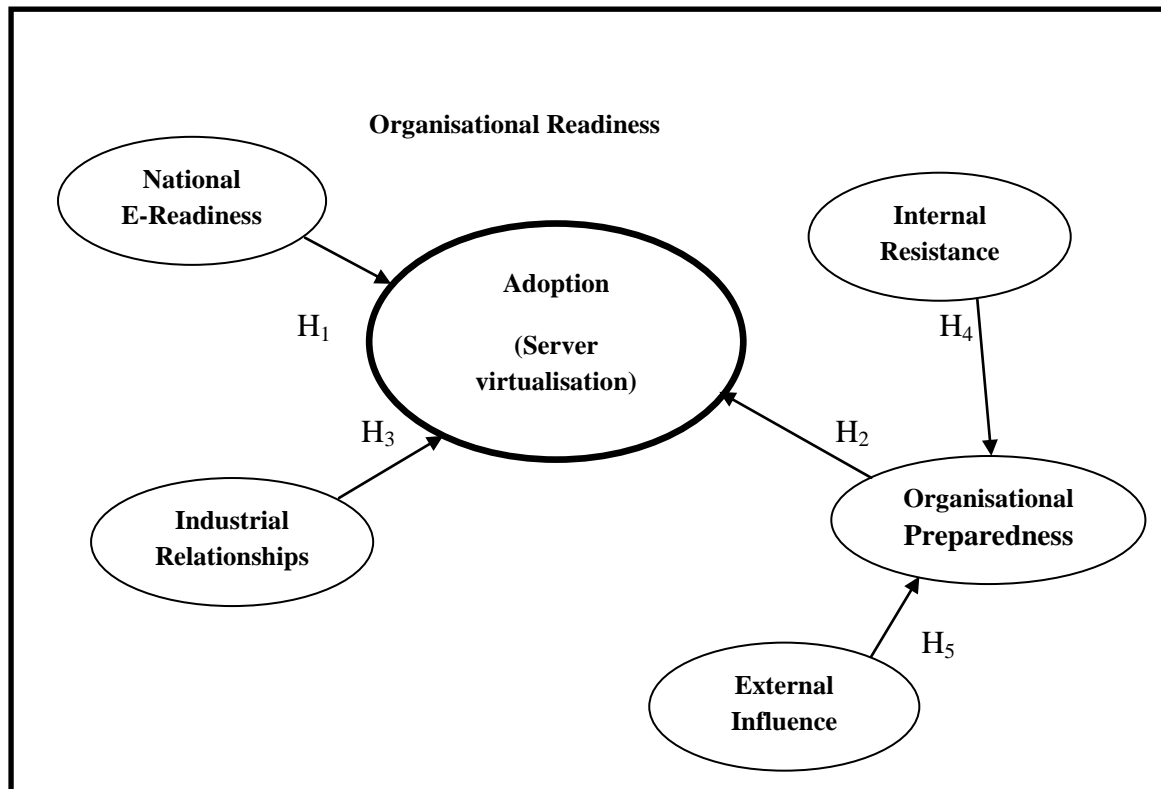


Figure 6: Conceptual NOIE readiness framework

Grounded in the Theory of Diffusion of Innovation and partly the Technology Organisation Environment (TOE) Framework, NOIE was developed from the contributions offered by EIU (2009), Kurnia, et al., (2009), and Molla and Licker (2005). As shown in Figure 6, the overall organisational readiness for server virtualisation is dependent on three variables namely: national e-readiness, industrial relationships, and organisational preparedness. Moreover, two extraneous factors; i.e. internal resistance and external influence, may influence organisational preparedness and affect the overall organisational readiness for emerging technologies (such as server virtualisation) indirectly. Thus, internal resistance within an organisation and, or external influence from peer organisations and business associates may influence organisational preparedness and affect adoption of emerging technologies. The dependent variable is the emerging technology (such as server virtualisation) being adopted, and is measured, based on the potentials the technology offers

(relative advantage or perceived usefulness) and the challenges (complexity or perceived ease of use) associated with the technology. The NOIIE framework was developed on a positivistic stance that reality is governed by objectives, measurable and independent of the researcher (Myers, 2010; Orlikowski & Baroudi, 1991). Table 3 shows the details of the NOIIE readiness variables.

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**Table 3: NOIE readiness variables and categories**

Readiness Variables	Categories	Description	References
National E-Readiness	Internet connectivity	Cost of bandwidth and availability, broadband affordability and internet service provisioning, internet bandwidth, and internet security.	(EIU, 2009; Ifinedo, 2005; Kurnia, Alzougool, Ali, & Alhashmi, 2009; Molla & Licker, 2005)
	Business environment	Attractiveness as a trading country and as a destination for business investment. Country's economy strength, political stability, taxation, competition policy, labour market, and openness to trade and investment.	
	Legal environment	Laws governing internet usage and impact it makes on use of digital technology to inform, communicate and transmit business areas – ease of registering a new business, laws covering the internet.	
	Government policy and vision	Provision of a clear roadmap for the adoption of technology to the citizens and organisations, country's exemplary leadership on use of technologies to create efficiencies.	
	Consumer and business adoption	The success of e-readiness implementation is evident by the citizens and organisations' use of such implementation such as their level of e-business initiatives, internet use, and consumers ICT spending per head.	
Organisational Preparedness	People	Stakeholders' IT skills, application owners, application users, mission critical servers, business vision.	(Info-Tech, 2008; Kurnia, et al., 2009; Kwon & Zmud, 1987 Rogers, 2003)
	Governance	Business and IT policies, disaster recovery (DR) plan, Service level requirements, IT budget, knowledge management, technology awareness, strategic planning and alignment, and change management.	
	Technology	IT infrastructure flexibility, hardware capacity to accommodate new technologies, integration workability, server candidature, capability maturity.	
Industrial Relationships	Product awareness	Vendors' awareness drive for the product	(Kurnia, et al., 2009; Molla & Licker, 2005; Tornatzky & Fleischer, 1990)
	Product availability and reliability	Vendors' willingness to support product despite releases. Products' reliability to perform to expectation	
	Service level supports	Online and offline technical supports, product updates and upgrades, compatibility with other applications.	
	Product license	License agreements, product's non-license vulnerability.	
	Drive for competitiveness	Controlled Risk vs. Calculated Risk, Business growth.	
Internal Resistance	IT staff Application owners Top executives	Resistance to product among internal staff such as IT staff and application owners, mission critical servers, IT staff job security, and other stakeholders such as application users, and top level executives.	(Info-Tech, 2008; Lapointe & Rivard, 2005)
External Influence	Peer organisations Business associates	Competition and alliances from business associates, and external organisation to accept or reject a technology or product.	(Kurnia, et al., 2009; Molla & Licker, 2005; Tornatzky & Fleischer, 1990)

NOIIE is a reflective model as it assesses reflective latent variables, and posits that the overall readiness of an organisation for an emerging technology (such as server virtualisation) depends on such organisation's preparedness which is measured by people, governance, and technology in such an organisation. Organisational readiness also depends on the e-readiness of the environment in which the organisation operates, i.e. national e-readiness, and the relationships between the organisation and its technology supplier, i.e. industrial relationships. As depicted in Figures 1 and 6, two extraneous factors identified as internal resistance, and external influence may influence people, governance, and technology (organisational preparedness) within an organisation. A reflective latent variable is the formation of reflective indicators (effects). Reflective indicators change as the latent variable changes thereby establishing internal consistency (Urbach & Ahlemann, 2010). This implies that NOIIE variables will change as a change is introduced to the reflective indicators measuring such variable (latent).

## **3.2 NOIIE READINESS ASSESSMENT AREAS**

This section discusses the NOIIE e-readiness assessment areas. The purpose is to provide a holistic guide to assessing organisations' e-readiness for emerging technologies such as server virtualisation.

### **3.2.1 National E-Readiness**

Considering the significance of e-readiness assessment and the role ICTs play in narrowing the digital divide between developed and developing countries, national e-readiness is important in order to provide enabling environment for organisations to operate (Ifinedo, 2005; Mutula & van Brakel, 2006b). Government formulates policies, provides ICT infrastructures, enters into collaborations and seeks global partnerships in order to enhance

the lives of its people (Kurnia, et al, 2009). Most e-readiness studies focus on countries in order to determine if ICTs are being used extensively and to enhance drives for effective participation of countries and its members (citizens and organisations) in the global economy (Molla & Licker, 2005; Mutula & van Brakel, 2006b). National e-readiness (perceived supporting services) was found to be significant to organisations' readiness for ICT adoption in a study by Kurnia, et al. (2009). In another study by Molla and Licker (2005), national e-readiness (government e-readiness) was found to be insignificant.

The EIU provides a five-category assessment of e-readiness of countries: internet connectivity, business environment, legal environment, government policy and vision, and consumer and business adoption (EIU, 2009). The EIU e-readiness assessment tool also takes consideration of other stakeholders such as people and organisations' use of ICT in a given country, and has been adapted as the national e-readiness variable of NOIIE.

Grounded in the contributions of EIU (2009) and Kurnia et al. (2009), National E-Readiness is defined as the enabling environment in terms of ICT infrastructures, policies, market, business attractiveness, consumers ICT spending and use, e-business and e-government initiatives, political and economic stabilities, and provision of a clear roadmap for technologies adoption for the citizens and organisations, provided by the country in which an organisation operates. Therefore national e-readiness is hypothesized to contribute significantly and positively to organisational readiness for server virtualisation.

### **3.2.2 Organisational Preparedness**

An organisation's preparedness to adopt a technology in order to achieve competitive advantage is critical to its readiness (Luftman & Kempaiah, 2007). People in such an organisation, such as IT staff may not have appropriate skill to support the implementation

and use of emerging technologies and top-executives' lack of IT skill may affect adoption decision, which may eventually impact such organisations' e-readiness negatively (Info-Tech, 2008). Furthermore, technology users, customers, and application owners may be unwilling to support the adoption and implementation processes of emerging technologies because of complexities and compatibility issues around most emerging technologies (Ashley, 2009).

Governance in organisations revolves around change management, knowledge management, strategic planning and alignment, IT adoption policies, and should be considered in readiness assessments (Maranto-Vargas & Rangel, 2007; Zhang, 2005). Existing IT platform support, platform integration, capacity, and IT infrastructure flexibility for implementing emerging technologies also require consideration (Issa-Salwe, et al., 2010). These three factors (people, governance, and technology) have been investigated for organisational readiness in some notable studies. People and technology were found to be highly significant to organisational readiness (Hourali, et al., 2008; Molla & Licker, 2005), and governance is contextual depending on what innovation is being adopted and organisational policies and culture, as some studies established its significance e.g. (Kurnia, et al., 2009; Tsao, Lin, & Lin, 2004), and some others found governance to be insignificant e.g. (Kaynak, Tatoglu, & Kula, 2005; Molla & Licker, 2005).

Grounded in the Theory of Diffusion of Innovation, and the contributions of Kurnia et al. (2009), Kwon and Zmud (1987) and Molla and Licker (2005), Organisational Preparedness entails individuals (people), governance and IT infrastructure (technology within an organisation and how they interplay to enhance the overall readiness of such an organisation. Therefore, organisational preparedness is also hypothesised to contribute significantly and positively to organisational readiness for server virtualisation.

### **3.2.3 Industrial Relationships**

The role of the technology provider to influence organisations' decision to use such technology cannot be over-emphasised (Molla & Licker, 2005). For instance, awareness is observed to be significant in organisations' readiness to use technologies (Kurnia, et al., 2009; Mutula & van Brakel, 2006b). Availability of technologies and reliability to fulfil intended use are other imperatives (Bajgoric, 2006). Technical support from the technology provider should also be considered (Bajgoric, 2006). Industrial relationship was found as insignificant to organisational readiness due to a number of factors such as lack of awareness of technology and enabling environment (national e-readiness) (Kurnia, et al., 2009; Molla & Licker, 2005). Based partly on the TOE Framework of Tornatzky and Fleischer (1990) and contributions of Kurnia et al. (2009) and Molla and Licker (2005), Industrial Relationship is therefore defined as the mutual and continuous business relationship between a technology provider (vendor) and the user (organisation) in such a way that mutual benefits and cost effectiveness are achieved. Thus, industrial relationship is also hypothesised to contribute significantly and positively to organisational readiness for server virtualisation.

### **3.2.4 Internal Resistance**

It has been observed that the success of adoption of a technology by organisations depends among other things, on the people within such organisations (Kurnia, et al., 2009). People within an organisation may resist the implementation of a technology due to several reasons such as their refusal to buy in to such technology, perceived security risk in using such technology, and perceived job loss, or loss of control due to implementation of such technology (Hourali, et al., 2008; Kwahk & Lee, 2008). Thus, internal resistance is an extraneous factor that may influence an organisation's preparedness to adopt a new or emerging technology.

Based on the contribution of Lapointe and Rivard (2005), Internal Resistance is defined as the opposition to adoption of a technology due to perceived negative impact of innovation on existing IT infrastructure (incompatibility), lack of skill to manage the new technology and lack of IT skill to support adoption decisions which may occur within an organisation. Therefore, internal resistance is hypothesised to influence organisational preparedness for server virtualisation negatively.

### **3.2.5 External Influence**

The influence to accept or reject a technology may come from external organisations or other business associates (Kurnia, et al., 2009; Molla & Licker, 2005). An organisation may be influenced to adopt a technology if other peer organisations are implementing the technology and such an organisation is moved by the need to remain competitive (Kuan & Chau, 2001). Similarly, business associates can exert influence on organisations by recommending or requesting such organisations to adopt certain technologies (Gibbs & Kraemer, 2004). Thus, external influence is another extraneous factor that should be examined for its influence on organisational readiness.

Grounded partly on the TOE Framework and the contribution of Kurnia et al. (2009), External Influence is defined in this context as the pressure exerted on an organisation by peer organisations and business associates to adopt a technology. Therefore, external influence is hypothesised to influence organisational preparedness for server virtualisation positively.

### 3.3 RESEARCH HYPOTHESES

Based on the research objectives and questions, the research hypotheses are:

**H<sub>1</sub>** H1<sub>1</sub>: National E-Readiness contributes significantly and positively to organisational readiness for server virtualisation.

H1<sub>0</sub>: National E-Readiness does not contribute to organisational readiness for server virtualisation.

**H<sub>2</sub>** H2<sub>1</sub>: Organisational Preparedness contributes significantly and positively to organisational readiness for server virtualisation.

H2<sub>0</sub>: Organisational Preparedness does not contribute to organisational readiness for server virtualisation.

**H<sub>3</sub>** H3<sub>1</sub>: Industrial Relationships contribute significantly and positively to organisational readiness for server virtualisation.

H3<sub>0</sub>: Industrial Relationships do not contribute to organisational readiness for server virtualisation.

**H<sub>4</sub>** H4<sub>1</sub>: Internal Resistance influences organisational preparedness for server virtualisation negatively.

H4<sub>0</sub>: Internal Resistance does not influence organisational preparedness for server virtualisation.

**H<sub>5</sub>** H5<sub>1</sub>: External Influence influences organisational preparedness for server virtualisation positively.

H5<sub>0</sub>: External influence does not influence organisational preparedness for server virtualisation.

## **CHAPTER FOUR RESEARCH METHODOLOGY**

This chapter discusses the underlying philosophy of this study. It also discusses the research purpose, time frame, strategy, data type, research population, data collection, data coding and analysis, and finally provides the research hypotheses.

### **4.1 RESEARCH PHILOSOPHY AND APPROACH**

This study was both quantitative and qualitative by method and adopted a positivist stance. Positivist research posits that reality is objective and is measurable and the researcher cannot influence what is being measured (Myers, 2010). By objective it means “that people other than the researcher should agree on what is being observed, such as the score that the observation should register on a measuring instrument” (Welman & Kruger, 2001, p. 7). Though positivist research has been criticised for lack of relevance in “human behavioural sciences” (Kaplan & Duchon, 1988; Welman & Kruger, 2001) yet its emphasis on representative data and validity of observed and measured phenomena cannot be over emphasised (Straub, Boudreau, & Gefen, 2004).

“Valid measures represent the essence or content upon which the entity or construct is focused. They are unitary. They are not easily confused with other constructs. They predict well. If they are supposed to manipulate the experience of subjects, they do so.” (Straub, et al., 2004, p. 381)

A positivist research primarily tests theory in its bid to widen predictive knowledge of phenomena (Orlikowski & Baroudi, 1991). It is also more flexible than other philosophical approaches because it can accommodate the use of more than one method of research, for example it can allow both qualitative and quantitative methods to be used for data collection

and analysis (Myers, 2010). This research proposed a NOIIE readiness framework and tested it; therefore a positivist stance was ideal.

Other paradigms in Information Systems research are: interpretive, and critical (Orlikowski & Baroudi, 1991). Interpretive research is based on “hermeneutics” and “phenomenology” (Klein & Myers, 1999). It posits that reality is a “social construction” governed by “human actors” (Walsham, 2006). These social constructions include “language, consciousness, and shared meanings” (Myers, 2010, p. 2). Critical research posits that social reality is historically arranged and that it is provided and manipulated by people (Myers, 2010).

A research method is the technique for investigating a phenomenon based on the underlying philosophical paradigm which stipulates how such investigation will be carried out and data collected (Myers, 2010). This research seeks to understand contextual factors that enable and or inhibit adoption of innovations in organisations in developing countries, and adopted a qualitative stance to provide a deeper insight. Qualitative research is subjective and seeks to understand how individuals perceive the world (Bell, 2005). Qualitative research uses such strategies as interview, semi-structured questions and observations to gather its data, and its methods include: action research, case study, ethnography, participant observation, and grounded theory (Myers, 2010; Welman & Kruger, 2001). Quantitative research is objective and concerned with the collection of facts and the study of the relationship between two sets of facts in order to produce quantified and generalisable conclusions (Bell, 2005). Experiments and surveys are common strategies in qualitative research (Welman & Kruger, 2001).

## **4.2 RESEARCH PURPOSE**

This study was both explanatory and predictive. Positivist researches try to test “theory” in a bid to widen “the predictive understanding of phenomena” (Myers, 2010, p. 2). Further, explanatory positivist research aims at identifying causative factors in a given phenomenon in order to test the underlying theory thereof (Dube & Pare, 2003). This study aimed to investigate and explain the antecedents of organisational readiness for emerging technologies (such as server virtualisation). The broad purpose was to predict causal relationship between readiness factors and emerging technologies (such as server virtualisation) in the context of developing countries, especially the African countries (Hussey & Hussey, 1997).

The purpose of IS research can take a broad form of exploratory, descriptive, explanatory or predictive. Exploratory research is employed when there are few or no background knowledge about a phenomenon being investigated and seeks to understand “patterns, ideas, or hypotheses, rather than testing or confirming hypothesis” (Hussey & Hussey, 1997, p. 10). Descriptive research describes phenomena as they occur and is used to gather information of a particular phenomenon (Hussey & Hussey, 1997; Welman & Kruger, 2001). Explanatory research is also called analytical research in some school of thought and it seeks to analyse and explain occurrence of phenomena by identifying and “measuring causal relations among them” (Hussey & Hussey, 1997, p. 11). Predictive research seeks to generalise from the analysis of explanatory studies and predicts the possibility of similar contextual occurrence elsewhere (Welman & Kruger, 2001).

## **4.3 RESEARCH TIME FRAME**

This study was cross-sectional in terms of time frame as it sought to obtain information on e-readiness and server virtualisation in different organisations and perhaps different sectors, at

the same time (Hussey & Hussey, 1997). This study is hoped to be concluded in 2010/2011 academic session of the university. A longitudinal study is inappropriate for this study as it can span a long period of time and is usually useful in investigating changes which occur in a given phenomenon over a period of time (Welman & Kruger, 2001)

#### **4.4 RESEARCH STRATEGY**

The strategy of this study was a survey, and the survey instrument was a questionnaire. The questionnaire was constructed based on the information provided in Section 3.2 and detailed in Table 3. The questionnaire was tested for reliability and validity in a pilot survey of 10 individuals who are very familiar with server virtualisation. A survey is objective and follows the positivist paradigm and was the best strategy for this study as it attempts to draw a sample from its population and study it in order “to make inferences about the population” (Hussey & Hussey, 1997, p. 63). Analytical survey, other than descriptive survey, uses a theoretical framework to “identify the independent, dependent and extraneous variables” (Hussey & Hussey, 1997) in a given phenomenon. The research questionnaire contains two open-ended questions which sought to identify factors that enable or inhibit server virtualisation implementation in developing countries' organisations. It also sought to identify benefits and drawbacks of server virtualisation. The purpose was to confirm existing literature on these items and possibly identify emerging concerns.

#### **4.5 DATA TYPE**

Based on the paradigm of this study, the type of data collected and analysed were largely quantitative in nature. Measurement is the basis of positivist research and this study strove to ensure accurate measurements were taken (Hussey & Hussey, 1997). Furthermore, two open-ended questions were asked and analysed qualitatively.

#### 4.5.1 Questionnaire Design

An online survey using questionnaire was the primary source of data for this study. An online survey was chosen based on the approach used in other similar readiness studies such as Kurnia et al. (2009) and Molla and Licker (2005). Questions on national e-readiness were drawn based on the EIU's (2009) e-readiness assessment framework. Questions on server virtualisation were drawn based on the discussions provided in Section 2.5. Questions on Organisational Preparedness were drawn based on Section 2.2.2. Similarly, questions on Industrial Relationships were drawn based on Section 2.2.3; Internal Resistance, based on Section 2.2.4; and External Influence, based on Section 2.2.5.

The questions were drawn on a 7-point Likert scale and were chosen after a considerable factor analysis for grouping of questions (Bell, 2005; Hussey & Hussey, 1997). A 7-point Likert scale unlike 5-point, allows respondents to have a broad range of options to choose from, ensures responses are not unnecessarily skewed, and allows for rigorous analysis (Hussey & Hussey, 1997). The research questionnaire is provided in Appendix B. Table 4 shows a summary of the data source.

**Table 4: Data source by requirements**

<b>Readiness areas (NOIIE)</b>	<b>Data requirement</b>	<b>Research hypotheses being addressed</b>	<b>Section of the questionnaire and question numbers</b>
<b>National E-Readiness (N)</b>	Internet Connectivity	H <sub>1</sub>	Section C, Items 1-3
	Business Environment	H <sub>1</sub>	Section C, Items 4, 6-8
	Legal Environment	H <sub>1</sub>	Section C, Item 10
	Government Policy & Vision	H <sub>1</sub>	Section C, Items 5, 9, 11
	Consumer & Business Adoption	H <sub>1</sub>	Section C, Items 12-16
<b>Organisational Preparedness (O)</b>	People	H <sub>2</sub>	Section B, Questions 22-23, 28
	Governance	H <sub>2</sub>	Section B, Questions 11, 24-27, 29
	Technology	H <sub>2</sub>	Section B, Questions 18-21
<b>Industrial Relationships (I)</b>	Product Awareness	H <sub>3</sub>	Section B, Questions 30
	Availability & Reliability	H <sub>3</sub>	Section B, Questions 31-32
	Service Level Support	H <sub>3</sub>	Section B, Questions 33-34
	Product License	H <sub>3</sub>	Section B, Questions 35
	Drive for Competitiveness	H <sub>3</sub>	Section B, Questions 36-37
<b>Internal Resistance (I)</b>	Internal Resistance	H <sub>4</sub>	Section B, Questions 38-41
<b>External Influence (E)</b>	External Influence	H <sub>5</sub>	Section B, Questions 42-43
<b>Others</b>	Server virtualisation implementation overview, Demographic Data analysis, enablers, and inhibitors, and benefits, and drawbacks of server virtualisation		Section A, Section, Section D Questions 1-7, Questions 8-9

## 4.6 RESEARCH POPULATION

The context of this study was South Africa, and the data sample comprised of small to large-sized organisations located across major cities in South Africa, and majorly in Cape Town, Durban, and Johannesburg. Selections were drawn from a snowball sampling where respondents were selected based on their relevant knowledge of the phenomena being investigated (Hussey & Hussey, 1997). Based on this background, organisations in sectors such as information technology, banking and finance, retail, telecommunication, manufacturing, government service, oil and gas/energy, internet services, and software

development formed the sample of this study. The target respondents were the IT executives in South African organisations.

#### **4.7 DATA COLLECTION**

The final questionnaire was made available online between 10<sup>th</sup> November, 2010 and 30<sup>th</sup> April, 2011, after the initial pilot survey was conducted. A total of 1500 invites were sent out to various individuals and organisations. Furthermore, 25 copies of the paper version of the questionnaire were administered simultaneously at a research colloquium organised by the CIO Forum, Cape Town chapter, in order to provision for adequate response rate. Poor response rate has been a major limitation to quantitative survey studies (Cycyota & Harrison, 2006). The researcher also sent out invites to chambers of commerce in Durban, Johannesburg, Free State, Pretoria, and Port Elizabeth, in order to ensure that the responses are representative enough. Finally, personal networking in form of sending out invites to targeted respondents was also utilised.

A total of 124 organisations responded to the invites out of the 1525 organisations that received the invite, accounting for an 8% response rate. Eighty three responses were useful and 41 incomplete questionnaires were dropped either because blank responses in a questionnaire were more than 25% of the entire questionnaire, or an unqualified person took the survey. Several emails were received from organisations which did not participate.

#### **4.8 DATA CODING AND ANALYSIS**

Responses from all the respondents were transferred to Microsoft Excel spread sheets and coded as 1 for Strongly Disagree, 2 for Disagree, 3 for Disagree somewhat, 4 for neutral, 5 for Agree somewhat, 6 for Agree, and 7 for Strongly Agree. Questions 18, 19, 27, 35, 42, and 43, in Section B were negatively phrased and were reversed in order to ensure that coding

was uniform (Cavana, Delahaye, & Sekaran, 2001). The reason for the negatively phrased questions was to engage the respondents' thinking and to ensure that their responses were not skewed (Cavana, et al., 2001). Questions 38, 39, 40, and 41 (other negatively-constructed questions) were however not reversed because they were questions seeking to determine the influence of internal resistance to server virtualisation technology on organisational readiness.

From the literature, it appears that internal resistance always leads to technology rejection, and questions 38, 39, 40, and 41 were constructed as such. Questions 42 and 43 were reversed since the questions suggest that external organisations or business associates influence organisations to reject a technology. Again, from the literature, external influence may trigger acceptance or rejection of a technology; therefore questions 42 and 43 were reversed. Where less than 25% of a questionnaire was returned blank, the blank responses were coded as 4. Forty-seven incomplete responses were received and only six incomplete responses were less than 25% of the entire questionnaire, used and formed part of the 83 valid responses.

Because of the limitations of first-generation techniques, this study used structural equation modelling (SEM) to analyse the data collected using WarpPLS 2.0 software. SEM is used to test the underlying assumptions in a given theoretical framework with empirical data with a view to accepting or rejecting the theory thereof (Haenlein & Kaplan, 2004). Since this study developed and proposed a NOIE readiness framework which the study also sought to validate, SEM made a good tool to achieve this purpose in order to establish a rigorous evaluation of the fit between the factors in the NOIE model and the data sample being used.

This study used the bootstrapping technique resampling method, and the Warp3 PLS regression analysis algorithm in partial least squares (PLS) to test the significance of

relationships between the dependent variable (server virtualisation) and the independent variables, i.e. e-readiness areas (predictors), and organisational readiness (also a dependent variable), and two influencing factors (internal resistance, and external influence), as stated in the research hypotheses (section 3.9).

PLS is a “second-generation multivariate analysis technique that is well suited for complex predictive models” (Eikebrokk & Olsen, 2007, p. 370) and is very relevant in analysing this study’s theoretical model. Further, PLS fosters on the research theoretical framework’s ability to predict, other than mere explanation of “the variability of the dependent variable, making it most useful in situations where the theory is still being developed” (Chin, 1998; cited in Eikebrokk & Olsen, 2007, p. 370).

To test the convergent and discriminant validity of this study instrument, the study used the WarpPLS 2.0 analysis tool. WarpPLS 2.0 (variance-based SEM) is an appropriate tool to establish a rigorous evaluation of the fit between theoretical factor analysis and the data collected. Furthermore, variance-based SEM produces “robust results even in the presence of small samples and multivariate deviations from normality” as it uses “robust statistics” to establish the confidence level of path relationships between latent variables (Kock, 2011, p. 2).

To test the research hypotheses, the beta coefficients, the p values and the effect sizes between the dependent variables and each independent variable (predictor) were examined. The null hypothesis was rejected if the resultant p value was less than or equal to 0.05. Beta coefficients help to determine more importantly if there is a positive or negative path relationship between an independent variable and a dependent variable (Urbach & Ahlemann, 2010). Effect size helps to determine how much influence an independent variable has on a

dependent variable it is predicting (Cohen, 1988). Table 3 shows the organisation of the questions.

#### **4.8.1 Analysis of Open-ended Questions**

Questions 8 and 9 in Section D of this study questionnaire were two open-ended questions seeking to identify factors that constitute as enablers and inhibitors to the implementation of the technology in developing countries' organisations, and benefits, and drawbacks of server virtualisation implementation. These questions were analysed using the Thomas (2006) general inductive approach for qualitative data analysis to group themes into categories. Furthermore, the contribution of Kwon and Zmud (1987) was used to understand and group factors that affect adoption of server virtualisation in South African organisations into different sub-categories. Finally, Rogers' (2003) diffusion of innovations (DOI) theory was used to analyse and discuss these factors. This study was however, limited to the adoption process of the innovation processes.

### **4.9 ETHICS**

This study provided for anonymity. All respondents were anonymous as personal identities such as respondents' names, age, sex, ethnic background or organisation's name were not requested.

The research instrument was approved by UCT ethics committee. The instrument was accompanied with a cover letter bearing the identities of the researcher, research supervisor, and their school affiliations. The purposes of the cover letter were to enable respondents have the authority to take the survey, make further enquiries and request for a feedback of the research findings.

The cover letter also provided a guarantee of confidentiality and as such no psychological or legal risk was anticipated. Finally, invitations were sent to participating organisations through UCT email facility, and the survey was conducted online on a web facility that was designed for academic use. A pre-survey screening through a process of email verification was conducted by the site hosting the survey, in order to confirm that the survey was for an academic research purpose.

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## CHAPTER FIVE ANALYSIS

This study developed a conceptual readiness assessment model (NOIIE) for investigating the readiness of organisations in developing countries for emerging technologies, and attempted to validate the model by investigating the antecedents for the readiness of 83 South African organisations that said they were using server virtualisation (an emerging technology).

This chapter provides the analysis of the data collected from the research survey. One hundred and twenty-four organisations of all sizes participated in the survey. After some data cleaning and editing, 83 organisations that used server virtualisation were suitable for testing the research framework, and the research hypotheses; however, 41 organisations were not suitable for testing the research framework. Some emails from non-participating organisations were used to provide some useful insights into the research.

Section 5.1 discusses the analysis of the demographic data. The purpose is to have a broad overview of the organisations that participated fully, as well as those who did not participate in the survey. This is to provide insights into the responding organisations, and checks with the literature.

Section 5.2 analyses the research framework assessments by testing the measurement and the structural parts of the research model (NOIIE). The purpose is to determine both the measurement and the structural validities of the framework. The outcome of these tests helps to determine the suitability and usability of the framework (NOIIE) to investigate the readiness of organisations for emerging technologies, and identify areas where the NOIIE framework could be developed further.

Section 5.3 analyses the hypotheses, and discusses both the theoretical and practical implications of the results. The purpose is to determine if the data collected confirms or rejects the theoretical assumptions in the research hypotheses.

Section 5.4 discusses the analysis of the qualitative part of the research. Two open-ended questions seeking to identify the enablers and inhibitors of the adoption of emerging technologies (such as server virtualisation) in organisations in developing countries, and the benefits and drawbacks of server virtualisation in South African organisations, were analysed. The purposes are to understand if the contributions of Rogers (2003) are suitable for understanding the adoption of emerging technologies (such as server virtualisation) in organisations in developing countries. Secondly, to know whether the contributions of Kwon and Zmud (1987) are relevant to understanding the factors that constitute both enablers and inhibitors of, and benefits and drawbacks to, the adoption of server virtualisation in organisations in developing countries.

Section 5.5 discusses the overall results of the study and set out their implications both to the body of knowledge, and to practice. The purpose is to provide insights into areas of further research, and to offer guidelines to practitioners.

## **5.1 DEMOGRAPHIC ANALYSIS**

This section discusses the demographic analysis of the survey. One hundred and twenty four responses to the survey invitations were analysed to obtain an in-depth understanding of server virtualisation adoption in South African organisations.

### **5.1.1 Virtualisation Software under Implementation**

The result of the research revealed that diverse virtualisation software is being implemented in South African organisations. Fifty nine percent of the 83 respondents, who had adopted

and implemented server virtualisation, implemented VMware software. A further 25% implemented Microsoft Virtual Server. The full results are shown in Figure 7.

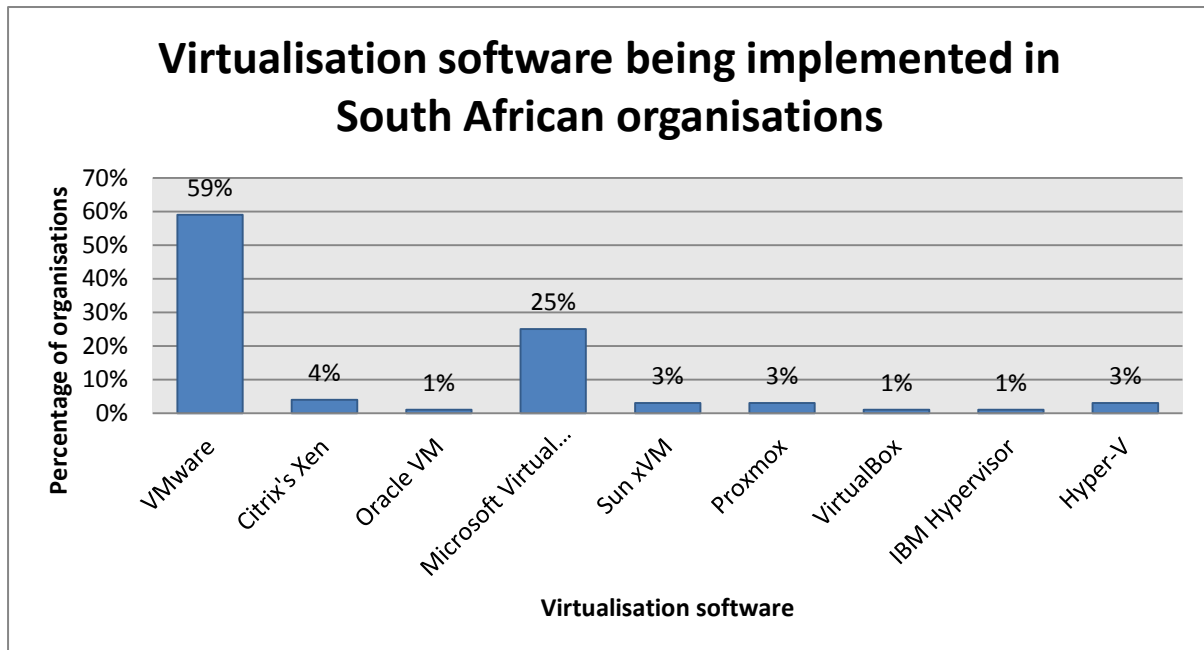


Figure 7: Virtualisation software being implemented in South African organisations

Forty-one organisations that did not complete the survey appear not to be adopting server virtualisation as only 11% each, of these organisations had implemented VMware and Microsoft Virtual Server respectively.

Organisations who did not participate in the survey are not likely adopting server virtualisation. One of these organisations emailed:

*“Our business is too small to give meaningful input in your survey. We have a single server, situated in the country area with no high-speed broadband and do not contemplate any changes”*

Non-profit organisations may not likely be implementing server virtualisation as one of these organisations also reported:

*“I work for an NGO and while server virtualization is very interesting, cutting edge, etc. We are an organization that relies heavily on distributed systems and not so much on servers as more commercial companies would (we're not a 'for profit' company)... our IT requirements are different to that of private business”.*

### **5.1.2 Organisations by Economic Sector**

The results in Figure 8 reveal widespread use of server virtualisation in major economic sectors of South Africa. The analysis provided here helped to understand which sectors server virtualisation adoption is tailored to? It is interesting to see that server virtualisation is also beneficial to such sectors as the government, (and) education and research. This finding suggests that server virtualisation implementation may not only be suitable for cost reduction benefits, but also to ensure a higher utilisation of computer resources, which may be the major interest of non-business organisations (Gay, 2007). Virtualisation helps to reduce number of physical computers, and increase the workloads on physical computers; non-business organisations, such as education and research may use server virtualisation in a test environment for training and research purposes (Ogunyemi & Johnston, 2010). Government organisations may use server virtualisation to reduce their carbon footprints (Molla, et al., 2008). However, an analysis of the organisations that did not complete the survey revealed that these organisations similarly belong to such sectors as IT, Manufacturing, Government and Non-Governmental Organisations. Surprisingly, organisations in the Construction sector appear not to be using server virtualisation.

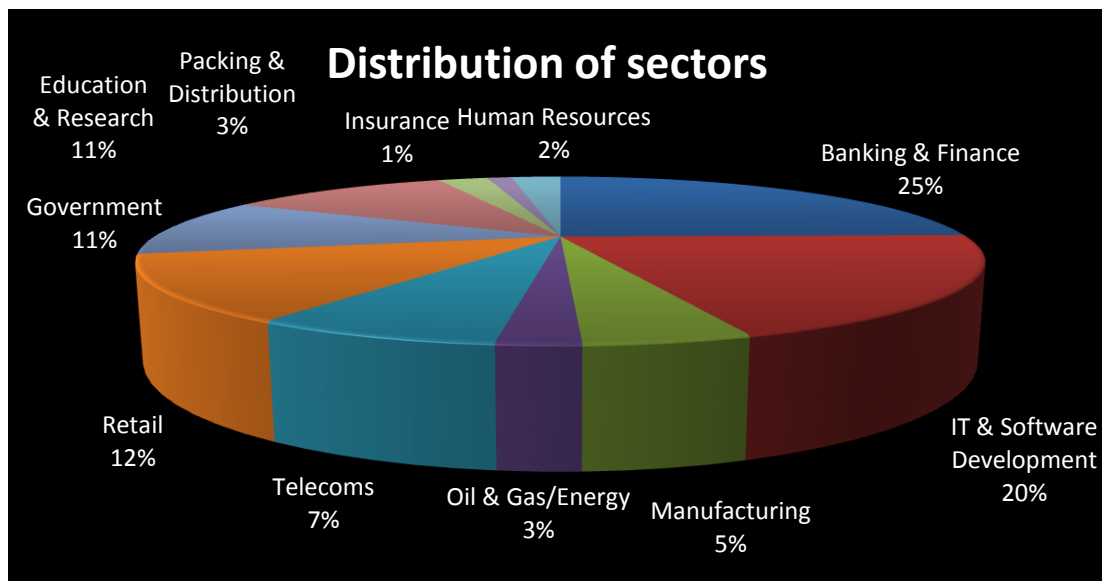


Figure 8: Organisations and their economic sectors

### 5.1.3 Locations of Organisations

Invitations were emailed to organisations and chambers of commerce in major cities of South Africa such as Johannesburg, Durban, Pretoria, Bloemfontein, and Port Elizabeth. The majority of the 83 respondents who use server virtualisation were from the Western Cape Province (84%), 10% from Gauteng, 5% from KwaZulu-Natal, and 1% from Mpumalanga. An analysis of the organisations that did not complete the survey produced similar results. Seventy eight per cent were located in the Western Cape Province and 11% each were located in Gauteng and KwaZulu-Natal respectively.

This research strove to ensure that invitations were distributed evenly across the country/throughout organisations of different sizes. Furthermore, reminders were repeatedly sent to respondents. The invitations sent to the chambers of commerce did not yield any contribution. One of the chambers of commerce emailed thus:

*“Thank you for your email. Unfortunately it is our policy not to forward such requests to our members”.*

#### 5.1.4 Number of Employees

Figure 9 reveals that 61% of the 83 organisations using server virtualisation were large organisations, 22% medium, and 17% small. The South African small business amendment act categorises organisations with more than two hundred employees as large, between fifty-one and two hundred as medium, and from one through to fifty employees as small (South Africa, 2003).

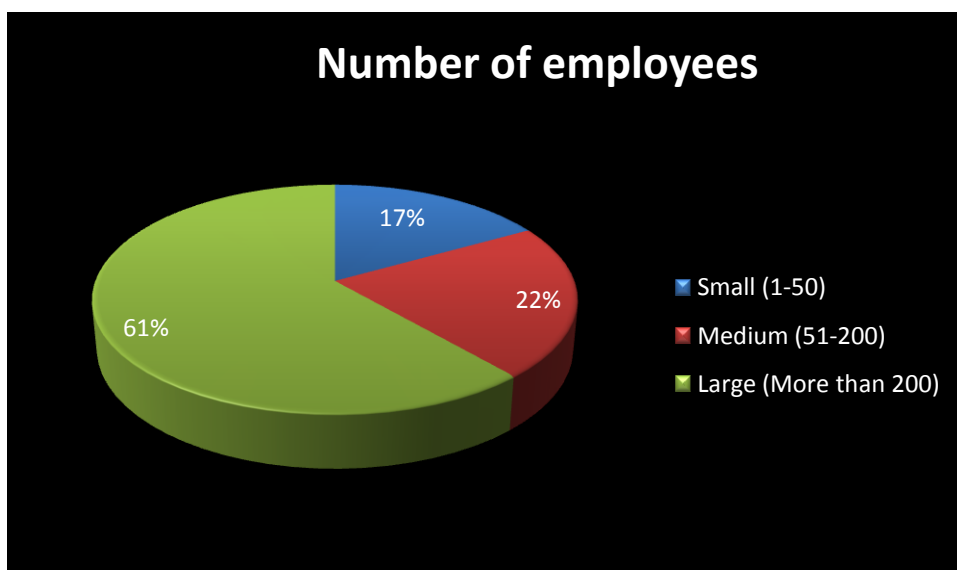


Figure 9: Organisations' size by number of employees

Small organisations in South Africa are likely not implementing server virtualisation as only 17% of the 83 organisations using server virtualisation are small organisations. During the survey, several e-mails were received from small organisations, indicating their lack of suitability to take this survey as a result of their size (such as number of employees). Furthermore, these small organisations claimed not to be using server computers in their business operations. Two of this set of organisation emailed thus:

*“As we are a very small company and does not use file servers as such, I am unable to assist you with your survey”*

*"I am afraid we are not in a position to participate in this survey at this time".*

From an analysis of organisations that did not complete the survey, 80% were small organisations and 10% each were medium and large organisations respectively. These results were consistent with the analysis of the 83 organisations using server virtualisation as it appears that small organisations are not adopting server virtualisation. Large organisations appear to have a better disposition to server virtualisation as 61% of these organisations have adopted server virtualisation.

### 5.1.5 Number of Server Computers in Organisations

A larger per cent of the large organisations of the 83 using server virtualisation still use physical servers extensively as can be seen in Figure 10.

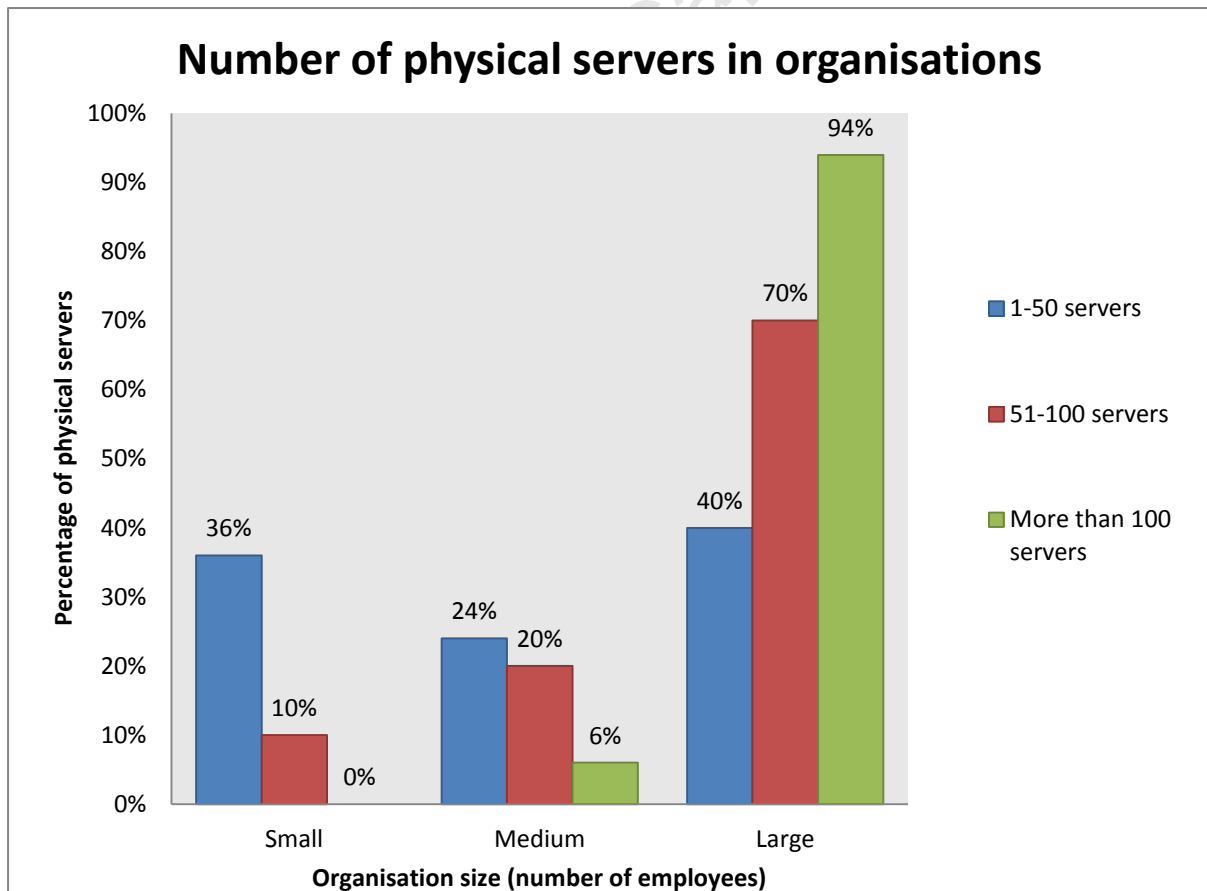


Figure 10: Distribution of server computers

Ninety-four percent of the large organisations indicated that they have more than 100 physical servers. A study by Molla, et al. (2008) revealed that most organisations that use physical servers extensively are still far from being green-ready. This finding suggests that the large organisations surveyed may not be green-ready despite using server virtualisation. Other reason for large organisations' extensive use of physical servers may be that these organisations have mission-critical servers which they may deem unsuitable for server virtualisation (Uddin & Rahman, 2011). Thirdly, these large organisations may possess inadequate knowledge of the potentials of server virtualisation, or have experienced implementation failure, which are usually associated with emerging technologies such as server virtualisation (Colivet, 2008). Twenty four per cent of the medium-sized organisations indicated that they have between one and fifty servers. In comparison to the large organisations, the medium-sized organisations using server virtualisation appear to be reducing the number of physical servers used, and this suggests that these organisations may be benefitting from the consolidation benefit of server virtualisation (Luftman & Ben-Zvi, 2010a). Only 6% of medium-sized organisations out of the 83 organisations using server virtualisation have more than 100 physical servers. Not too surprisingly, 36% of the small organisations out of the 83 organisations using server virtualisation, claimed to be using between one and fifty physical servers in their environments. Small organisations are said to often have difficulty in adapting to technological changes, are conservative, and do not want to take risk (Hausman, 2005; Premkumar, 2003). An innovation such as server virtualisation is associated with perceived risk, and this may explain why the 36% of the small organisations still use physical servers extensively (Hausman, 2005).

### 5.1.6 IT Budget Allocations

Analysis of a company's annual budget which goes to IT at the 83 organisations who indicated that they are using server virtualisation is presented in Figure 11. It is interesting to see that large organisations appear to be conservative in IT allocation, as 76% of these organisations allocate 1-5% of their annual budget to IT. Large organisations are said to have a traditional attitude of seeking cost reduction(s) incentives during economic recessions (Latham, 2009). In a study by Luftman and Ben-Zvi (2010a), IT executives indicated that their IT budgets were reduced in contrast to their allocations before the economic downturn began. One of the reasons why organisations adopt server virtualisation is to reduce the cost of maintenance, and TCO (Daniels, 2009). One major effect of the current economic downturn is that most organisations are not only reducing their IT budgets, but are also reducing corporate costs (Luftman & Ben-Zvi; 2010a), and these large South African organisations may be no exception.

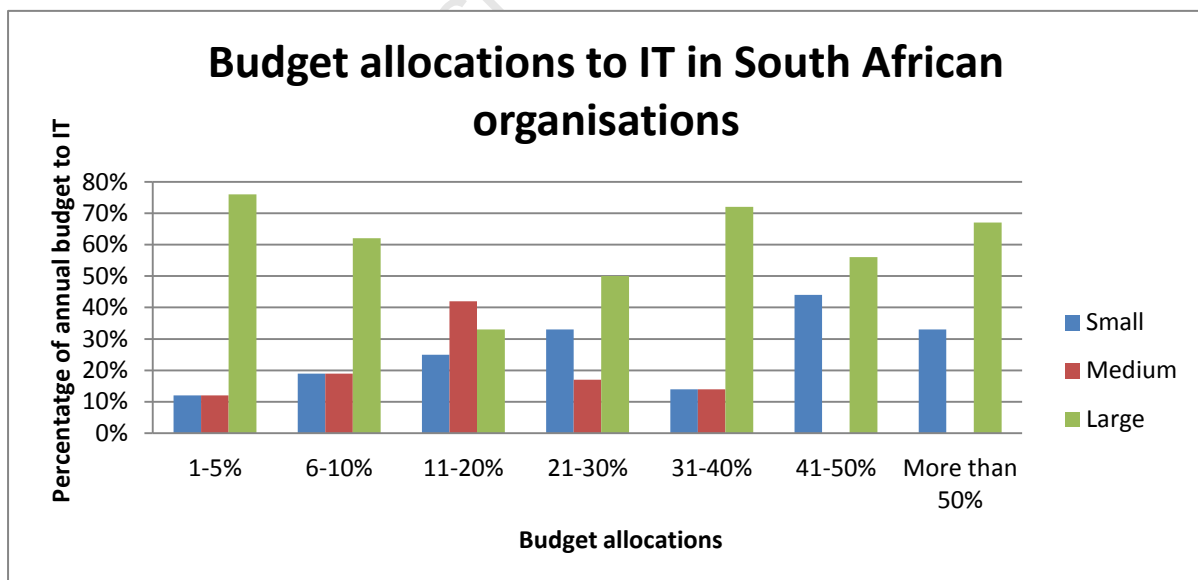
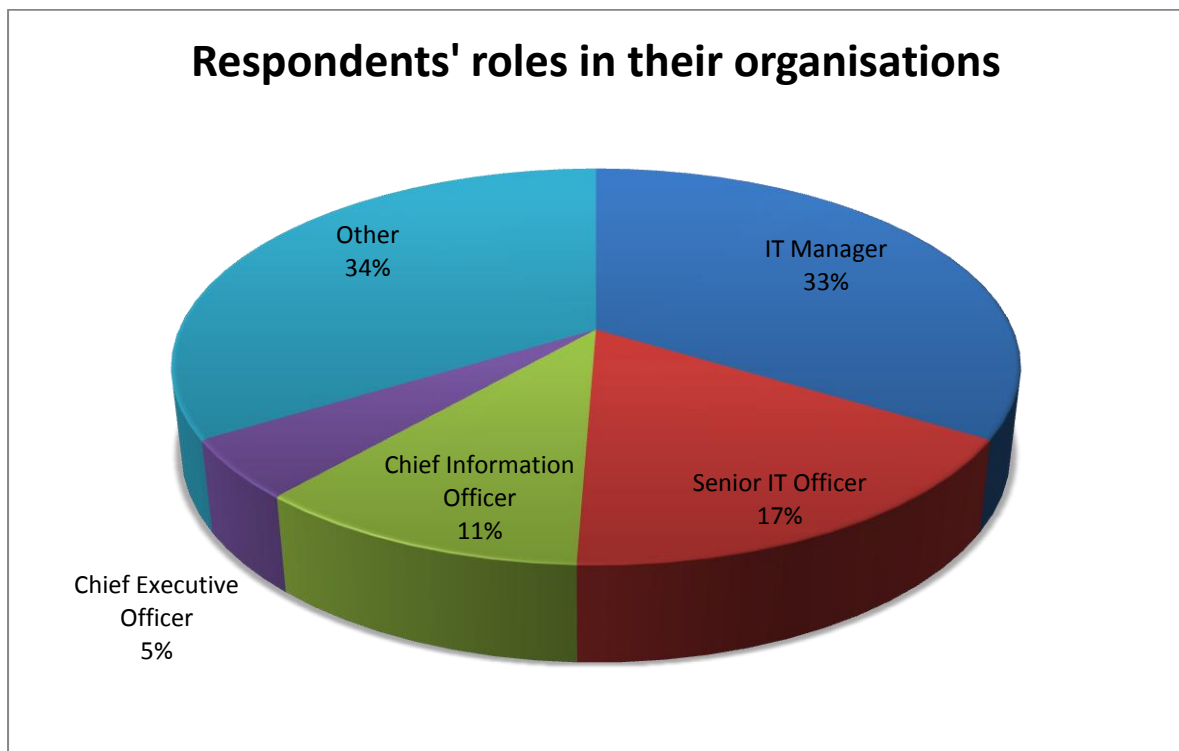


Figure 11: IT budget allocations by South African organisations

Interestingly too, small organisations appear to be allocating a larger percent of their annual budget to IT, as 44% of these organisations allocate 41-50% of their annual budget to IT, and 33% allocate more than 50%. Small organisations have been said to be much interested in “strategic investments” during recessions rather than reducing costs (Latham, 2009), and this may explain why these small organisations allocate more to the IT budget. Medium-sized organisations tend to be more conservative as only 42% allocate 11-20% of their total annual budget to IT.

### **5.1.7 Roles of Respondents**

Figure 12 shows how the positions held by respondents in their organisations are distributed. Thirty three per cent of the 83 respondents from the organisations using server virtualisation, were IT Managers, 17% Senior IT Officers, 11% Chief Information Officers. Thirty four per cent (the others) were comprised of Software Test Analysts, IT Architects, Installation and Support Engineers, and Systems Engineers. These roles are relevant to the understanding of server virtualisation adoption in these organisations. For example, the IT Architects were from the large organisations.



**Figure 12: Respondents' roles**

Interestingly, 56% of respondents that did not complete the survey were CEOs, 22% were IT Managers, and 11% each were Network Administrators and Software Analysts. Interestingly too, all the CEOs, IT Managers and Software Analysts were from small organisations. Only the Network Administrators were from large organisations.

#### **5.1.8 Server Virtualisation Implementation Status**

Fifty-one per cent of the 83 organisations using server virtualisation have implemented extensively. The full results are shown in Figure 13.

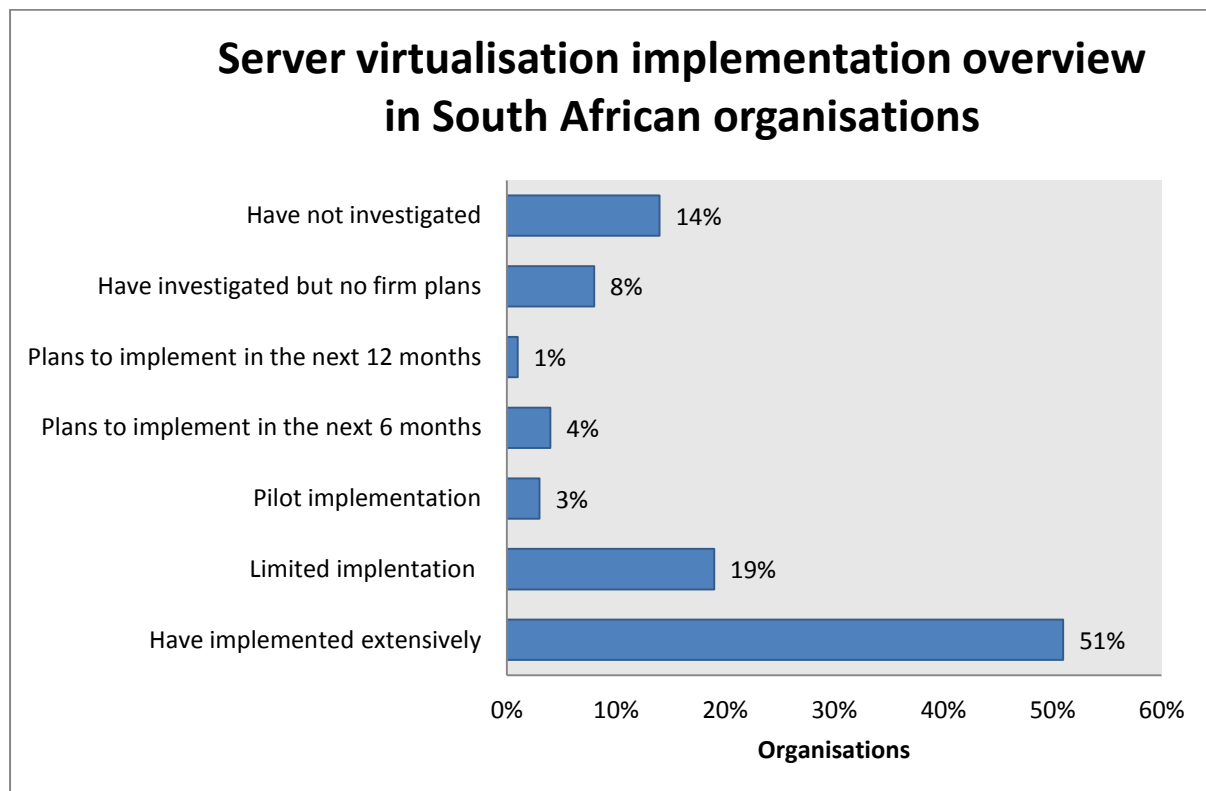


Figure 13: Overview of server virtualisation implementation in South African organisations

Adoption of an innovation increases when future adopters can see (observability) the benefits. In relation to the results in Figure 13, it appears that server virtualisation adoption is likely to increase in South African organisations, as 19% have made limited implementation, and 5% are likely to implement within 12 months from the time they were surveyed.

## 5.2 RESEARCH FRAMEWORK TEST

This section provides the analysis of the tests and validation of the research framework (NOIIE). The descriptive statistics are shown in Table 5. Forty two out of the 59 indicators of the research instrument met the convergent validity criteria and were chosen for analysis of the NOIIE framework and for testing the hypotheses. Furthermore, the 83 responses from the organisations using server virtualisation formed the sample size.

<b>Table 5: Descriptive statistics</b>			
LATENT VARIABLES	INDICATORS		
		Mean	Std. Deviation
SERVER VIRTUALISATION	SV 1	5.94	.874
	SV 2	5.82	1.084
	SV 3	5.64	1.143
	SV 4	5.46	1.451
	SV 5	5.81	1.184
	SV 6	5.93	.947
	SV 7	5.90	1.165
	SV 8	5.73	1.344
	SV 9	5.65	1.029
	SV 10	5.58	1.037
	SV 11	5.14	1.106
	SV 12	5.22	1.148
NATIONAL E-READINESS	NER 1	2.78	1.631
	NER 2	2.14	1.415
	NER 3	2.94	1.484
	NER 4	3.58	1.531
	NER 5	3.60	1.388
	NER 6	2.95	1.545
	NER 7	3.12	1.477
	NER 8	3.29	1.502
	NER 9	3.75	1.395
	NER 10	3.52	1.434
	NER 11	3.63	1.479
	NER 12	3.48	1.603
	NER 13	3.12	1.477
	NER 14	3.80	1.512
	NER 15	3.36	1.330
	NER 16	3.05	1.489
ORGANISATIONAL PREPAREDNESS	OR 2	5.14	1.515
	OR 3	5.28	1.417
	OR 6	5.49	1.417
	OR 11	4.63	1.737
INDUSTRIAL RELATIONSHIPS	IRL 1	5.57	1.026
	IRL 2	5.83	.881
	IRL 3	5.53	.888
	IRL 4	5.39	.935
	IRL 5	5.61	.908
INTERNAL RESISTANCE	IRS 1	4.31	1.667
	IRS 2	3.88	1.580
	IRS 3	4.10	1.605
EXTERNAL INFLUENCE	EIF 1	3.81	1.410
	EIF 2	4.72	1.564

Table 5 shows the mean and the standard deviation scores of the research instrument. The result reveals that the indicators were close to the mean, and suggests that the indicators were not widely spread from the latent variables they were measuring.

Similarly, an assessment in the WarpPLS software, of the variance inflation factor was made in order to check for multicollinearity or redundancy among the latent variables that were postulated to influence another latent variable, and the results are as shown in Table 6.

<b>Dependent variables</b>	<b>Independent variables</b>				
	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External influence
Server Virtualisation	1.125	1.118	1.089		
Organisational Preparedness				1.125	1.125

Multicollinearity is a measure of the correlation between the predictors of a variable (Kock, 2011). In other words, the latent variables (at least two) that predict another latent variable are highly correlated (close to being the same). The results presented in Table 6 indicate that the indicators on each independent variable were not multicollinear as they were not measuring the same thing on the different constructs against their respective dependent variable. A value that is lower than 5 is generally acceptable to determine multicollinearity among latent variables (Hair, Anderson, & Tatham, 1987).

PLS-based SEM embodies two sets of linear equations: measurement model and structural model in order to produce a “complete structural equation model” (Urbach & Ahlemann, 2010). The measurement model (outer model) determines whether a latent variable explains what was actually observed, while the structural model (inner model) determines whether the latent variables (unobserved) have significant relationships (Henseler, Ringle, & Sinkovics, 2009). The next section discusses the assessment of the measurement model of the NOIIE framework.

### **5.2.1 Measurement Model Assessment**

The research instrument was tested for reliability, convergent validity, and discriminant validity. The 3 tests have been widely used in major IS research in order to ensure that a

research instrument is dependable and consistent (Henseler, et al., 2009; Urbach & Ahlemann, 2010).

### 5.2.1.1 Reliability Test

Table 7 shows the results of the NOIIE construct reliability test. WarpPLS 2.0 was used to test the reliability of the research instrument in order to establish internal consistency of the research questionnaire. A reliability test helps to ensure that measures are free from error and therefore yield consistent results (Fornell & Larcker, 1981). Two measures, namely; Cronbach's alpha and composite reliability are widely used to determine item reliability. However, Cronbach's alpha is weak for its underestimation of internal consistency reliability of latent variables in PLS-based SEM, as it assumes that all indicators have equal reliability (Urbach & Ahlemann, 2010). Composite reliability on the other hand, takes the Cronbach's alpha deficiency into consideration by treating indicators as having different loadings, and is recommended (Henseler, et al., 2009). A measurement instrument has good reliability if either the composite reliability or Cronbach alpha coefficient is equal to or greater than 0.7 (Fornell & Larcker, 1981; Urbach & Ahlemann, 2010).

<b>Table 7: Results of construct reliability assessment</b>					
<b>R-squared coefficient</b>					
Server virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
<b>0.45</b>		<b>0.12</b>			
<b>Composite reliability coefficients</b>					
Server virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
<b>0.915</b>	<b>0.932</b>	<b>0.860</b>	<b>0.875</b>	<b>0.888</b>	<b>0.843</b>
<b>Cronbach alpha coefficients</b>					
Server virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
<b>0.897</b>	<b>0.921</b>	<b>0.799</b>	<b>0.821</b>	<b>0.808</b>	<b>0.627</b>
<b>Average variances extracted</b>					
Server virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
<b>0.475</b>	<b>0.465</b>	<b>0.612</b>	<b>0.585</b>	<b>0.727</b>	<b>0.728</b>

The results in Table 7 demonstrate that the research instrument passed the reliability assessment as the latent variables all loaded above 0.7. The External Influence variable has a Cronbach's alpha coefficient score of 0.627 and composite reliability coefficient score of 0.843. From the analysis provided in Table 5, the mean and standard deviation scores of the two items measuring External Influence were adequate. However, External Influence is the only latent variable in the NOIIE framework with least items and this may account for the low Cronbach's alpha of 0.627. Since the composite reliability is more suitable to PLS-based SEM, and the External Influence composite score was 0.843, the survey instrument was considered to be consistent with the results obtained (Henseler, et al., 2009). The  $R^2$  coefficient indicates the extent to which the independent variables explain the dependent variable, and is explained in detail in section 5.2.2.1. The values of the average variance extracted are useful in determining the discriminant validity, and are discussed next in section 5.2.1.2.

#### **5.2.1.2 Discriminant Validity Test**

Discriminant validity is the extent to which items in a measurement instrument differentiate among measures or measure distinct concepts (Fornell & Larcker, 1981). The square roots of the average variances extracted of each variable displayed at the bottom of Table 7 are taken and the resulting values are displayed in bold along the diagonal of Table 8. If the items associated with a measure correlate more highly with other items of the same measure in the model, then the measure is said to have adequate discriminant validity (Fornell & Larcker, 1981). The values on the diagonal exceed values below them in the same column and in the same row in Table 8, and the associated p values indicate that the inter-correlations of most of the latent variables are significant at  $p < 0.05$ , and highly significant at  $p < 0.001$ . Thus, the research instrument is determined to have adequate discriminant validity.

**Table 8: Latent variable correlations**

	Server Virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
Server Virtualisation	<b>0.689</b> <b>p=1.000</b>					
National E-Readiness	0.361 <b>p&lt;0.001***</b>	<b>0.682</b> <b>p=1.000</b>				
Organisational Preparedness	0.496 <b>p&lt;0.001***</b>	0.236 <b>P=0.031*</b>	<b>0.782</b> <b>p=1.000</b>			
Industrial Relationships	0.414 <b>P&lt;0.001***</b>	0.332 <b>P=0.002**</b>	0.189 p=0.087	<b>0.765</b> <b>p=1.000</b>		
Internal Resistance	0.183 P=0.098	-0.087 P=0.435	0.172 P=0.120	0.051 p=0.646	<b>0.853</b> <b>p=1.000</b>	
External Influence	0.229 <b>P=0.037*</b>	-0.126 P=0.258	0.253 <b>p=0.021*</b>	-0.017 p=0.880	0.507 <b>p&lt;0.001***</b>	<b>0.853</b> <b>p=1.000</b>

**Note:** Significance at: \* $p<0.05$ , \*\* $p<0.01$ ,  $p<0.001$ \*\*\*

### 5.2.1.3 Convergent Validity Test

Convergent validity is the extent to which items forming a construct combine together when compared to “items measuring different constructs” (Urbach & Ahlemann, 2010, p 19). Table 9 provides the results of the convergent validity test. An instrument has good convergent validity if the respondents answered the research questionnaire in the same way and in the way intended by the researcher (Hair, et al., 1987).

The research instrument for this study comprised a total of 59 indicators. Seventeen items measure server virtualisation, 16 items measure National E-Readiness, 14 items measure Organisational Preparedness, 6 items measure Industrial Relationships, 4 items measure Internal Resistance and 2 items measure External Influence. The loadings in each latent variable were examined and loadings that were equal to or greater than 0.5 were determined to have good convergent validity and selected (Hair, et al., 1987). All indicators that were not 0.5 and above were rejected, and removed. All indicators in the National E-Readiness variable loaded adequately at initial and final readings. Indicator ‘OR 10’ met the convergent threshold of 0.5 at the initial reading, but in Table 9, after the final loadings were made and indicators were further examined for convergent validity, ‘OR 10’ in the Organisational

Preparedness latent variable was dropped because it failed to meet the convergent validity threshold value of 0.5 or greater. One indicator each was dropped in Industrial Relationships and Internal Influence variables. The 2 indicators in External Influence variable were adequate for convergent validity. Thus, 42 indicators were selected for framework analysis as shown in Table 9. The results demonstrated that since most of the items loaded, the constructs were to a reasonable extent valid.

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**Table 9: Combined loadings at the final reading**

Latent Variables	Indicators	Server Virtualisation	National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
SERVER VIRTUALISATION	SV 1	<b>0.798</b>					
	SV 2	<b>0.775</b>					
	SV 3	<b>0.736</b>					
	SV 4	<b>0.697</b>					
	SV 5	<b>0.745</b>					
	SV 6	<b>0.653</b>					
	SV 7	<b>0.684</b>					
	SV 8	<b>0.657</b>					
	SV 9	<b>0.707</b>					
	SV 10	<b>0.503</b>					
	SV 11	<b>0.596</b>					
	SV 12	<b>0.665</b>					
NATIONAL E-READINESS	NER 1		<b>0.531</b>				
	NER 2		<b>0.574</b>				
	NER 3		<b>0.577</b>				
	NER 4		<b>0.590</b>				
	NER 5		<b>0.761</b>				
	NER 6		<b>0.662</b>				
	NER 7		<b>0.620</b>				
	NER 8		<b>0.543</b>				
	NER 9		<b>0.732</b>				
	NER 10		<b>0.720</b>				
	NER 11		<b>0.790</b>				
	NER 12		<b>0.731</b>				
	NER 13		<b>0.731</b>				
	NER 14		<b>0.713</b>				
	NER 15		<b>0.776</b>				
	NER 16		<b>0.772</b>				
ORGANISATIONAL PREPAREDNESS	OR 2			<b>0.879</b>			
	OR 3			<b>0.918</b>			
	OR 6			<b>0.666</b>			
	OR 11			<b>0.624</b>			
INDUSTRIAL RELATIONSHIPS	IRL 1				<b>0.696</b>		
	IRL 2				<b>0.747</b>		
	IRL 3				<b>0.821</b>		
	IRL 4				<b>0.705</b>		
	IRL 5				<b>0.844</b>		
INTERNAL RESISTANCE	IRS 1					<b>0.744</b>	
	IRS 2					<b>0.919</b>	
	IRS 3					<b>0.884</b>	
EXTERNAL INFLUENCE	EIF 1						<b>0.853</b>
	EIF 2						<b>0.853</b>

#### 5.2.1.4 Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity

The Kaiser-Meyer-Olkin (KMO) test examines the adequacy of sample data for factor analysis. KMO determines the relevance of factor analysis. Usually values between 0.5 and 1 suggest factor analysis is relevant. Values below 0.5 suggest that the correlations between selections of variables cannot be explained by other variables and as such factor analysis may be irrelevant (Iglesias, Birks, & Torgerson, 2001).

Bartlett's test of sphericity is similarly used to establish the appropriateness of factor analysis. Bartlett's test of sphericity determines whether to accept or reject the hypothesis (usually the null) that certain variables in a given sample are not correlated. Thus if in a given relationship the null hypotheses cannot be rejected, then factor analysis may not be appropriate (Iglesias, Birks, & Torgerson, 2001).

The results in Table 10 suggest that the sample data were adequate for factor analysis at 0.721 for the KMO and 2371.049,  $p < 0.000$  for the Bartlett's test of sphericity.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.721
Bartlett's test of Sphericity Approximate Chi-Square	2371.049
Degree of freedom (df)	861
Significance	0.000

#### 5.2.1.5 Eigenvalues

The eigenvalues is the total variance that each factor in a given sample, explains. Table 11 shows the full results and suggests that based on the threshold value of ( $>1$ ), the total

variance explained by the data is 74.234% on 11 components (Ledesma & Valero-Mora, 2007).

**Table 11: Total Variance Explained**

Component	Eigenvalues		
	Total	% of Variance	Cumulative %
1	10.450	24.881	24.881
2	5.394	12.842	37.723
3	2.984	7.106	44.828
4	2.252	5.362	50.190
5	2.005	4.775	54.965
6	1.743	4.149	59.115
7	1.531	3.645	62.760
8	1.492	3.553	66.314
9	1.167	2.779	69.093
10	1.137	2.706	71.799
11	1.023	2.435	74.234
12	.958	2.281	76.515
13	.915	2.179	78.694
14	.850	2.023	80.717
15	.729	1.736	82.454
16	.646	1.539	83.992
17	.605	1.441	85.433
18	.579	1.379	86.812
19	.516	1.229	88.041
20	.485	1.154	89.196
21	.465	1.108	90.304
22	.453	1.080	91.383
23	.419	.997	92.380
24	.357	.849	93.229
25	.327	.778	94.007
26	.300	.714	94.721
27	.269	.639	95.361
28	.253	.602	95.962
29	.244	.580	96.543
30	.231	.550	97.093
31	.186	.444	97.537
32	.177	.422	97.958
33	.157	.373	98.331
34	.139	.330	98.661
35	.104	.247	98.908
36	.091	.216	99.124
37	.082	.195	99.319
38	.071	.169	99.488
39	.062	.149	99.637
40	.058	.138	99.774
41	.053	.127	99.901
42	.041	.099	100.000

### 5.2.2 Structural Model Assessment

SEM is predominantly a testing and confirmatory analysis technique, which helps to determine causal relationships among latent and formative constructs, and establish the validity of a model (Haenlein & Kaplan, 2004). SEM focuses on latent (non-measurable, unobservable, and hypothetical) variables, and helps to ensure that there is no bias in estimating relationships between latent variables (Eikebrokk & Olsen, 2007). Finally, SEM allows for multiple estimations on a single latent variable. SEM is chosen for this study based on its positivist epistemological stance to investigate causal effects in linear relationships and to assess and validate the NOIIE (a reflective model), which is being developed (Urbach & Ahlemann, 2010). Unlike other analysis techniques such as multiple regression, discriminant, and factor analysis, SEM allows for developing and analysing complex models, is suitable for reflective and formative latent constructs, allows for predictions, and embodies two sets of equations: structural model and measurement model to produce an entire structural equation model (Urbach & Ahlemann, 2010).

A structural equation modelling in partial least squares is conducted using WarpPLS 2.0 (variance-based) software to test the relationships between the e-readiness variables, in order to establish whether a significant relationship(s) exist(s) or not. Furthermore, PLS (variance-based SEM) is ideal for investigating a relatively new phenomenon and use of newly-developed models to assess a phenomenon, and for prediction, with a small sample of between thirty and one hundred (Urbach & Ahlemann, 2010). This study developed a new conceptual model (NOIIE), and uses PLS to assess the antecedents for the readiness of 83 South African organisations for server virtualisation with a view to predicting the readiness of organisations in developing countries for emerging technologies. PLS makes lower demands on measurement scales, and sample size (Urbach & Ahlemann, 2010). WarpPLS 2.0

estimates the strength and direction of the relationships in the NOIIE model by determining the path (beta) coefficients, and p values between latent variables and by providing the associated  $R^2$  values (coefficient of determination) which are shown in Table 7. The full results are presented in sections 5.2.2.1 to 5.2.2.4.

#### **5.2.2.1 Coefficient of Determination**

WarpPLS 2.0 was used to model the NOIIE framework using the Warp3 PLS regression algorithm. The bootstrapping resampling method was used in the analysis. However, the jackknifing resampling method was also used to check the level of consistency with the data sample of 83 organisations. Both bootstrapping and jackknifing resampling methods produced similar results and this confirmed the appropriateness of the resampling method used.

Of importance are the  $R^2$  values shown in Table 7. The  $R^2$  (coefficient of determination) is the measure of “the explained variance of a latent variable relative to its total variance” (Urbach & Ahlemann, 2010, p. 21). The  $R^2$  measure is important for determining the extent to which a dependent (endogenous) variable can be predicted by one or more independent (exogenous) variables. Server virtualisation and organisational readiness are two dependent variables in the NOIIE model as shown in Figure 13. The  $R^2$  value associated with server virtualisation is 0.45 (Figure 14). This implies that the independent variables (national e-readiness, organisational preparedness, and industrial relationships), pointing at server virtualisation (the dependent variable), are explaining the dependent variable (server virtualisation) by 45%, and is an acceptable moderate threshold for an endogenous variable with few exogenous variables (Henseler, et al., 2009). This result however, suggests that other independent variables or additional indicators to the existing independent variables (national e-readiness, organisational preparedness, and industrial relationships) might still

explain in more details the dependent variable (server virtualisation) in addition to the three variables (national e-readiness, organisational readiness, and industrial relationships), already identified (Cameron & Windmeijer, 1996). Similarly, organisational preparedness is predicted to be influenced by internal resistance, and external influence. The  $R^2$  value of 12% (Figure 14) is also acceptable (Falk & Miller, 1992) and suggests that there may be other factors which explain influence on organisational preparedness, in addition to the two factors (internal resistance and external influence) already identified (Henseler, et al., 2009).

PLS is suitable when a model is being developed, and interestingly, the results suggest that the model (NOIIE) demonstrated good predictive validity (Sosik, Kahai, & Piovoso, 2009), and may also be expanded to accommodate more factors that contribute to, or influence the overall readiness for emerging technologies of organisations in developing countries (Urbach & Ahlemann, 2010).

#### **5.2.2.2 Model Fit**

The NOIIE model is also evaluated for goodness of fit. A goodness of fit tells us how well our model will explain specific situations (Narsky, 2003). PLS-based SEM is known for its limitation in providing established global goodness of fit indices (Henseler, et al., 2009). However, WarpPLS 2.0 provides 3 basic model fit indices which are: average path coefficient (APC), average  $R^2$  (ARS), and average variance inflation factor (AVIF) (Kock, 2011). APC is the average of all the path coefficients in the inner model. WarpPLS takes all the path coefficients and averages them. WarpPLS then calculates a p value with the significance cut-off as the classic .05. ARS is the same; the average of the  $R^2$  of the inner model. AVIF is different. It is the average of the variance inflation factors of the paths of the inner model. It is a measure of multicollinearity. The results obtained, using the 3 indices

are: APC=0.273,  $p < 0.001$ , ARS=0.288,  $p < 0.001$ , AVIF=1.117. If the p values associated with both the APC and ARS are lower than 0.5, and the AVIF is lower than 5, then a model is determined to have a good fit with the sample data (Kock, 2011). The outcome of these results suggests that the NOIIE model has good fit with its theoretical assumptions and the sample data.

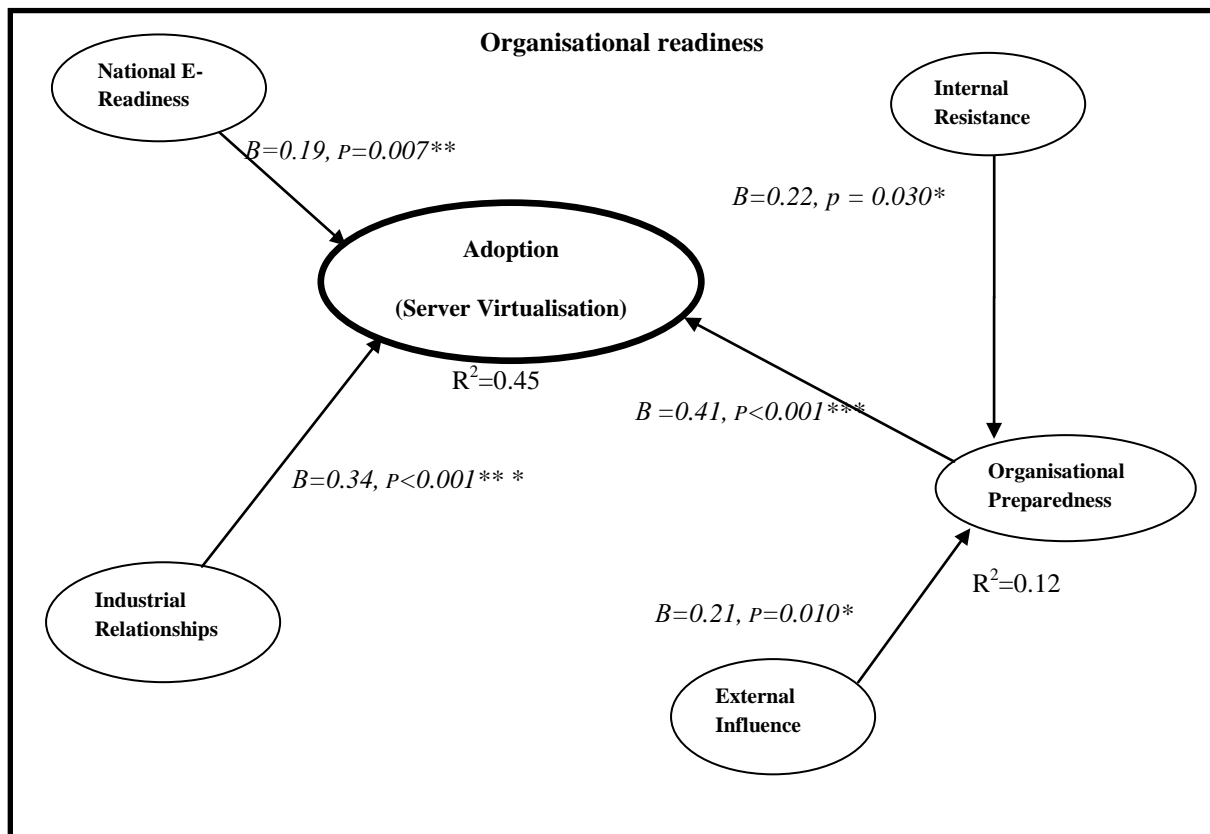


Figure 14: NOIIE readiness validation for an investigation of antecedents for organisations' readiness for server virtualisation in South Africa

Note: Significance at: \* $p < 0.05$ , \*\* $p < 0.01$ ,  $p < 0.001$ \*\*\*

Model fit indices: APC=0.273,  $P < 0.001$ , ARS=0.288,  $P < 0.001$ , AVIF=1.117, Good if  $< 5$

### 5.2.2.3 Path Coefficients

Path coefficients help to determine whether the structural path from an exogenous variable to the endogenous variable is empirically supporting the theoretical assumptions between the exogenous and endogenous variables, and are indicated by algebraic signs (Henseler, et al.,

2009). If a path coefficient has an algebraic sign that is contrary to the hypothesis formulated, then such path is determined not to support such hypothesis (Urbach & Ahlemann, 2010).

In Figure 13, the path between national e-readiness and server virtualisation has a beta coefficient of 0.19 and a p value of 0.007. Similarly, between organisational preparedness and server virtualisation,  $\beta=0.41$ ,  $p<0.001$ ; between industrial relationships and server virtualisation,  $\beta=0.34$ ,  $p<0.001$ ; between internal resistance and organisational preparedness,  $\beta=-0.22$ ,  $p=0.030$ ; and between external influence and organisational preparedness,  $\beta=0.20$ ,  $p=0.01$ . These results suggest that all the NOIIE variables are supported by their hypotheses and were significant (Urbach & Ahlemann, 2010). Furthermore, all the path coefficients range from 0.19 through to 0.41 and met the threshold of 0.2 and this suggests that the NOIIE framework has a good fit (Chin, 1998).

#### **5.2.2.4 Effect Size**

An effect size is the measure of the extent to which an exogenous (independent) latent variable has a significant influence on an endogenous (dependent) latent variable (Urbach & Ahlemann, 2010). The standard measure is Cohen's 'f<sup>2</sup>', which put the thresholds at 0.02 for small, 0.15 for medium, and 0.35 and above, for large effects (Henseler, et al., 2009).

Mathematically effect size can be determined using the following notation:

$f^2 = R^2_1 - R^2_* / 1 - R^2_1$ , where  $f^2$  = effect size,  $R^2_1$  = coefficient of determination of the full model, and  $R^2_*$  = the coefficient of determination when a dependent variable is removed (Cohen, 1988). Table 12 shows the effect sizes of the independent variables against their respective dependent variables.

**Table 12: Effect sizes of independent variables**

Dependent variables	R <sup>2</sup>	Independent variables and effect sizes (f <sup>2</sup> )				
		National E-Readiness	Organisational Preparedness	Industrial Relationships	Internal Resistance	External Influence
Server Virtualisation	0.45	<b>0.05</b>	<b>0.25</b>	<b>0.18</b>		
Organisational Preparedness	0.12				<b>0.05</b>	<b>0.03</b>

In order to determine the effect size of each independent variable, the initial R<sup>2</sup><sub>1</sub> of the model was taken, the independent variable was removed from the model, and a new value (R<sup>2</sup><sub>\*</sub>) was determined and used in the mathematical notation to arrive at the f<sup>2</sup> values shown in Table 12. The full statistical procedures are detailed in Appendix D.

In Figure 13 and as shown in Table 10, the R<sup>2</sup> values are 0.45 for server virtualisation, and 0.12 for Organisational Preparedness. Using the f<sup>2</sup> values in Table 12, one can interpret the effect size of each independent variable. The effect size of national e-readiness (0.05) suggests that this independent variable (national e-readiness) has a small effect on server virtualisation. In other words national e-readiness has a weak influence on server virtualisation in the overall readiness assessment of an organisation. Both the Organisational Preparedness and Industrial Relationships have a moderate effect on server virtualisation. The results suggest that in the overall readiness assessment of an organisation for emerging technologies, Organisational Preparedness and Industrial Relationships play moderate roles. Similarly, both the internal resistance, and external influence have weak influences on Organisational Preparedness.

### 5.3 Hypotheses Testing

This section provides a discussion on the evaluation of hypotheses the proposed in this study, and the implications of the tests.

#### 5.3.1 National E-Readiness

The hypotheses proposed to test this variable are:

**H<sub>1</sub> National E-Readiness contributes significantly and positively to organisational readiness for server virtualisation.**

**H<sub>10</sub>: National E-Readiness does not contribute to organisational readiness for server virtualisation.**

From the outcome of the tests shown in Figure 14, national e-readiness has a beta coefficient of 0.19, and a P value of 0.007, which shows a highly significant and positive relationship with the dependent variable (server virtualisation). In view of this outcome, the null hypothesis, **H<sub>10</sub>**, is rejected, and **H<sub>11</sub>** is accepted, (national e-readiness contributes significantly and positively to organisations' readiness for server virtualisation). This result in conjunction with Table 12 however, reveals that national e-readiness has a small influence on the readiness of organisations for emerging technologies. This result is consistent with existing knowledge that national e-readiness contributes significantly and positively to organisational readiness to adopt an innovation (Al-Solbi & Mayhew, 2005; Kurnia et al. 2009).

### **5.3.2 Organisational Preparedness**

Figure 15 reveals that people and technology in organisations are highly significant in organisational readiness to implement server virtualisation.

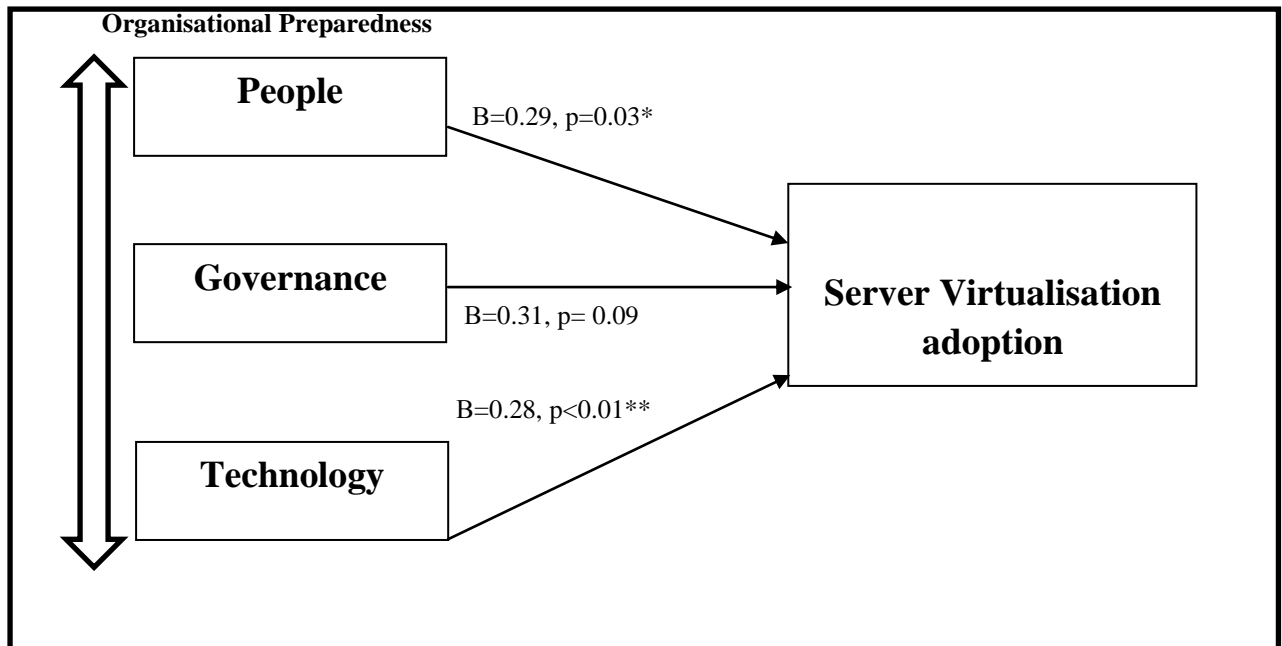


Figure 15: People, governance and technology as contributors to organisational preparedness for server virtualisation in South Africa

Note: Significance at: \* $p < 0.05$ , \*\* $p < 0.01$

The hypotheses put forward for organisational readiness were:

**H<sub>2</sub> H<sub>21</sub>: Organisational Preparedness contributes significantly and positively to organisational readiness for server virtualisation.**

**H<sub>20</sub>: Organisational Preparedness does not contribute significantly and positively to organisational readiness for server virtualisation.**

As shown in Table 9, only four indicators in the organisational readiness variable meet the convergent validity criterion. OR 2, and OR 3 assess server candidature for virtualisation, and the existing IT platform for implementing virtualisation respectively. OR 11 assesses adoption policy for technology. Organisations were asked if their IT policy supports early adoption. OR 6 assesses IT staff skills to support virtual servers. These indicators are tested against the dependent variable (server virtualisation) and the result (Figure 13) shows that

organisational preparedness significantly and positively contributes to the overall organisational readiness. Thus, the null hypothesis, **H2<sub>0</sub>**, is again, rejected. In conjunction with Table 10, organisational preparedness has a moderate effect on the overall readiness of organisations for emerging technologies.

Figure 15 is presented in order to understand which factors contribute to organisational preparedness at the organisational level. Figure 15 reveals that people and technology in organisations are highly significant in the adoption of server virtualisation. It is surprising to see that governance is less significant. In previous studies, governance is found to be highly contextual. Some studies (Teo & Ranganathan, 2004; Tsao, Lin, & Lin, 2004) find governance to be highly significant to organisational preparedness. In a study by Kaynak, et al. (2005), governance is found to be insignificant to organisational preparedness. This suggests that governance may be contextual, or based on organisational policies and culture (Peansupap & Walker, 2006).

Overall, this result confirms that organisational preparedness is highly important in the overall readiness of the organisation, and people, and technology play the major roles in the adoption process. The result is consistent with the existing knowledge on IT adoption in organisations in developing countries (Hourali, et al., 2008; Molla & Licker, 2005).

### **5.3.3 Industrial Relationships**

The proposed hypotheses for this variable are:

**H<sub>3</sub> H3<sub>1</sub>: Industrial Relationships contribute significantly and positively to organisational readiness for server virtualisation.**

**H3<sub>0</sub>: Industrial Relationships does not contribute significantly and positively to organisational readiness for server virtualisation.**

The results shown in Figure 14 reveal that industrial relationship has a beta coefficient of 0.34, and p value of less than 0.001 which confirms a highly significant positive relationship with the dependent variable (server virtualisation). This result in conjunction with Table 12 shows that industrial relationship contributes significantly and positively to organisational readiness for server virtualisation and has a moderate influence on the readiness of organisations for emerging technologies. Thus the null hypothesis, **H3<sub>0</sub>**, was rejected. This result is surprising as existing knowledge suggests that industrial relationships are insignificant to the overall organisational readiness (Kurnia, et al., 2009; Molla & Licker, 2005). The explanation this research may offer is that server virtualisation is an emerging technology, and its adoption in organisations in developing countries may still be at an early stage. Thus, organisations in developing countries may need the support of technology providers (vendors) to ensure that adoption is successful.

#### **5.3.4 Internal Resistance**

Internal resistance as an extraneous factor is tested against organisational preparedness. The hypotheses proposed for this variable are:

**H<sub>4</sub> H4<sub>1</sub>: Internal Resistance influences organisational preparedness for server virtualisation negatively.**

**H4<sub>0</sub>: Internal Resistance does not influence organisational preparedness for server virtualisation.**

From the results in Figure 14, internal resistance has a beta coefficient of -0.22, and a p value of 0.03, and suggests that internal resistance negatively influences organisational preparedness. This implies a 97% chance of being right if the alternate hypothesis, **H4<sub>1</sub>**, is

accepted. Thus, the null hypothesis, **H4<sub>0</sub>**, is again rejected. That is, internal resistance influences organisational preparedness negatively for server virtualisation. The implication of this result is that adoption of an innovation such as server virtualisation may be problematic in organisations in developing countries if the stakeholders (IT staff, top executives, application owners and users) do not buy into the adoption of such an innovation. Internal resistance however as shown in Table 12, has a small effect on organisational preparedness. This result confirms existing knowledge on readiness of organisations that resistance occurs if an innovation has certain potentials to change users' behaviours and the existing systems (Kwahk & Lee, 2008; Lapointe & Rivard, 2005).

### 5.3.5 External Influence

External influence is the other extraneous factor proposed for this research. External influence is also tested against organisational preparedness. The hypotheses proposed are:

**H<sub>5</sub> H5<sub>1</sub>: External Influence influences organisational preparedness for server virtualisation positively.**

**H5<sub>0</sub>: External Influence does not influence organisational preparedness for server virtualisation.**

Again from the results presented in Figure 14, the resulting beta coefficient of 0.21 and a p value of less than 0.001, show that external influence has a strong positive influence on organisational preparedness. The effect as suggested in Table 12, is however small. The null hypothesis, **H5<sub>0</sub>**, is therefore rejected. The implication of this result is that organisations in developing countries appear to adopt innovations due to pressure from peer organisations, and business associates. This result is consistent with the existing knowledge on readiness

assessment of organisations in developing countries (Kurnia, et al., 2009; Molla & Licker, 2005).

So to sum up, the NOIIE readiness model was found to have both the measurement and structural validities. All the relationships hypothesised were found to be very significant and ranged from small through to moderate effects between the independent variables and the dependent variables.

#### **5.4 QUALITATIVE DATA ANALYSIS**

This section provides analysis of responses to questions 8 and 9 in Section D of the research questionnaire (Appendix B). In question 8, respondents were asked through an open-ended question, to provide enablers and inhibitors to adopting server virtualisation in organisations in developing countries. Question 9 sought to identify what respondents have found to be the benefits and drawbacks of server virtualisation implementation in their organisations. The purpose of question 8 was to achieve a deeper understanding of factors that enable and inhibit the implementation of emerging technologies in organisations in developing countries, and to determine whether or not the generic ICT adoption enablers and, or inhibitors apply to server virtualisation adoption in South African organisations. Question 9 served to help understand if South African organisations are enjoying the benefits associated with server virtualisation implementation, and what drawbacks, if any, are associated with server virtualisation?

The Thomas (2006) general inductive approach for analysis of qualitative data was used to group emerging themes into two broad categories each, namely: enablers and inhibitors, and benefits and drawbacks. Furthermore, Kwon and Zmud (1987) were used to group themes into people, governance, and technology factors, in order to understand holistically the factors that influence technology adoption.

### **5.4.1 The Enablers and Inhibitors of Server Virtualisation Adoption**

Table 13 provides a list of enablers and inhibitors of server virtualisation adoption. As revealed in Figure 15, people, and technology have strong positive impacts on organisational preparedness for server virtualisation.

#### **5.4.1.1 People**

Only one respondent indicated that ease of use (relative advantage) enables the adoption of emerging technologies. This was surprising because 'lack of IT skill' was identified by 51 respondents as the main inhibitor for individuals (people) to adopt emerging technologies. This suggests that individuals (people) will adopt an innovation (emerging technology), if such innovation is well understood and can be used (Enfield, et al., 2011).

Lack of stakeholders' support was identified by 17 respondents as another major inhibitor to the adoption of server virtualisation in organisations. Lack of confidence was identified by only one respondent as another inhibitor to the adoption of emerging technology in organisations in developing countries. Lack of IT skills and lack of stakeholders' support confirm existing literature (Bruque & Moyano, 2007; Sanad, et al., 2010).

**Table 13: Server virtualisation enablers and inhibitors**

CATEGORY	ADOPTION FACTORS	COUNT	TOTAL	PERCENTAGE
ENABLERS	<b>People: sum total</b>	<b>1</b>	<b>1</b>	<b>4.4%</b>
	<i>Ease of use</i>	1		
	<b>Governance: sum total</b>	<b>7</b>	<b>7</b>	<b>30.6%</b>
	<i>Training &amp; certification</i>	5		
	<i>Business demand</i>	2		
	<b>Technology: sum total</b>	<b>15</b>	<b>15</b>	<b>65%</b>
	<i>Licensing flexibility</i>	1		
	<i>Cost saving</i>	4		
	<i>Consolidation</i>	3		
	<i>Standardisation of infrastructure</i>	1		
	<i>Open source and free product</i>	2		
<i>Compatible hardware</i>	1			
<i>Power backup systems</i>	1			
<i>Ease of use</i>	1			
<i>Fast entry into market</i>	1			
	<b>Group Total</b>		<b>23</b>	<b>100%</b>
INHIBITORS	<b>People: sum total</b>	<b>69</b>	<b>69</b>	<b>41.1%</b>
	<i>Lack of IT skill</i>	51		
	<i>Lack of stakeholders' support</i>	17		
	<i>Lack of confidence</i>	1		
	<b>Governance: sum total</b>	<b>20</b>	<b>20</b>	<b>11.9%</b>
	<i>Bandwidth and broadband</i>	13		
	<i>Process maturity</i>	4		
	<i>IT adoption policy</i>	3		
	<b>Technology: sum total</b>	<b>79</b>	<b>79</b>	<b>47%</b>
	<i>Software and license costs</i>	40		
	<i>Product license</i>	5		
	<i>IT infrastructure / Hardware</i>	15		
<i>Lack of product awareness</i>	5			
<i>Product security</i>	1			
<i>Vendor support</i>	8			
<i>Power supply</i>	4			
<i>Network complexity</i>	1			
	<b>Group total</b>		<b>168</b>	<b>100%</b>
	<b>Overall Total (Enablers and Inhibitors)</b>		<b>191</b>	

#### 5.4.1.2 Governance

Training and certification, and business demand were identified as enablers of governance in organisations. Training and certification help IT support teams to master technologies, and to

acquire the requisite skills needed to support organisational use of such technologies. One of the organisations using server virtualisation reported:

*“Ensure that training is available, certify as many employees as possible which will be of huge benefit to any company.”*

Business demand on the other hand is perceived by two respondents to be facilitated by IT, as one of the respondents pointed out:

*“IT can be responsive to new business requirements and infrastructure requests.”*

However, thirteen respondents indicated that costs of bandwidth and broadband may inhibit the adoption of emerging technologies in organisations in developing countries. This finding is consistent with existing literature on IT implementation in organisations in developing countries (Hourali, et al., 2008; Molla & Licker, 2005). A respondent reported:

*“Bandwidth issues could hinder from a disaster recovery / business continuity management perspective.”*

Four respondents indicated also that process maturity hinders the adoption of emerging technology. Process maturity enhances business demands, and is essential for organisations to institutionalise through standards, policies, and organisational structures (McCormack, et al., 2009).

Finally, three respondents identified IT adoption policy as another inhibitor to the adoption of emerging technologies in organisations in developing countries. Adoption of an innovation is only likely to increase when such an innovation has a relative advantage, and IT adoption policy may support a late adoption if the innovation is not better than the existing practice (Molla & Licker, 2005). However, a lack of awareness (observability) may trigger a late adoption even when the innovation offers potential benefits (Ashley, 2009).

### 5.4.1.3 Technology

Nine respondents identified cost saving, consolidation, and open source and free software as the main enablers to server virtualisation adoption in organisations in developing countries. Server virtualisation adoption provides cost savings and consolidation benefits to organisations (Uddin & Rahman, 2011). Open source software (OSS) is being considered by organisations to provide improved cost effectiveness (Rahim, Alias, & Carroll, 2010). However, OSS has many challenging factors such as competition from proprietary software vendors, lack of technical support, and incompatibility with legacy applications, and these factors cause adoption failure (Rahim, et al., 2010), as one of the respondents reported:

*“Lack of support for open source virtualisation products limits adoption.”*

Software and license costs were identified as the major technological inhibitor to the adoption of emerging technologies (such as server virtualisation) in organisations in developing countries. Cost is a conundrum in the adoption of technologies in developing countries (Rahim, et al., 2010). For example rates of foreign exchange influence the cost of purchases, as the US dollar remains the standard currency for foreign exchange (Zhu & Kraemer, 2005). Another reason may be due to the fact that the economic recession affects developing countries more than the developed (Naude, 2009). IT infrastructure / hardware, lack of product awareness, vendor support, and power supply were identified as other technological inhibitors to server virtualisation adoption. IT infrastructure / hardware is important in order to adopt a technology, as it takes into consideration the compatibility, flexibility, and suitability of the existing infrastructure in relation to the technology being adopted (Bhatt, et al., 2010). Lack of product awareness as indicated by five respondents also confirmed the existing knowledge, as adopters have to be aware of the innovation they are adopting (Rogers, 2003). Vendor support is very important to organisations in developing countries for

the adoption of emerging technologies, especially to provide product awareness, make cost and licensing affordable, and provide technical assistance from time to time (Molla & Licker, 2005). Power supply (electricity) appears to be peculiar to developing countries, due to their low economic power, leadership problems, and socio-political instabilities (Stewart & Mohamed, 2002).

Using Table 13, the computation of the percentage of the relative frequencies (factor sum total divided by group total) of each Category/factor are thus:

Enablers; people 4.4%, governance 30.6%, and technology 65%;

Inhibitors; people 41.1%, governance 11.9%, and technology 47%.

In all, technology appears to be playing the major role in technology adoption.

Here is a summary of the major factors influencing innovation adoption.

- People: Ease of use (enabler) and lack of IT skill, and lack of stakeholders' support (inhibitors).
- Governance: Training and certification (enablers), and bandwidth and broadband, and process maturity (inhibitors).
- Technology: Cost saving, consolidation, and OSS (enablers), and software and license costs, IT infrastructure/hardware, lack of product awareness, and vendor support (inhibitors).

Thus, the server virtualisation adoption process is such that cost saving and consolidation benefits may trigger an increase in adoption (observability). Furthermore, use of server virtualisation (complexity) may be facilitated (relative advantage) through training and certification (trial ability).

However, lack of skill (complexity), software and license costs (relative advantage), IT infrastructure/hardware (compatibility), and lack of stakeholders' support (observability) may constitute the major inhibitors to server virtualisation adoption in organisations in developing countries.

#### **5.4.2 The Benefits and Drawbacks of Server Virtualisation Implementation in South African Organisations**

Table 14 lists the benefits and drawbacks of server virtualisation implementation in the 83 South African organisations already using the technology.

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<b>Table 14: Server virtualisation benefits and drawbacks</b>				
<b>CATEGORY</b>	<b>IMPLEMENTATION FACTORS</b>	<b>COUNT</b>	<b>TOTAL</b>	<b>PERCENTAGE</b>
<b>BENEFITS</b>	<b>People: sum total</b>	<b>10</b>	<b>10</b>	<b>5.9%</b>
	<i>Ease of administration/management</i>	10		
	<b>Governance: sum total</b>	<b>114</b>	<b>114</b>	<b>67%</b>
	<i>High Availability</i>	8		
	<i>Disaster recovery</i>	67		
	<i>Redundancy support</i>	2		
	<i>Agility</i>	6		
	<i>Improved ROI</i>	2		
	<i>Reduced TCO</i>	20		
	<i>Service expansion / Space</i>	9		
	<b>Technology: sum total</b>	<b>46</b>	<b>46</b>	<b>27.1%</b>
	<i>Fast deployment</i>	16		
	<i>Consolidation</i>	10		
	<i>Resource sharing</i>	5		
	<i>Better utilisation</i>	13		
<i>Reduced carbon footprints</i>	2			
	<b>Group Total</b>		<b>170</b>	<b>100%</b>
<b>DRAWBACKS</b>	<b>People: sum total</b>	<b>13</b>	<b>13</b>	<b>19.1%</b>
	<i>Lack of IT skill</i>	8		
	<i>Duration of training</i>	1		
	<i>Lack of commitment to see benefit</i>	1		
	<i>Lack of stakeholders' support</i>	3		
	<b>Governance: sum total</b>	<b>30</b>	<b>30</b>	<b>44.1%</b>
	<i>Complex planning</i>	2		
	<i>Infrastructure outsource</i>	2		
	<i>Initial setup/start-up cost</i>	8		
	<i>Mission critical servers</i>	2		
	<i>Legacy applications</i>	1		
	<i>Management overhead</i>	1		
	<i>Virtual sprawl</i>	5		
	<i>Fail-over service costs</i>	3		
	<i>Migration of existing system/ change management</i>	3		
	<i>Complex DR for multiple VMs</i>	2		
	<i>Capacity/resource management</i>	1		
	<b>Technology: sum total</b>	<b>25</b>	<b>25</b>	<b>36.8%</b>
<i>License cost</i>	7			
<i>Access reliability</i>	1			
<i>Limited application</i>	2			
<i>Network complexity</i>	4			
<i>Single point of failure</i>	8			
<i>Storage cost</i>	3			
	<b>Group total</b>		<b>68</b>	<b>100%</b>

#### **5.4.2.1 People**

Ease of administration / management is an emerging benefit of server virtualisation adoption, and was indicated by ten respondents. Drawbacks to server virtualisation adoption in South African organisations were individuals' (people) lack of IT skills, duration of training, lack of commitment to see benefit, and lack of stakeholders' support. Lack of IT skills, and lack of stakeholders' support confirmed the existing knowledge (Bruque & Moyano, 2007; Sanad, et al., 2010), while duration of training, and lack of commitment to see benefit were emerging drawbacks.

#### **5.4.2.2 Governance**

High availability, disaster recovery, agility, reduced TCO, and service expansion / space, were identified as major benefits of server virtualisation adoption and they confirm existing literature (Luftman & Ben-Zvi, 2010a; Tomory, 2010; Uddin & Rahman, 2011). Redundancy support is an emerging benefit. Disaster recovery appears to be a major benefit of server virtualisation as indicated by sixty-seven respondents. Effective disaster recovery helps organisations to mitigate unexpected downtimes and single point of failure, and to fulfil certain service level requirements (Saleem, et al., 2008; Uddin & Rahman, 2011).

Server virtualisation helps organisations to gain floor space which could be utilised as an estate for service expansion (Tomory, 2010). In addition, consolidation of servers enables organisations to deploy more applications for service expansion (Edison, 2006). A respondent reported:

*“Expansion of services has become easier.”*

However, respondents also indicated that initial setup/start-up cost, management overhead, virtual sprawl, fail-over service costs, and migration of existing system / change management were governance drawbacks to server virtualisation adoption in South African organisations, and this confirmed the existing knowledge on IT adoption (Brasol, 2009; Colivet, 2008).

#### **5.4.2.3 Technology**

Fast deployment, consolidation, resource sharing, better utilisation, and reduction of carbon footprints, were all confirmed benefits of server virtualisation. Considering the results in Figure 16 and Table 14, South African organisations using server virtualisation may have been achieving all the advertised benefits of server virtualisation implementation, as one respondent said:

*“Virtualisation has had a huge impact on how we manage our ICT infrastructure at our company”.*

Another respondent reported:

*“Every advertised benefit of virtualization has become a reality for us”.*

Server virtualisation adoption also gives South African organisations a balanced use of hardware. This confirms the existing knowledge on better utilisation of systems resources (Luftman & Ben-Zvi, 2010a). A respondent reported that:

*“Balanced use of hardware - certain dedicated apps only used at peak periods so underlying hardware can be re-purposed virtually for rest of month”.*

Access reliability, network complexity, and storage costs were emerging technological drawbacks to server virtualisation adoption in South African organisations.

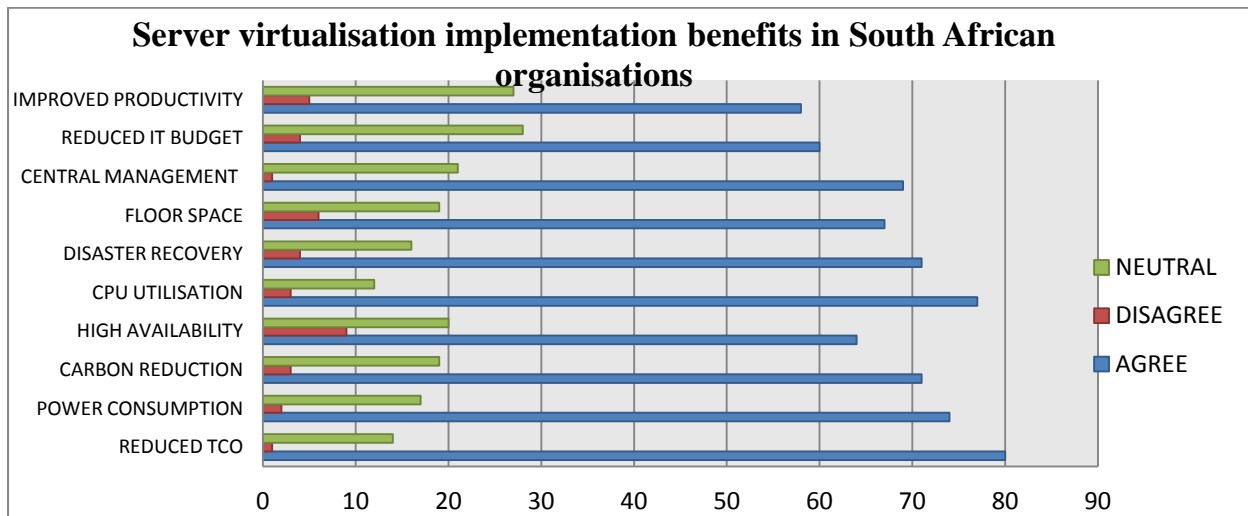


Figure 16: Server virtualisation benefits

Using Table 14, the computation of the percentage of the relative frequencies of each Category / factor is:

Enablers; people 5.9%, governance 67%, and technology 27.1%;

Inhibitors; people 19.1%, governance 44.1%, and technology 36.8%.

Here it can be seen that governance explained the benefits and drawbacks of server virtualisation adoption more significantly.

## **CHAPTER SIX                      CONCLUSIONS**

An e-readiness assessment framework (NOIIE) for emerging technologies was developed based on previous studies. The outcome of this research also revealed that cost reduction incentives and productivity remain among top concerns for IT executives, and organisations are ready to implement such technologies as server virtualisation to meet these demands.

This chapter discusses the summary of the study, followed by a discussion on the lessons learnt from the study, and recommendations for further research for policy makers and practitioners, and further development of the NOIIE research framework.

### **6.1      SUMMARY**

This study identifies that the overall readiness of organisations in developing countries depends largely on the enabling environment provided by the country in which the organisation operates (national e-readiness), positive readiness of the organisation (organisational preparedness), and positive relationship between the organisation and the technology provider (industrial relationships). However, internal resistance has a strong negative influence on organisational preparedness, and external influence has strong positive influence on organisational preparedness for emerging technologies (such as server virtualisation).

The generic enablers and inhibitors to ICT adoption in organisations appear to be applicable to server virtualisation implementation in organisations in developing countries, as themes discussed in section 2.4, emerged in this study.

All the advertised benefits identified in the literature appear to be enjoyed by the 83 South African organisations surveyed using server virtualisation as seen in Table 12, and Figure 15.

However, notable drawbacks being experienced in these organisations are identified and discussed in section 5.5.

The qualitative analysis of the enablers, inhibitors, benefits, and drawbacks of the adoption of server virtualisation in South African organisations, offers further explanations on governance in organisations in developing countries. Paucity of academic research has limited empirical discussions on server virtualisation and the frameworks which have been used to investigate organisational readiness for emerging technologies (such as server virtualisation), and this research has been able to narrow this gap further. The results obtained in this study validate the NOIIE framework and also suggested the need to expand the framework.

In sum, this study demonstrates that it is possible to have a unifying theory to understand an innovation in the context of its adoption in organisations in developing countries. Previous studies argued against this. For instance, one can look at organisational readiness more comprehensively by considering factors that contribute to innovations adoption, and factors that influence organisational preparedness as well. This appears to be a shift from the current knowledge on readiness studies.

Finally, this study also demonstrates that industrial relationships significantly and positively contribute to the overall readiness of organisations in developing countries, contrary to existing literature on readiness. Internal resistance within an organisation and external influence also have strong negative and positive influences respectively, on organisational preparedness.

The qualitative analysis shows that technology explains the enabler and inhibitor to adoption of server virtualisation in organisations in developing countries better than people and governance, and the benefits and drawbacks, are explained better by governance.

## **6.2 DISCUSSIONS AND IMPLICATIONS OF RESULTS**

The results provided by the quantitative analysis of this research validated the proposed NOIE readiness framework. All the null hypotheses were rejected. National e-readiness, organisational preparedness, and industrial relationships were highly significant and positive contributors to organisational readiness for server virtualisation. Furthermore, the extraneous factors (internal resistance and external influence) were found to have significant influence on organisational preparedness. Thus, these extraneous factors (internal resistance, and external influence) should not be ignored by organisations in assessing their readiness for emerging technologies.

The outcome of this research shows that the e-readiness of South Africa is highly significant to the readiness of its organisations, which suggests that national e-readiness is a significant and positive contributor to organisational readiness for emerging technologies. Server virtualisation offers cost reduction benefits to South African organisations, and may help to enhance business productivity in these organisations.

Furthermore, people and technology were significant and positive contributors to organisational preparedness. Governance as a factor in organisational preparedness remains contextual based on perceived policies, the culture in organisations, and the innovation being adopted.

Industrial relationships (defined in this research as the mutual support organisations derive from the technology providers) were found to be highly significant and positive contributor to

organisational readiness. Innovations such as server virtualisation may still remain at the early stage of adoption in organisations in developing countries, and these organisations may require effective support in terms of product cost, license cost, updates, upgrades, and other technical support, from the IT industry (innovation providers).

In this study, internal resistance was found to have a strong negative influence on organisational preparedness, and confirms existing knowledge on readiness of organisations to adopt innovations. Internal resistance may influence organisations' readiness; it may prompt an organisation to reject an innovation due to lack of skill to support the innovation, or there may be no adoption decision, because of both fear of perceived loss of control or job, and fear of perceived incompatibility with the existing IT infrastructure and system.

The results finally showed that external influence has a strong positive influence on organisational preparedness to adopt emerging technologies (such as server virtualisation), and is consistent with existing knowledge that the need to remain competitive influences adopters of innovations (Kurnia, et al., 2009).

The outcome of this study suggests that South African organisations using server virtualisation may constitute the late majority that are sceptical and only adopt because of "peer pressure or as an economic necessity" (Enfield, et al., 2011, p. 4). More importantly is the fact that server virtualisation is being adopted in most organisations to cushion the effect of the current economic downturn (Luftman & Ben-Zvi, 2010a). Furthermore, small organisations (in terms of size or turn over), may be the slowest in adopting emerging technologies. This may be due to a centralised decision making system (usually by one or two people), lack of standard procedures, and lack of long term planning (Premkumar, 2003). Another reason may be due to the fact that these kinds of organisations are traditional in nature and often constitute the laggards who are the last adopters of innovations (Enfield, et

al., 2011; Premkumar, 2003). In addition, “they possess almost no opinion leadership and often have little interaction with others” (Enfield, et al., 2011, p. 4).

The qualitative analysis provides further insight into factors that contribute to readiness of organisations. As has been said earlier, national e-readiness is a significant and positive contributor to organisational readiness.

One of the enablers to server virtualisation adoption, as seen in Table 13, is open source and free products. Eight respondents indicate that the initial set up cost for server virtualisation is a drawback. Thus, open source and free licensed products such as Virtual Box may encourage an increased rate of server virtualisation adoption in developing countries. However, organisations need to understand certain challenges with OSS such as its lack of technical support, and incompatibility with the existing IT infrastructure (Rahim, et al, 2010).

Lack of IT skills is reported as both an inhibitor and a drawback for adopting and implementing server virtualisation in South African organisations. The lengthy duration of training as, reported by respondents, suggests that organisations should make continuous training part of their business processes. This will ensure that IT staff are well-equipped to support emerging technologies such as server virtualisation.

The cost of bandwidth and the affordability of high broadband connectivity are still inhibiting the adoption of emerging technologies such as server virtualisation in organisations in developing countries (Hourali, et al., 2008). This may affect organisations' strive “to pursue value creation opportunities facilitated by the use of the internet”, which organisational readiness should achieve (Choucri, et al., 2003, p. 4). Market monopolies such as Telkom (the major telecommunication provider in South Africa) have been affecting ICT investments in Africa (Bollou & Ngwenyama, 2008). For instance, one of the respondents reported:

*“We have a single server, situated in the country area with no high-speed broadband and do not contemplate any changes”.*

A respondent also reported:

*“Bandwidth issues could hinder from a disaster recovery / business continuity management perspective”.*

Thus, there is a need for a competitive telecommunication market in South Africa in order to bring down the costs of bandwidth and broadband.

Lack of product awareness may also be inhibiting the adoption of server virtualisation in South African organisations, and this is consistent with the existing literature on IT adoption and adoption in organisations in developing countries. It is common for an organisation to outsource part, or all of its IT functions due to lack of product awareness and inability to see the full potentials of existing IT/IS systems. As a result, investment decisions for new or emerging technologies become challenging. This may be the situation with some South African organisations as one respondent said:

*“I have outsourced our complete IT function and passed your original survey questionnaire to this company and encouraged them to participate, but ultimately it is their decision”.*

South African organisations that have adopted and implemented server virtualisation to any significant extent, may have been benefitting from server virtualisation, as all the benefits associated with the technology are being achieved in these organisations. This is a confirmation of the existing literature on server virtualisation benefits. High availability and disaster recovery for example, are important for server uptime and failover to enhance business continuity.

Some South African organisations strive to achieve a sustainable environment by adopting energy efficient technologies such as server virtualisation, thereby reducing their carbon footprint.

South African organisations however reported numerous drawbacks associated with server virtualisation. One of the respondents reported:

*“Single point of failure for multiple machines requires complex Disaster Recovery”.*

Hosting multiple virtual machines on a physical server complicates disaster recovery because each virtual machine may be running a major application.

Other issues such as network complexity, storage costs, limited applications within virtual servers, legacy applications, migration of existing systems, and complex planning, all hinder returns on server virtualisation adoption in South African organisations. Only 51% of South African organisations that participated in the survey have implemented server virtualisation extensively. Overall, the outcome of this research suggests that if more attention is given to the inhibitors and drawbacks of adopting emerging technologies (such as server virtualisation), then adoption will increase, and implementation will become less-complex, less tedious, more successful and more cost effective.

### **6.2.1 Implications for Researchers**

Readiness assessments help to identify areas where organisations need to explore when making IT adoption decisions. This study has confirmed that server virtualisation offers all its advertised benefits as detailed in the literature review.

Furthermore, the validation of the NOIIE readiness assessment framework offers a huge contribution to the investigation of antecedents for organisational readiness for emerging

technologies. The NOIIE framework needs to be used in other developing countries, to enhance its validity.

There is a need to expand the NOIIE framework to accommodate more factors that contribute to the overall readiness of organisations in developing countries for emerging technologies, and factors that influence organisational preparedness.

However, this study could not provide an in-depth understanding of the emerging themes that constitute as the enablers, inhibitors, benefits, and drawbacks to adoption of emerging technologies (such as server virtualisation), in organisations, and this aspect requires further qualitative studies.

Finally, there is a need for more empirical investigations with the NOIIE framework, using a larger sample size, and perhaps in other developing countries. These limitations present opportunities for further research.

### **6.2.2 Implications for Practitioners**

As discussed in subsection 2.5.1.1, server virtualisation may be viewed, as indicated by IT executives in recent surveys, as a technology fit to address the economic effects of the current economic downturn. This suggests that there is a relative advantage with the technology.

Furthermore, certain drawbacks such as network and storage, and disaster recovery complexities, associated with server virtualisation implementation, suggest that adopting organisations should endeavour to establish at an early stage the compatibility of the emerging technologies with their own standard IT/IS systems.

The learning curve associated with every innovation tells how quickly and easily the innovation can be understood and implemented (Ashley, 2009). Thus, there is a need to determine the complexity associated with server virtualisation before adoption takes place.

It is however, pertinent to note that adopters may seek to try innovations before the full adoption decision is made, or the implementation is conducted (Enfield, et al., 2011). Thus, supporting industries (vendors) should make virtualisation software available to organisations for test implementations. In addition, the trial ability characteristic of innovations suggests that it is advantageous to implement server virtualisation is better in a test environment before actual deployment in a production environment (Uddin & Rahman, 2011).

Finally, adopting organisations need to determine whether they are fully achieving all the advertised benefits of server virtualisation, and if the drawbacks are being addressed.

### **6.3 LIMITATION**

The major limitation to this study is the low response rate to the survey (Cycyota & Harrison, 2006). Eighty three responses were found useful out of the 124 responses received from the organisations which participated in the survey, and 84% of the 83 organisations which use server virtualisation were located in the Western Cape. In view of this, a qualitative approach is suggested to provide further insights on the phenomenon investigated.

### **6.4 RECOMMENDATIONS**

This research provides practical insights into the readiness of South African organisations for emerging technologies (such as server virtualisation), and offers some practical recommendations. It provides insights for decision makers, IS/IT researchers, and the IT industry. The following recommendations are made:

#### **6.4.1 Further research**

- More academic research should be carried out on new and emerging technologies and readiness assessments of these technologies perhaps through other research approaches.

- This study is suggested to be repeated using the NOIIE framework, and perhaps on other technologies than server virtualisation, in other developing countries, in order to enhance its validity.
- Further studies are suggested on governance as it affects the preparedness of organisations in developing countries for emerging technologies.

#### **6.4.2 Policy and practice**

- Lack of awareness continues to be a prominent inhibitor to adoption of technologies especially emerging technologies, and technology providers should take up this challenge.
- Organisations should improve their training programmes as each technology has its learning curve.
- Technology providers should consider cost of set up, license and software costs, to motivate organisational adoption decisions.
- The IT industry should develop more open source and free license software such as Virtual Box and ensure technical support is available to organisations.
- Organisations should review their IT and business policies from time to time, and ensure that technological readiness is part of organisational culture.

#### **6.4.3 Further development**

- There is a need to expand the NOIIE framework in order to accommodate additional factors that contribute to organisational readiness in developing countries for emerging technologies, and factors that influence organisational preparedness.

This study developed and validated a new readiness model (NOIIE), and hopes that the model will be useful for researchers to investigate readiness of organisations in developing countries, and for practitioners to have a holistic understanding of factors that contribute to, or influence their organisational readiness.

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University of Cape Town

## APPENDIX A: COVER NOTE



### UNIVERSITY OF CAPE TOWN

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#### An investigation of antecedents for organisations' readiness for server virtualisation in South Africa

Dear Sir/Madam,

I am a Masters student in the Department of Information Systems at the University of Cape Town and I am conducting a research survey on the above topic.

I will greatly appreciate your participation in this survey. Due to the current global economic recession, IT departments in organisations are challenged to provide solutions which are capable of reducing costs, and increasing productivity.

Server virtualisation is an emerging technology which is being used in developed countries to meet these demands, and it is also relevant in carbon emission reduction campaign. It is a technology which allows an x86 server computer to host up to 5 or more virtual servers.

These virtual servers behave exactly as physical servers, and in this way organisations can afford to consolidate their physical servers into few virtualised servers. The benefits include: cost reduction on cooling, maintenance, floor space, total cost of ownership, etc.

It is yet unclear if African organisations are using this technology, and what issues are they having with it?

Your own input will help me to understand the antecedents for the readiness of South African organisations to adopt server virtualisation in their environments.

The survey should take you approximately 15 minutes.

Your participation will be treated anonymously and no personal information such as name; address, and organisation's affiliation are required. The data collected will be kept in strict confidence.

I will be delighted to provide you with the final outcome of the research if you are keen to have it. Please remember to send me your email address should you be interested in the final result of the research.

Please be free to contact the researcher or supervisor at the addresses below, if you have any further inquiries.

Thank you for your time and participation.

Sincerely,

Abiodun Ogunyemi

Masters Student (Researcher)

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Kevin Johnston (Professor)

Research Supervisor

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## APPENDIX B: SURVEY QUESTIONNAIRE

### Section A

#### Server Virtualisation Implementation

(Type (x) in the appropriate box)

Has your organisation implemented server virtualisation?					
Have implemented extensively	Pilot implementation	Plans to implement in the next 12 months		Have not investigated	
Limited implementation	Plans to implement in the next 6 months	Have investigated but no firms plans			

### Section B

Please indicate your level of agreement with each of the following server virtualisation factors:

(Type (x) in the appropriate box)

		Strongly Disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly Agree
1	Server virtualisation reduces our organisation's Total Cost of Ownership (TCO) and improves its Return on Investment (ROI)							
2	Our organisation reduces costs on power and cooling as result of server virtualisation implementation							
3	Our organisation cuts its carbon footprint as a result of server virtualisation implementation							
4	Our organisation achieves less down times as a result of server virtualisation implementation							
5	Server virtualisation improves our organisation's disaster recovery capability							
6	Our organisation achieves more efficiency in CPU utilisation as a result of server virtualisation implementation							
7	Virtual machines are quicker to re-configure and deploy							
8	Our organisation gained more floor space in its data centre as a result of server virtualisation implementation							
9	Server virtualisation provides for a better management through central environment control							

		Strongly Disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly Agree
10	Server virtualisation is the backbone technology in cloud computing services							
11	It is better to implement and manage server virtualisation through outsourcing services than in-sourcing							
12	Server virtualisation implementation helps organisations to reduce the effects of economic downturn such as cut in IT budgets							
13	Virtual servers are more vulnerable to malicious attack than stand-alone servers							
14	Virtual sprawl could arise from uncontrolled deployments of virtual servers							
15	Skill set scarcity affects successful management of virtual server environments							
16	Cost of virtualisation software is critical to server virtualisation implementation							
17	Server virtualisation deployments create licensing legal risks							
18	Our organisation's current server computers do not have good hardware support for virtualisation							
19	Our IT infrastructures do not have good platform support for virtualisation							
20	Virtualisation software has limited multi-monitor support within virtual machines							
21	Our organisation must purchase new server hardware in order to implement server virtualisation							
22	Our organisation's IT department has the expertise to support server virtualisation							
23	Our organisation's top-executives have relevant IT skills to support IT decisions							
24	Our organisation is very critical about Business and IT alignment							
25	Disaster Recovery and High Availability are critical to our organisation							
26	Change management is crucial to our organisation							
27	Our organisation's IT policy does not support early adoption of new technologies such as server virtualisation							

		Strongly Disagree	Disagree	Disagree somewhat	Neutral	Agree somewhat	Agree	Strongly Agree
28	Personnel training and development programmes are crucial to our organisation							
29	Clients' service level requirements are critical to our organisation							
30	Virtualisation software vendors such as VMware, Microsoft, Citrix, Sun, and Oracle offer product awareness							
31	Virtualisation software products such as VMware, Microsoft Virtual Server, Citrix Xen, Sun xVM, and Oracle VM are readily available in markets							
32	Virtualisation products such as VMware, Microsoft Virtual Server, Citrix Xen, Sun xVM, and Oracle VM perform to expectation							
33	Virtualisation software vendors such as VMware, Microsoft, Citrix, Sun, and Oracle provide products online and offline supports							
34	Virtualisation software vendors such as VMware, Microsoft, Citrix, Sun, and Oracle provide products update and upgrade supports							
35	Our organisation virtualisation software product does not have licensing complexity							
36	Our organisation moved from controlled risk to calculated risk as a result of server virtualisation implementation							
37	Our organisation's business growth enhances as a result of server virtualisation implementation							
38	There are IT staff in our organisation that are not interested in server virtualisation							
39	There are Application Owners and Users in our organisation that are not interested in server virtualisation							
40	There are certain top-executives in our organisation that are not interested in server virtualisation							
41	Our organisation has mission-critical servers that are unsuitable for server virtualisation							
42	Our organisation has business associates that are not interested in server virtualisation							
43	Certain external organisation(s) influenced our organisation's decision to reject server virtualisation							

### Section C

Please rate the following e-readiness indicators for South Africa

(Type (x) in the appropriate box)

<b>Question: How will you assess the e-readiness of South Africa in terms of the following criteria?</b>							
	<b>Poor</b>	<b>Fair</b>	<b>Average</b>	<b>Neutral</b>	<b>Good</b>	<b>Very Good</b>	<b>Excellent</b>
High broadband connectivity							
Low costs of broadband and bandwidth							
Internet Service Providers (competitiveness, secure connectivity, and affordability)							
Attractiveness to business investments							
Business laws and government policies							
Labour market							
Socio-economic stability							
Political stability							
ICT policies							
Business registration process							
Internet regulations and policies							
ICT use by the citizens and organisations							
E-Government services							
E-Commerce							
ICT investments by the citizens and organisations							
E-Government participation by the citizens and organisations							

### Section D

<b>1. What virtualisation software has your organisation implemented?</b>					
VMware		Citrix Xen		Oracle VM	
Microsoft Virtual Server		Sun xVM		Other	Please specify here:

<b>2. What sector does your organisation belong to?</b>					
Automobile		Construction		Internet Services	Oil & Gas/Energy
Banking & Finance		Information Technology		Manufacturing	Software Development/Services
Telecommunications		Textile		Other	Please specify here:

3. Where is your organisation located in South Africa?				
Eastern Cape		Gauteng		Limpopo
Free State		KwaZulu-Natal		Mpumalanga
Western cape				Northern Cape
				North West

4. How many server computers do you have in your organisation?				
1-10		21-30		41-50
11-20		31-40		51-100
				101 - 200
				More than 200

5. How many employees do you have in your organisation?				
1-10		21-50		101-200
11-20		51-100		201 - 250
				More than 250

6. What percentage of your organisation's annual budget goes to IT?				
1-5%		11-20%		31-40%
6-10%		21-30%		41-50%
				More than 50%

7. What is your role in your organisation?				
Chief Executive Officer		IT Manager		Network Administrator
Chief Information Officer		Senior IT Officer		Systems Manager
Other		Please specify here:		
				IT Analyst
				Chief Technical Officer

8. Please identify at least three factors that would enhance or hinder adoption of server virtualisation in developing countries' organisations

.....  
 .....  
 .....  
 .....

9. What have you found to be the benefits and drawbacks of server virtualisation?

.....  
 .....  
 .....  
 .....

Thank you for your time and participation.

## APPENDIX C: A SNAPSHOT OF PART OF THE SURVEY SPREAD SHEET

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	SV1	SV2	SV3	SV4	SV5	SV6	SV7	SV8	SV9	SV10	SV11	SV12	SV13	SV14	SV15	SV16	SV17	OR1	OR2	OR3	OR4	OR5	OR6	OR7	OR8	OR9	OR10	OR11	OR12
2	7	7	5	4	7	7	6	3	5	7	4	6	3	5	6	4	4	4	3	3	2	7	2	6	7	7	5	2	
3	7	7	7	7	7	7	7	7	7	7	6	7	1	4	1	5	7	4	6	6	4	5	7	3	5	5	4	5	
4	7	6	6	7	7	7	7	7	7	6	4	6	5	7	6	5	4	5	7	7	4	1	7	6	4	7	7	7	
5	7	7	7	7	7	6	7	6	6	6	7	6	4	5	4	4	6	6	7	7	4	6	6	5	7	7	7	4	
6	6	6	6	3	5	6	6	6	5	6	5	4	2	5	4	3	5	4	3	4	4	5	6	6	6	7	7	6	
7	6	7	7	7	7	6	7	7	5	5	4	7	3	7	6	3	5	6	7	7	2	3	7	2	2	7	7	6	
8	7	7	6	7	6	7	7	7	7	6	6	4	6	4	6	5	5	6	6	6	5	6	3	6	5	7	6	3	
9	7	7	6	4	5	7	4	7	4	6	6	6	4	6	5	4	5	5	6	6	3	4	6	7	7	7	7	3	
10	6	6	5	5	5	6	6	7	5	6	6	5	3	5	5	5	5	5	6	6	5	5	5	6	5	6	5	6	
11	6	7	6	5	6	7	7	7	4	4	5	6	4	7	4	6	4	7	6	6	4	2	4	4	4	7	7	1	
12	7	7	6	6	7	5	7	7	7	6	3	6	1	5	7	3	6	6	6	6	2	5	6	3	6	7	7	7	
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16	5	6	5	6	6	6	6	6	6	6	5	6	5	5	5	5	6	5	2	2	6	5	5	5	6	6	6	2	
17	6	6	6	6	6	6	6	6	6	6	6	6	2	7	7	3	6	7	5	5	3	5	6	6	6	6	6	6	
18	7	6	6	5	6	6	4	5	6	5	4	5	4	6	7	7	5	4	7	7	4	1	7	6	4	4	4	4	
19	6	7	7	7	7	7	7	7	6	6	5	6	2	7	6	4	6	5	4	7	4	6	7	6	6	7	7	2	
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23	7	7	7	7	7	7	5	6	6	6	6	5	3	3	6	4	3	6	6	6	4	3	6	5	5	7	7	5	
24	7	7	7	6	6	7	7	6	6	6	6	4	2	4	6	4	4	4	6	6	4	2	7	7	1	4	6	6	
25	7	6	6	7	5	7	7	7	7	5	7	6	2	5	1	1	4	4	7	7	2	3	7	5	6	5	6	6	
26	5	6	6	4	4	6	5	7	4	6	5	5	2	5	6	6	4	4	6	6	3	2	6	3	6	7	7	5	
27	6	6	6	6	6	6	6	6	5	7	5	5	2	6	6	6	5	6	4	6	4	5	6	6	6	6	7	5	
28	6	6	6	6	6	6	6	6	4	7	5	4	2	7	5	2	4	5	6	6	3	5	6	2	1	7	6	1	
29	5	4	5	6	6	7	3	5	5	4	6	6	6	4	6	6	4	6	6	6	4	5	5	3	3	6	6	3	
30	5	6	6	4	6	6	4	4	4	6	6	4	2	6	5	4	4	5	3	4	4	5	5	4	4	4	5	3	
31	6	5	5	5	4	5	6	6	6	5	3	4	3	3	5	3	5	6	6	6	3	2	6	3	5	6	6	5	
32	6	6	6	5	4	5	6	7	6	6	4	6	4	6	5	6	5	5	5	5	4	3	6	6	5	6	5	6	
33	7	6	6	6	6	6	7	7	7	7	7	6	4	6	4	4	6	3	6	6	2	3	7	5	7	6	6	5	
34	6	7	5	6	7	6	7	7	6	4	6	6	2	4	2	1	4	3	6	6	4	4	6	6	6	7	7	6	
35	7	7	7	7	7	7	7	7	7	7	6	5	1	5	1	1	4	2	7	7	4	1	7	7	5	3	6	6	
36	6	5	5	5	7	5	6	6	5	5	5	6	4	5	5	5	4	4	6	6	4	5	6	5	7	7	7	6	
37	6	6	6	6	7	6	7	7	7	6	5	6	2	5	7	2	6	7	3	5	3	6	6	6	6	6	6	6	
38	6	7	6	7	7	6	7	7	7	5	6	6	4	7	7	4	4	4	6	6	2	5	6	6	2	7	7	5	
39	7	7	7	7	7	7	7	7	7	6	5	6	3	5	1	4	2	3	5	6	4	4	6	2	4	5	2	6	
40	6	7	7	6	6	5	6	6	5	4	5	6	3	4	6	4	6	3	6	6	2	3	6	7	7	7	7	6	
41	6	6	7	7	7	7	7	7	7	7	4	4	2	5	5	4	4	5	6	6	4	2	7	5	6	7	6	7	

## APPENDIX D: STATISTICAL PROCEDURES FOR NOIIE EFFECT SIZES

Dependent variable: Server virtualisation

$$R^2_1 = 0.45$$

Without National E-Readiness,  $R^2_* = 0.42$ , thus

$$f^2 \text{ (for National E-Readiness)} = 0.45 - 0.42 / 1 - 0.45$$

$$= 0.03 / 0.55$$

$$= 0.05$$

Similarly, without Organisational Preparedness,  $R^2_* = 0.31$ , thus

$$f^2 \text{ (for Organisational Preparedness)} = 0.45 - 0.31 / 1 - 0.45$$

$$= 0.14 / 0.55$$

$$= 0.25$$

Similarly, without Industrial Relationships,  $R^2_* = 0.35$ , thus

$$f^2 \text{ (for Industrial Relationships)} = 0.45 - 0.35 / 1 - 0.45$$

$$= 0.10 / 0.55$$

$$= 0.18$$

Dependent variable: Organisational Preparedness

$$R^2_1 = 0.12$$

Without Internal Resistance,  $R^2_* = 0.08$ , thus

$$f^2 \text{ (for Internal Resistance)} = 0.12 - 0.08 / 1 - 0.12$$

$$= 0.04 / 0.88$$

$$= 0.05$$

Similarly, without External Influence,  $R^2_* = 0.09$ , thus

$$f^2 \text{ (for External Influence)} = 0.12 - 0.09 / 1 - 0.12$$

$$= 0.03 / 0.88$$

$$= 0.03$$

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