UNIVERSITY OF CAPE TOWN

Department of Construction Economics and Management

Research Report

Master of Science in Project Management

A SYSTEMIC EXPLORATION OF INFORMATION SYSTEMS PROJECT RISKS IN THE SOUTH AFRICAN PUBLIC SECTOR

Poelo Leo Chiloane

CHLPOE001

Supervisor: Dr Nien-Tsu Tuan

Plagiarism Declaration

I know the meaning of plagiarism and declare that all the work in the document, save for that which is properly acknowledged, is my own. This thesis/dissertation has been submitted to the Turnitin module (or equivalent similarity and originality checking software), and I confirm that my supervisor has seen my report and any concerns revealed by such have been resolved with my supervisor.

Signature: Signed by candidate

Date: 21 February 2021

Abstract

Purpose: This study aims to investigate Information Systems (IS) project risks in the South African public sector, and to develop a systemic model of the most dominant risks encountered and identify the interrelationships that exist between these risks.

Design and methodology: The study is conducted through the application of Interactive Management (IM) to identify IS project risks and structure the interrelationships between them. The IM methodology comprises of four key phases: Idea Generation, Idea Clarification, Idea Structuring, and Interpretation. A workshop with a group of participants is required to carry out an IM intervention successfully. During the Idea Generation phase, participants are asked a triggering question to elicit ideas, which are then clarified and structured in the subsequent phases of IM before final interpretation.

Findings: In the Idea Generation phase, six IM participants working on public sector IS projects were asked a triggering question to elicit dominant IS project risks they perceive to be important. The participants initially identified 34 IS project risks, which were reduced to 24 after they brainstormed their relevance during the Idea Clarification phase. Further deliberations led to the participants removing another risk during the Idea Structuring phase. During the Idea Structuring phase, the remaining 23 risks were structured to produce an Interpretive Structural Modelling (ISM) digraph with the aid of software. The ISM digraph revealed three risk factors as the primary drivers of IS project risks in the public sector, specifically, in the context of this study. These risks are 'lack of consultation with users', 'budget cuts' and 'excessive red tape'.

Value of study: This research contributes to the following: (1) the existing knowledge-base on public sector IS project risk management; (2) the focus on a soft systemic approach such as IM helps in uncovering context-specific issues on IS project risks that may not be available in extant literature; and (3) the collaborative learning process of the IM approach adds to research on the sustainability of complex IS projects implemented in the public sector.

Keywords: Systemic Thinking, Interactive Management, Interpretive Structural Modelling, Information Systems Risks, Risk Management

Acknowledgements

I would like to thank everyone who played a role in supporting me throughout the execution of this research:

To Promise, Justin and Fabio, thank you for being great study mates during the coursework component of this degree.

To the IM workshop participants, this research project would have been impossible to complete without your participation. Thank you for providing insights on current challenges faced by public institutions implementing IS projects.

Most importantly, to my supervisor Dr Nien-Tsu Tuan, thank you for all the guidance you have provided me and all the patience you have shown throughout my research journey.

Table of Contents

List of Tables

List of Figures

List of Acronyms

ANOVA	Analysis of Variance
APMBoK	Association for Project Management Body of Knowledge
CDA	Critical Discourse Analysis
CSH	Critical Systems Heuristics
CSIR	Council for Scientific and Industrial Research
DOL	South African Department of Labour
ICT	Information and Communications Technology
ICT4D	ICT for Development
ICT4RED	ICT for Rural Education
IFMS	Integrated Financial Management System
IM	Interactive Management
IS	Information Systems
ISM	Interpretive Structural Modelling
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PPP	Public-Private Partnership
SD	Systems Dynamics
SIS	Siemens Information Services
SOSM	System of Systems Methodologies
SSM	Soft Systems Methodology
U.S	United States of America

Chapter 1 - Introduction

1.1. CONTEXT

The fourth industrial revolution is rapidly transforming the fundamental ways in which organisations and people relate to one another. The Information Technology (IT) sector is at the forefront of this revolution, and with this, an increase in the adoption of Information Systems (IS) will be one of the main drivers of organisational change. Despite increased rates of IS adoption, the failure rates of IS projects still remains very high (Standish Group, 2015; Geneca, 2017). This persistent failure rate that has plagued the performance of IS projects is even higher in public sector IS project implementations, more so in developing countries than developed economies (Heeks, 2002; 2003; Matavire *et al.*, 2010; Anthopoulos *et al.*, 2016).

The literature on public sector IS projects implemented in developing countries suggests that there are contextual risk archetypes and country context-specific issues driving the underperformance of IS (Heeks, 2002; 2006; Bhuiyan, 2010; Matavire *et al.*, 2010; Aladwani, 2016). These are mostly driven by mismatches stemming from design-reality gaps between project designs that do not fit the realities of developing country contexts (Heeks, 2003). Furthermore, another factor adding to the underperformance of IS projects is the multi-dimensional complexity of IS projects and their environments (Joseph, 2017). This research report presents a study on the exploration of risks in public sector IS projects, which contribute to the underperformance and high failure rates of these projects.

A systemic view of IS project risks is promoted as the adequate approach for exploring risks factors due to the complex nature IS projects and their environments (White, 1995; Joseph, 2017). This is because reductionist approaches are not suitable for dealing with IS project risks since they cannot adequately deal with the emergent nature of risks and the interrelationships that exist between them (White, 1995). Furthermore, literature sources (Alexander, 2002; Tuan, 2004) suggest that cognitive issues have a significant contribution to complex problems. In order to effect change, complexity should be addressed through a systemic view of problems and an adequate approach for dealing with such complexity should allow for the consideration of multiple perspectives from stakeholders affected by the problem (Alexander, 2002; Reynolds and Holwell, 2010).

The study is conducted through the application of Interactive Management (IM) to identify IS project risks and structure the interrelationships among them. IM is a systemic approach created for the management of complexity in organisations (Warfield and Cárdenas, 1994: 1). The IM approach uses collaborative teamwork to define and resolve highly complex issues and problems that cannot be readily solved by organisations (Warfield and Cárdenas, 1994; Alexander, 2002). It is an interactive learning process that transforms inadequately expressed mental models of systems into well-defined structural models. The learning process centres around participation and is facilitated by conducting a structured intervention with a group of participants representing different stakeholder perspectives.

1.2. STUDY BACKGROUND

This section presents a theoretical background to the study by briefly discussing the challenges and risks of IS projects in the public sector. Before the discussion begins, a brief description of IS project terminology to clarify what the term IS encompasses is provided.

1.2.1. Clarity on IS Project Terminology Used in this Study

In the context of this study, Information Systems (IS) is an inclusive term for describing the organisational and technological aspects of Information Technology (IT) implementations. As such, different terms relating to IS project types will be encountered throughout the document. The term is often used interchangeably with IT and Information and Communications Technology (ICT) depending on the context. IT is also used as an inclusive term in literature, often encompassing software development and implementation. Furthermore, the focus of this study is on public sector IS projects. There are different terms denoting different types of IS project implementations in the public sector. Frequent examples included in this report include eGovernment and ICT for Development (ICT4D). The reader should note that all of these terms are subsets of IS projects.

1.2.2. Prevalence of Challenges in IS Projects

Studies on the performance of IS implementations are prominent in IS research (Dwivedi *et al.*, 2015), yet the failure rates of IS projects remains high, and researchers are still exploring their underperformance (Joseph, 2017). Several statistics published in industry and academia might shed some light on the extent of IS project challenges. Table 1-1 shows a summary of statistics gathered from academic literature and industry reports.

Table 1-1: Summary statistics of IS project challenges and failure sourced from industry reports and academic literature

#	Source	**Description of Challenges or IS Project Failure**
1	Standish Group (2015)	The Standish Group publishes an annual survey on the success of IT projects. In the report, success is defined as a measure of meeting the schedule requirements, the budget, and delivering satisfactory results. The 2015 report indicates that 19% of IT projects completely fail, and 52% of projects fail partially.
2	Flyvbjerg and Budzier (2011)	In a Harvard Business Review survey of 1,471 projects, of which 92% were from public agencies, it was estimated that the average cost overrun in IT projects is 27%. Furthermore, one in six of the surveyed IT projects had a 200% cost overrun and a schedule overrun of almost 70%.
3	Bloch *et al.* (2012)	In a study conducted by McKinsey and the University of Oxford, in which more than 5400 large scale IT projects were surveyed, it was reported that *"17% of IT projects go so bad that they threaten the very existence of the company".*
4	Geneca (2017)	In a study of 600 IT and business executives conducted by U.S software company Geneca, respondents revealed: • 75% of their projects "were either always or usually doomed right from the start." • 80% of their project time was spent on rework. • 55% of their projects did not have clear objectives.
5	Heeks (2001; 2003); Neto *et al.* (2005); Goldfinch (2007); Hidding and Nicholas (2009); Anthopoulos *et al.* (2016)	These are studies on the success of IS projects in the public sector. They reveal some insightful statistics on the success of IS implementations: • 35% of public IS projects around the world are complete failures, 50% of them fail partially, and only 15% of them succeed (Heeks, 2001; 2003). This suggests an 85% failure rate in the implementation of IS in the public sector, which is a significantly higher number than the failure rates of approximately 70% reported by the Harvard Business Review and in the CHAOS reports published by the Standish Group on the general success rates of IS projects (Flyvbjerg and Budzier, 2011; Standish Group, 2015).

		• In a study by the World Bank, Neto *et al.* (2005) suggest that public sector IS project failure is even worse in developing countries than developed countries, with a majority of public IS projects failing in the developing world. This sentiment is also shared by Heeks (2002; 2006); Elkadi (2013); Teklemariam and Mnkandla (2017); Taherdoost and Keshavarzsaleh (2018); Gupta *et al.* (2019) [See Section 1.2.3. for a discussion on challenges with IS implementation in developing countries] • A New Zealand government study reported a 59% partial failure rate for public ICT projects and a complete failure rate of 3% (Goldfinch, 2007). Together, these constitute a failure rate of 62%, which is significantly lower than the 85% reported by Heeks (2003), thereby indicating a disparity between developed and developing countries. • In a study of eGovernment (IS) in the U.S, Anthopoulos *et al.* (2016) state that "more than half of e-government projects result in total or partial failures. Research shows that more than half of eGovernment projects result in total or partial failures with regard to the initially grounded standards, scheduling or budgeting plans, while even more fail to meet end-users' expectations."

The statistics shown in Table 1-1 suggest that IS project failure is more prevalent in the public sector, with approximately ±85% of projects failing (Heeks, 2003; Taherdoost and Keshavarzsaleh, 2015) against the ±70% industry average (Flyvbjerg and Budzier, 2011; Standish Group, 2015). The study by Anthopoulos *et al.* (2016) explored the causes of IS project failure by analysing eGovernment implementation in the United States (U.S). The study analysed the implementation of the U.S healthcare.gov website, as it was a highly publicised eGovernment project failure and enough data could be gathered on why the project failed throughout the life-cycle of the project and beyond (looking at user-satisfaction), by analysing social media information about its implementation. The healthcare.gov is a medical insurance website operated by the federal government of the U.S (Department of Health and Human Services). Anthopoulos *et al.* (2016: 165) describes the website as a "clearinghouse to allow Americans that need a health insurance plan" to compare price plans in their respective states, enrol, and discover if they qualify for subsidised healthcare.

The launch of the website was described to be a very complicated undertaking ever to be implemented by the federal government (Anthopoulos *et al.*, 2016). In fact, the development of the website involved 55 different contractors. As a result, it suffered from multiple publicised failures, which included (Anthopoulos *et al.*, 2016):

1) a crash during its launch, remaining inactive for several weeks,
2) failing to meet its initial requirements after the launch,
3) several glitches for a period of time, and
4) of the 9.47 million users that attempted to register on the website, only 271,000 succeeded.

The causes of failure are well documented by Anthopoulos *et al.* (2016), but a close inspection of the failures mentioned above indicates that they were post-completion project failures hence they might have been avoided by paying attention to and managing pre-completion project failures. Anthopoulos *et al.* (2016: 163) points out that *"design-reality gaps appear to the most important pre-completion failure reason"* identified in research. Furthermore, risks associated with political sources increase this design-reality gap (Anthopoulos *et al.*, 2016).

A design-reality gap is described as a mismatch between IS project design and on-the-ground reality (Heeks, 2002; 2003). Heeks (2002; 2003) describes it as the underlying cause of eGovernment (IS) failure and characterises it by three risk archetypes, which include:

1) **Hard-Soft Gaps:** ICT systems are often designed in terms of notions of engineering, rationality and objectivity ("hard" ideas). But the reality is dominated by "soft" factors which include people, politics, emotions and culture.
2) **Private-Public Gaps**: This relates to differences between the private and public sectors. Often the public sector uses information systems designed for, or by the private sector. This creates a design-reality gap where an information system is designed for an environment that is not the same as its use (reality) environment.
3) **Country-Context Gaps:** This relates to developed vs developing country context. The design-reality gap, in this case, is created by introducing an IS designed in, and for a developed country to a developing country (reality).

Heeks (2003) points out that the greater the design-reality gap, the higher the risk of IS failure. Conversely, the chances of IS success improve with a smaller design-reality gap. The country-context gap risk archetype increases the risk of IS failure in developing countries. As a matter of fact, Heeks (2002: 102) indicates that *"there is evidence and practical reason - such as lack of technical and human infrastructure – to support the idea that failure rates in developing countries might be higher, perhaps considerably higher".* Thus, it is imperative to understand the risk factors that exacerbate IS project failure in developing countries, not only because IS project failure rates are higher, but also due to the fact that most developing countries are resource-poor and cannot absorb losses from IS investments. The next section provides an overview of the critical challenges of IS implementations in the context of developing countries.

1.2.3. IS Implementation in the Context of Developing Countries

The previous sub-section highlighted the country-context gap as one of the reasons why IS project failure is higher in developing countries. To elucidate a similar point, Matavire *et al.* (2010) highlight that developing countries often adopt ICT's naively without considering social, cultural and historical contexts in the implementation environment. Adoption of ICT's without considering the country context could give rise to out-of-area risks. These are risks associated with projects outside the country of the implementing organisation (Cooper *et al.*, 2014: 387). Thus, the key challenges and risks in the implementation of IS projects should also be considered from a regional or country perspective. The key challenges to IS implementation in Africa posited by Matavire *et al.* (2010: 155) include: "*development of ICT infrastructure; human resources development and employment creation; the current African position in the world economy; and insufficient legal and regulatory frameworks and government strategy".* Adding to the different social, cultural and historical contexts the literature also points to corruption and political factors as another big challenge in the public sector implementation of IS in developing countries (Bhuiyan, 2010; Aladwani, 2016).

1.2.4. Public Sector IS Projects in South Africa

The South African public sector is administratively differentiated according to three spheres of government. These are the national government, provincial government and local government. In the context of this study, any organisation that:

1) is primarily funded by any of these spheres of government;
2) is co-owned by the government; and
3) receives its mandate from the government

is considered to be an organisation operating in the public sector. It is within this context, with which IS project risks in this study will be considered. Moreover, the scarcity of skilled IT professionals often results in the government of South Africa engaging in Public-Private Partnerships (PPP) to enhance public sector skills development (Albertus *et al.*, 2015). Information systems projects implemented within this context will also be considered to fit within the context of this study. The following sub-sections detail examples of IS project implementations and the challenges and risks associated with them. The examples include the implementation of the Integrated Financial Management System (IFMS) for South Africa (Hendriks, 2013); a PPP contract between the South African Department of Labour and Siemens Information Services (Albertus *et al.*, 2015); and an ICT4D implementation for rural education in the Eastern Cape Province of South Africa (Meyer *et al.*, 2017b).

Integrated Financial Management System (IFMS) for South Africa

The implementation of the IFMS is an example of a very challenged IS project by the South African government. The IFMS project is an initiative led by the National Treasury department intended to integrate transverse (general administrative) IT systems operated by the South African government (Hendriks, 2013). It is envisaged that the IFMS would be used by multiple spheres of the South African government because transverse systems are required by national and provincial government departments (Hendriks, 2013). The transverse systems to be integrated by the IFMS include functions related to *"financial management; human resource management; integrated supply chain management; and related business intelligence, audit and decision systems* (Hendriks, 2013: 3)*"*. As such, due to its sheer size and complexity, the IFMS poses a significant number of challenges and risks that go beyond technological risks (Hendriks, 2013). From similar studies conducted in other developing countries in Africa (Tanzania, Malawi, Ghana, Uganda, Kenya, Ethiopia and Rwanda) Hendriks (2013) indicates that the challenges and risks associated with the IFMS project implementation are:

1) **Lack of capacity:** this relates to the shortage of skilled IT personnel;
2) **Weak commitment to change:** this relates to risks caused by weak commitment to adapt to changes in technology, required skills, and behaviours by high ranking government officials and senior managers;

3) **Organisational arrangements:** this covers risks related to organisational culture and lack of collaboration between teams; and
4) **Legal framework:** lack of legal guidance on the responsibilities and roles of organisations involved in the implementation of IFMS.

The IFMS for South Africa was initially approved for implementation in the year 2005 with plans for it to be fully implemented by the year 2011 (Hendriks, 2013; South African National Treasury, 2019). Due to multiple challenges and the risks associated with them, the IFMS has not been fully implemented to this date, and currently, the final phase is projected to be only completed in the year 2021 (South African National Treasury, 2019). If the concept of project success were to be measured by the Standish Group resolution introduced earlier in section 2.2 [i.e. as meeting the schedule requirements, the budget, and delivering satisfactory results (Standish Group, 2015)], the IFMS would be classified as an extreme case of project failure as this would indicate a schedule overrun of 160% or 10years from the original plan. Detailed documentation of challenges encountered in the implementation of IFMS in South Africa, which explain the schedule overrun are well documented by the South African National Treasury (2019) as a roadmap from the year 2005 (project inception) to the year 2021 (estimated project completion year). The challenges encountered led to the South African Parliament to initiate a series of public hearings with National Treasury from the year 2017 to the year 2018. These hearings are documented in a forensic report which is accessible on the Parliamentary Monitoring Group website (Public Accounts (SCOPA), 2018).

Public-Private Partnership IS Contracts: Labour and Siemens Information Services

Efforts to enhance skills and services in the public sector sometimes lead to governments engaging in Public-Private Partnership (PPP) contracts (Albertus *et al.*, 2015). Driven by the scarcity of key IS skills in the public sector, the South African Department of Labour (DOL) contracted Siemens Information Services (SIS) for the implementation of ICT services (Albertus *et al.*, 2015). Albertus *et al.* (2015) used Critical Discourse Analysis (CDA) to analyse the PPP contract between the DOL and SIS in an effort to uncover issues affecting the implementation of IS in this type of contracting between the public and private sectors. It is reported that the contract between the DOL and SIS was the first of its kind in South Africa (Albertus *et al.*, 2015). If successful, this method of contracting could have reduced the public sector's over-reliance on the private sector for IS services by way of outsourcing, as this often results in wasteful expenditure and aggravates the skills gap between the public and private sectors (Albertus *et al.*, 2015). However, the contract between the DOL and SIS ended up being classified as a failure. The DOL and SIS project fits into the context of this research due to its end result. The novelty of the contract could provide more insights on risks arising from PPP contracting in the implementation of IS in the public sector.

The contract between the DOL and SIS had a duration of 10 years and was for the implementation of Enterprise Resource Planning, which is an integrated way of managing business processes facilitated by software (Albertus *et al.*, 2015). In a way, this project shared similarities with the IFMS project reviewed in the previous section because both projects are for the implementation of IS in managing day-to-day business processes. The DOL/SIS project, however, was a novelty in that it was also a way of building IS skills capacity in the public sector because SIS had to train DOL staff to manage the IS services themselves within that ten year period (Albertus *et al.*, 2015). However, due to the fact that this did not materialise and that most of the delivered systems had functional problems, the project can be classified as a failure. Some of the issues and inherent risks identified in the implementation of this project include (Albertus *et al.*, 2015):

1) **Lack of skills:** this relates to the failure to develop internal capacity at DOL to manage the IS after the contract ended;
2) **Poor IS management competencies:** the DOL management personnel did not have enough competencies to manage oversight of the IS implementation by SIS. Furthermore, there was a general lack of involvement and proper contract management by the DOL;
3) **Relationship breakdown:** the relationship breakdown between the DOL and SIS *"led to fewer constructive discussions and decision-making forums."*
4) **Lack of integration** between the new system and existing systems at the DOL;
5) **Failure to conduct a post-implementation review:** this resulted in corrective actions not being taken to resolve outstanding issues;
6) **Problems with subcontracting:** SIS subcontracted another company (EOH) for services and the DOL was not happy with the arrangement; and
7) **Length of the contract period:** A ten year period is too long for the IT industry. This brings about additional risks and challenges driven by rapid technological changes.

ICT4D: ICT for Rural Education in the Eastern Cape Province of South Africa

ICT4D projects are another focus of IS application in the public sector. These are IS projects targeted at socio-economic development and are considered as a way to address development problems because of their role in reducing the digital divide between developed and underdeveloped societies, which exacerbates the failure to achieve development objectives (Meyer *et al.*, 2017b). The key differences between ICT4D projects and commercial IS projects (phases) are summarised in Table 1-2. By reflecting on a study carried out by Meyer *et al.* (2017b), which applied systems thinking perspectives to uncover challenges in the project implementation of an ICT for Rural Education (ICT4RED) in the Eastern Cape province of South Africa, this section points out the problems associated with these key differences.

Table 1-2: Key differences between commercial IS project phases and ICT4D projects. Adapted from Meyer *et al.* (2017b)

Project phase: Commercial IS Project	**ICT4D Project**
Single proposals with budget and timelines	Many proposals to different funders; Unclear objectives and milestones
Conceptualisation	Ambitious concept; Unfamiliar project environment
Design	Design by learning
Solution development	Resource-rich solution for a resource-poor world
Implementation	Unexpected challenges
Training and maintenance	Limited literacy; Remote locations; Low skills and technology base

The key differences of ICT4D projects and the challenges encountered during the implementation of the ICT4RED project corroborate the significance of the previously mentioned risk archetypes caused by the design-reality gaps highlighted by Heeks (2003). This can be ascertained from Meyer *et al.* (2017b: 465) who states that the differences of ICT4D implementations are “*attributable to the divergences between resource-rich and resource-poor environments (such as differences in literacy, skills, and the ability to maintain the technology)”.* Evidence of this from the ICT4RED implementation was that the pilot phase for the project, undertaken by the resource-rich Council for Scientific and Industrial Research (CSIR) Meraka Institute was initially successful when the ICT intervention involved the introduction of computers and tablets in 26 rural schools in the Eastern Cape. However, the project failed later due to sustainability issues exacerbated by the lack of resources, skills and capacity when it had to be handed over to the resource-poor Eastern Cape Department of Education (ECDoE). Specific issues mentioned by Meyer *et al.* (2017b) include:

1) An underestimation of the state of unreadiness within the district and provincial education entities;
2) Difficulty in obtaining financial commitment; and
3) Low prioritisation of project needs which was not caused by an unwillingness in the ECDoE, but was a reflection of the lack of resources and problems with the structural design of the project.

These problems which are related to the design-reality gap risk archetypes described in Heeks (2002; 2003), led to Meyer *et al.* (2017b) taking on a systems approach to develop a conceptual framework to study the issues of sustainability encountered in the ICT4RED project, and by extension ICT4D projects. In this framework, the sustainability of ICT4D is defined in systems terms by the elements and interrelationships required to sustain ICT4D interventions (Meyer *et al.*, 2017b). It is the application of a systems approach in exploring the elements (issues) of an IS project that will be of relevance to this research because ICT4D projects also share similarities with other types of public sector IS implementations in developing countries. These similarities also extend to project risks, as highlighted by the challenges and risk factors discussed in the IS project implementation examples given in this and the above sub-sections. As such, it is also essential to understand how IS project risk management is practised in the South African public sector. The next chapter provides a review of IS project risk management, highlighting the most commonly encountered project risks. Before the review of commonly encountered IS project risks is given, a statement of the research problem, research questions, aim and objectives of the study are provided for context.

1.3. PROBLEM STATEMENT

The complexity of public sector IS projects is multi-faceted. Moreover, public sector IS projects implemented in developing countries are more complex because of contextual project risk archetypes inherent in these environments, but the interrelationships that exist between these risks have received very little attention. This results in persistently high project failure rates, *which have a negative impact on the sustainability of IS projects in resource-poor developing countries.*

1.4. RESEARCH QUESTIONS

The following research questions will be addressed in this study:

1) What are the dominant risk factors that significantly give rise to the under-performance of Information Systems projects in the South African public sector?
2) Are the risks factors that dominate public sector IS projects in South Africa interrelated?
3) Which of the identified risks are the drivers of persistent IS project under-performance?

1.5. AIM OF THE STUDY

This study is aimed at developing a systemic model of the most dominant risks in IS projects implemented in the South African public sector and identifying the interrelationships that exist between these risks.

1.6. RESEARCH OBJECTIVES

The objectives of the study are to:

1) Identify dominant risks affecting the performance of IS projects implemented in the South African public sector;
2) Identify significant interrelationships that exist between these risks; and to
3) Identify the persistent drivers of IS project under-performance from the identified risks.

1.7. STRUCTURE OF THE REPORT

This research report comprises of five major chapters plus a detailed list of references cited in the report and annexures with ancillary information used to support the research. The title and contents of each chapter are given below:

1) **Chapter 1: Introduction**

   Chapter 1 introduces the research topic by providing the rationale behind the study as well as an outline of the research approach and structure of the dissertation. The chapter also gives more detailed information on the study background, including examples of IS project implementations in the South African public sector and the problems and risks associated with them.

2) **Chapter 2: Literature review**

   Chapter 2 comprises of a chronological review of literature on the evolution of IS risk management, identifying common risks in IS projects.

3) **Chapter 3: Research methodology**

   Chapter 3 provides an overview of the complex nature of IS projects. A review of systemic approaches, including the IM methodology is provided along with how it can be applied to study IS project risks in the South African public sector.

4) **Chapter 4: Research findings and discussion**

   Chapter 4 presents a detailed analysis of findings from the IM intervention.

5) **Chapter 5: Conclusions**

   Chapter 5 summarises the major points covered in the preceding chapters of the study with a focus on critical reflection from the findings. Limitations, recommendations as well as areas for further research are also presented in this chapter.

. . .

Chapter 2 - Literature Review

2.1. INTRODUCTION

Data from IS literature suggests the success rate of IS projects is persistently low (Standish Group, 2015; Geneca, 2017). Effective risk management appears among the prominent suggested methods for improving the success rate of IS projects (Smith *et al.*, 2006; Javani and Rwelamila, 2016). Thus, understanding the most common IS project risks and how they should be managed is essential for managing successful projects. This chapter provides a chronological review of IS project risk management practices, with the objective of understanding the most commonly encountered project risks and their perceived level of importance.

2.2. IS PROJECT RISK MANAGEMENT

2.2.1. Overview of IS Project Risk Management

Project management standards such as the Project Management Body of Knowledge *(PMBOK® Guide)* (PMI, 2017) and the Association for Project Management Body of Knowledge *(APMBoK)* (APM, 2012) highlight project management risk management as one of the core knowledge areas of effective project management. These standards are widely adopted in the management of IS projects and offer slightly different definitions of risk and its management, but there is a general consensus that the risk management process is iterative and includes risk identification, risk assessment and risk response managed through planning, implementation and monitoring (APM, 2012: 178; PMI, 2017: 401-402). Carvalho and Rabechini Junior (2015) point out that even though project management practices are driven by the adoption of these standards, with numerous studies conducted on the relationship between risk management and IS project success, findings on the impact of risk management are not always consistent. These divergent views on the impact of risk management are attributed to the contingent nature of project risk management and its underlying complexity (Carvalho and Rabechini Junior, 2015). Due to the contingent nature of projects, an effective project management approach (and by extension risk management) will also depend on the type of project and its level of complexity (Shenhar and Dvir, 2007). Thus, to select an effective risk management approach on the management of IS projects, one should not just consider the different risk analysis techniques available, but also the risks involved and their relative importance. This research focuses on identifying the most dominant risks encountered in the management of IS projects in the South African public sector. As such, this review will focus on common risks identified in IS projects and then highlight additional risk factors encountered in the context of developing countries with a specific focus on the South African context. Due to limited research outputs from developing countries (Marnewick and Labuschagne, 2009; Gupta *et al.*, 2019; Kanjanda and Tuan, 2020), the review will include IS literature from developed countries as well. The specific focus on the public sector of South Africa will highlight the additional risk archetypes discussed in Heeks (2002; 2003) and the background section of this report.

2.2.2. Evolution of Risk Identification and Perception in IS Projects

In a review of the limitations of IS literature, Sherer and Alter (2004) highlight that information systems risk discussions go back to at least the 1970s. Something they pointed out at the time was that while there were numerous articles identifying risks, there were still challenges presented by the lack of frameworks organising how the risks relate to one another. The section below provides a selection of prominent studies on risk identification from each decade since the 1970s and some detail on how the perceived level of importance of IS project risks has evolved over time.

One of the earliest studies that helped shape the thinking on the identification of common risks in IS and their influence on the success of IS projects was conducted by Alter and Ginzberg (1978). An analysis of fifty-six system implementations found the following eight risk factors as sources of uncertainty that appeared to reduce the likelihood of project success (Alter and Ginzberg, 1978):

1) Designer lacking experience with a similar system;
2) Non-existent or unwilling users;
3) Multiple users or designers;
4) Disappearing users, designers or maintainers;
5) Lack of support for the system;
6) Inability to specify purpose or usage patterns in advance;
7) Unpredictable impact; and

8) Technical problems or cost-effectiveness issues.

The risks identified by Alter and Ginzberg (1978) were not ranked by order of importance, partly because the risk factors and their influence were not well understood yet. The argument proposed by Alter and Ginzberg at the time was that if uncertainties or risks were detected, then appropriate measures could be taken to minimise their impact (Lyytinen *et al.*, 1998). However, the severity of impact for each risk item was not a concept thoroughly explored at the time.

Davis (1982) perceived difficulty in gathering information systems requirements as the primary source of problems plaguing the implementation of information systems. Davis (1982) argued that poor performance and high risks were caused by generalising strategies in obtaining and documenting user requirements rather than seeing alternative strategies connected in a contingency framework, with each strategy embodying a different technology/structure combination which the risk manager can configure to obtain the best fit (Lyytinen *et al.*, 1998). Davis identified the following risk items (Lyytinen *et al.*, 1998):

1) Existence and stability of a set of usable requirements;
2) The ability of a user to specify requirements; and
3) The ability of analysts to elicit and evaluate requirements.

Although strategies were identified to resolve the risks from Davis (1982), their relative importance from one another was not adequately discussed.

McFarlan (1982; 1989) proposed three risk dimensions as influencing inherent risks in IS projects. Unlike prior studies, McFarlan developed a classification system for these risks with each identified risk dimension having its own inherent risks; however, the relative importance of each risk was not highlighted (Lyytinen *et al.*, 1998). The classified risks and their dimensions are shown in Table 2-1.

Table 2-1: Mc Farlan's risk dimensions and content risk items. Adapted from Lyytinen *et al.* (1998)

Risk dimension	**Risk items**
Project size	Size in cost, Time, Staffing level, Number of affected parties
Experience with technology	Familiarity of the project team and the IS organisation with the target technologies
Project structure	How well structured is the project task

Risk identification and ranking rose into prominence in the early 1990s, most notably in the study by Boehm (1991) which identified risks through a survey of project managers. The identified risks included:

1) Personnel shortfalls;

2) Unrealistic schedules and budgets;

3) Developing the wrong functions and properties;

4) Developing the wrong user interface;

5) Gold-plating;

6) Continuing stream of requirement changes;

7) Shortfalls in externally furnished components;

8) Shortfalls in externally performed tasks;

9) Real-time performance shortfalls; and

10) Straining computer science capabilities.

Noticing very little empirical evidence of a positive impact on risk management provided by earlier risk management guidelines, Ropponen and Lyytinen (2000) identified six risk components and their associated variables (environmental factors) by surveying project managers. The survey instrument was based on the top 10 risks identified by Boehm (1991). One-way ANOVA with multiple comparisons was used to examine how environmental factors (variables) influence project risks. This resulted in these six risk components:

1) Scheduling and timing risks;
2) System functionality risks;
3) Subcontracting risks;
4) Requirement management risks;
5) Resource usage and performance risks; and
6) Personnel management risks.

By the 2000s IS risk identification and ranking was a well-established concept, with researchers at the time seeking answers to additional questions not adequately addressed in the literature. Schmidt *et al.* (2001) noted that questions on (1) typical risk factors faced by software project managers; (2) risk factors considered deserving more attention; and (3) effective countermeasures in mitigating risks, given a particular set of risk factors were not adequately dealt with in prior literature. Specific concerns included too many variations in previous attempts at theory building, lack of rigour, samples being taken from a single culture and lack of knowledge of the relative importance of risk factors (Schmidt *et al.*, 2001). These concerns were dealt with by conducting a ranking type Delphi survey with participants from Hong Kong, Finland and the United States. This was to ensure that the inquiry covered divergent opinions on the risk factors perceived important (Schmidt *et al.*, 2001). The findings yielded a composite ranking of 53 risk items, but the top 11 risk factors were found in all three participating countries. Ranked by order of importance, they are as follows (Schmidt *et al.*, 2001):

1) Lack of top management commitment to the project;
2) Failure to gain user commitment;
3) Misunderstanding the requirements;
4) Lack of adequate user involvement;
5) Lack of required knowledge/skills in the project personnel;
6) Lack of frozen requirements;
7) Changing scope/objectives;
8) Introduction of new technology;
9) Failure to manage end-user expectations;
10) Insufficient/inappropriate staffing; and
11) Conflict between user departments.

In an analysis of common risk factors relevant to the South African context, Smith *et al.* (2006) identified the top ten most important risk factors as perceived by project managers in South Africa. The study was based on an analysis of seven of the most cited research outputs at the time and the 53 risk factors identified in Schmidt *et al.* (2001). The ten most important risk factors identified included:

1) Lack of top management commitment to the project;
2) Unclear/misunderstood scope/objectives;
3) Schedule flaw;
4) Lack of client responsibility, ownership and buy-in;
5) Inadequate planning;
6) Project not based on a sound business case;

7) Lack of available skilled personnel;
8) Poor change management;
9) Lack of adequate user involvement; and
10) Poor risk management.

Of the ten identified risks from Smith *et al.* (2006), risks 5, 6, 7, and 8 were identified as uniquely important to South Africa because they were not listed in prior literature rankings.

A study by Marnewick and Labuschagne (2009) also considered factors that influence the outcome of IT projects in a South African context, although not explicitly limited to risk factors. A total of 206 respondents were surveyed through a structured questionnaire. The data were analysed through statistical tests comprising of reliability analysis, one way ANOVA and T-tests (Marnewick and Labuschagne, 2009). The following factors were identified to have a strong influence on IS project outcomes (Marnewick and Labuschagne, 2009):

1) Communication between team and customers;
2) Executive support;
3) Handling of change;
4) User involvement;
5) Clarity of business objectives;
6) Clarity of requirement definition;
7) User understanding of technology;
8) Change control processes;
9) Understanding of user's needs
10) Communication between project team members;
11) Formal methodologies;
12) Project manager competency; and
13) Support for innovative technology.

Although Marnewick and Labuschagne (2009) highlighted risks that were common in most IS projects. Their relative importance, when compared to each other, was something not discussed in detail.

Matavire *et al.* (2010) applied a grounded theory approach to investigate: (1) factors inhibiting the implementation of e-Government in the Western Cape; (2) relationships between key factors affecting eGovernment implementation; (3) How key concerns could be resolved. Grounded theory was chosen because of its usefulness in generating concepts and their relationships. The challenges and inhibiting factors ranked by order of importance are shown in Table 2-2.

Table 2-2: Key factors affecting the implementation of e-Government in the Western Cape. Adapted from Matavire *et al.* (2010)

#	Challenge	Inhibiting Factors
1	**Leadership**	1.1. Leadership structure 1.2. Government performance measurement system for department heads 1.3. Continuity of leadership 1.4. Sustained interest
2	**Fragmentation of Projects**	2.1. Financial systems fragmentation 2.2. Service fragmentation 2.3. Legislative fragmentation
3	**Appreciation of Perceived IT Value**	-
4	**Citizen Inclusion**	-
5	**Task scheduling conflict**	5.1. Task priority 5.2. Task cooperation

Unlike the previous approaches, the grounded theory approach was useful in identifying the key relationship between the issues found. However, the findings were still limited in that they did not identify which challenges should be addressed first to avoid project implementation failure.

In seeking to understand the status of risk management in public South African IT projects, Javani and Rwelamila (2016) took a quantitative approach in the form of a questionnaire survey. The rationale for the study was based on the fact that the rates of IT project failure continue to be very high and increase with IT project complexity (Javani and Rwelamila, 2016). This is despite considerable research being conducted on the failure of IT projects. By looking into the risk management practices within the public sector, Javani and Rwelamila (2016: 390-391), sought to explore the following:

1) If risk management is recognised as a knowledge base among IT experts;
2) The extent of risk management application in current IT projects; and
3) The extent to which risk management is understood by IT clients.

Risk management was considered in the context set out by the Project Management Institute (PMI, 2017) and Taylor *et al.* (2012). This involves the processes of risk identification, risk assessment (risk analysis and prioritisation), risk response planning (elimination, mitigation, transfer, acceptance and contingent action planning of risk), risk monitoring (progress feedback, progress analysis and corrective action) (Taylor *et al.*, 2012). Key aspects of the research, which make the findings relevant to this study include:

1) The research population involved 500 employees from the South African IT public sector.
2) Most of the respondents were IT project managers, with more than six years of experience and the remainder represented different stakeholder views as they were employed in a different capacity.

What is interesting from the research findings from Javani and Rwelamila (2016) is that risk management is recognised as a knowledge base; that risk management is applied in the South African public sector; and that IT project clients are aware of the inherent project risks and are involved in the risk management strategies. However, despite all these positive findings on risk management in the South African IT public sector, IS project implementations in developing countries and by extension in South Africa continue to share similar risk archetypes as evidenced in the South African examples given earlier. The failure rates for these projects also remains persistently high and increases with IT project complexity (Javani and Rwelamila, 2016). It is this problem that makes the understanding of these project risks imperative. Furthermore, merely identifying and pointing out the risks does not seem to be working in limiting or reducing the high failure of IS project implementations in the public sector. The understanding of the risks involved could possibly be enriched by taking a systems view to explore the underlying elements (risks), and the interrelationships of the system represented by an IS project in the public sector, as was seen with the use of a systems approach to explore sustainability issues of the ICT4D implementation described in the study background section (Meyer *et al.*, 2017b).

The challenge of finding out how IS project risks are interconnected still persists to this day as exemplified in the study by Kanjanda and Tuan (2020), which explored risk factors in

Zimbabwean IT projects. Specific issues highlighted by Kanjanda and Tuan (2020) included: (1) Most studies assuming that IS project risk factors are independent; (2) Limited studies from developing countries; (3) The subjective nature of risk identification and assessments. These suggest that effective risk identification and assessment (management) should be conducted within the context of the project environment. Using Interactive Management as the methodology that would adequately address these issues Kanjanda and Tuan (2020) identified six drivers of project risks, which are:

1) Limited computer literacy;
2) Poor communication;
3) Lack of executive support;
4) The complexity of design;
5) Bureaucracy; and
6) Employee turnover.

The evolution of risk identification, as outlined in this section, indicates that although multiple techniques are available for risk identification, the context of the project environment and study area are also relevant. Schmidt *et al.* (2001); Smith *et al.* (2006); Kanjanda and Tuan (2020) all provide good evidence of this, with each of their studies identifying different risks as the most prominent or unique within their respective geographic areas. Furthermore, IS projects in developing countries are often adopted without consideration to social, cultural and historical contexts (Matavire *et al.*, 2010). These challenges highlight the need for more research in developing countries. The additional risk archetypes in public sector IS projects (Heeks, 2003; 2006) could also lead to the identification of risks that are more specific to the public sector. This research addresses these challenges directly by focusing on the South African public sector. The next chapter discusses some additional challenges in IS imposed by the complexity of project elements in order to appraise a suitable methodology for identifying IS project risks.

. . .

Chapter 3 - Research Methodology

3.1. COMPLEX NATURE OF IS PROJECTS

The study background section and literature review provided some details on the nature of IS projects in the South African public sector as well as the challenges and risks associated with them. However, the structural complexities of these projects and IS projects in general, was not explained. This chapter discusses the structural complexities inherent within these projects with the aim of discovering approaches that are well suited to address this complexity and the underlying risks.

Joseph (2017) remarks that the performance of ICT projects has been a subject of research for decades, yet the projects still underperform. The extant IS literature simply focuses on the success factors for determining project success, but this view is flawed because it is unilateral and fails to capture the level of complexity in ICT/IS projects (Joseph, 2017). ICT projects are multifaceted and have a number of dimensions that influence their outcomes. Furthermore, these dimensions are interdependent and interconnected (Joseph, 2017). Joseph (2017) attributes the multidimensionality of ICT projects to five different types of project complexity constructs, which are summarised in Table 3-1.

Table 3-1: IS project complexity dimensions identified from Joseph (2017) and corroborating literature sources.

Complexity Dimensions	Complexity Elements	Sources
Organisational complexity	• Vertical differentiation or organisational hierarchy • Horizontal differentiation or number of units within an organisation • Size • Project team • Trust • Risk • Interdependencies	Baccarini (1996); Williams (1999); Bosch-Rekveldt *et al.* (2011); Geraldi *et al.* (2011); Vidal *et al.* (2011); Senescu *et al.* (2013); Dunović *et al.* (2014); Bakhshi *et al.* (2016); Floricel *et al.* (2016); Remington and Pollack (2016)
Technical or technological complexity	• Differentiation in the diversity of project inputs and outputs • Project goals	Baccarini (1996); Bosch-Rekveldt *et al.* (2011); Geraldi *et al.* (2011); Vidal *et al.* (2011); Senescu *et al.*

	• Project scope • Diversity of project tasks • Experience of project teams • Project risks	(2013); Bakhshi *et al.* (2016); Floricel *et al.* (2016); Remington and Pollack (2016)
Environmental complexity	• Diversity of project stakeholders • Location • Market conditions • Risks	Bosch-Rekveldt *et al.* (2011); Geraldi *et al.* (2011); Vidal *et al.* (2011); Senescu *et al.* (2013); Dunović *et al.* (2014); Bakhshi *et al.* (2016); Floricel *et al.* (2016); Remington and Pollack (2016)
Uncertainty	• Conventional project constraints (time, scope and cost) • Project activities • Project goals • Technology • Stakeholders • Available project information	Williams (1999); Geraldi *et al.* (2011); Dunović *et al.* (2014); Bakhshi *et al.* (2016); Remington and Pollack (2016)
Dynamics	• Project change management	Geraldi *et al.* (2011); Remington and Pollack (2016)

The organisational, technological and dynamic complexities are also described in Xia and Lee (2004) in a study where they formulate a taxonomy for the complexity dimensions of IS development projects. However, their study also adds a structural complexity dimension. Furthermore, the interactions between the complexity dimensions aided in developing a taxonomy model for IS complexity classification (Xia and Lee, 2004). This taxonomy model is shown in Table 3-2.

<u>Table 3-2: Taxonomy of information systems project complexity. Adapted from Xia and Lee (2004)</u>

Organisational vs. Technological	Structural Organisational Complexity	Dynamic Organisational Complexity
	Structural Information Technology Complexity	Dynamic Information Technology Complexity
	Structural vs Dynamic	

The interactions in the taxonomy by Xia and Lee (2004) occur in the project environment, and the complexity dimensions are described as:

1) **Structural organisational complexity** reflecting the synergy of relationships among project elements within the organisational environment;
2) **Structural information technology complexity** capturing the relationships among IT elements in the project;
3) **Dynamic organisational complexity,** which measures the rate of change in the IS organisational environment; and
4) **Dynamic information technology complexity,** which measures the rate of change in the technology environment.

When it comes to the significance of the complexity dimensions, the organisational aspects were found to have a higher impact on IS project performance, albeit less apparent than the technological aspects (Xia and Lee, 2004). Moreover, there is empirical evidence to suggest that IS project complexity has negative effects on project performance (Xia and Lee, 2004). This makes the understanding of the IS project and organisation environments important for any study aimed at exploring how the high failure rates of IS projects can be reduced. Given the dynamic nature of IS projects and the effect of the interactions between the complexity elements, systems thinking approaches can be used to explore and describe the sustainability issues inherent within these projects since they are capable of capturing the multidimensional facets of complexity, as was seen with the ICT4D project described earlier and reported on in Meyer *et al.* (2017a). However, the correct systems approach would also depend on the *problem contexts,* characterised by the diversity of values and beliefs of participants against the complexity of environments (Jackson, 2003). This point is elucidated in detail by Jackson (2003: 17-24) in the description of the System of Systems Methodologies (SOSM). A summary of systems approaches is provided in Table 3-3.

To select the correct systems approach for exploring IS project risks in this study, one has to consider the problem contexts in which IS projects are implemented in the South African public sector, as well as the advantages and disadvantages of the different types of systems approaches. The next section discusses these concepts.

Table 3-3: Systems approaches as they relate to problem contexts and complexity. Adapted from Jackson (2003: 24)

<table>
<tr><td></td><td colspan="4">PARTICIPANTS</td></tr>
<tr><td></td><td colspan="2">Unitary</td><td>Pluralist</td><td>Coercive</td></tr>
<tr><td rowspan="2">SYSTEMS</td><td>Simple</td><td>Hard Systems Thinking</td><td rowspan="2">Soft Systems Approaches</td><td>Emancipatory Systems Thinking</td></tr>
<tr><td>Complex</td><td>System Dynamics
Organisational Cybernetics
Complexity Theory</td><td>Postmodern Systems Thinking</td></tr>
</table>

3.2. APPROACHES FOR ADDRESSING THE COMPLEXITY OF IS PROJECTS

In the preceding sections, it was established that IS projects are characterised by complexity. In relating this complexity to the risks inherent within IS projects, one has to also consider the risk management approaches based on the framework of risk identification, risk assessment, risk response planning and risk monitoring (Taylor *et al.*, 2012; PMI, 2017). The problem with this risk management framework is that it is linear, with each of the phases and risk management processes represented discretely. The complex nature of IS projects, characterised by interactions between project elements could render risk management approaches that do not take this complexity into consideration ineffective.

3.2.1. A Systemic View of IS Project Risks

There are numerous approaches that can be used in the risk management processes but taking on a systems thinking approach could also assist in identifying effective approaches that can address risks in a complex project environment. This is the view supported by Jackson (2003), who states that simple solutions are not adequate in dealing with complexity because they are not holistic. That is, they focus on parts of the system instead of the whole, which results in missing the crucial interactions between the parts. This holistic concept (or holism) differs from reductionism (the linear approach focusing on the parts) because it allows for the investigation of a problem's environment and simplifies the problem by taking multiple partial views rather than breaking down the problem into its simplest parts (White, 1995). Furthermore, White (1995) reviewed risk literature and provided a framework which suggests that risk management approaches based on reductionism were the most common, but they are ineffective in dealing with ill-structured complex and emergent risks arising from socio-technical systems. In socio-technical systems, emergent risks can be considered systemic because they originate from multiple sources and affect different stakeholders (agents) with different views and interest (Carlo *et al.*, 2004). IT risks mix with other socio-technical risks and dynamically shape through a network of interrelationships over time (Carlo *et al.*, 2004).

Based on the IS project examples given in the background section, there is enough evidence that the IS project environments in the South African public sector involve a diverse group of stakeholders representing different interests in the project. For example, since these projects are publicly funded, there may be political interests from the funders, economic interests from the implementing agents and social interests from the beneficiaries. Relating this environment back to Jackson's SOSM described in the previous section, the IS project participants can be classified as inhabiting a 'pluralist' environment (Jackson, 2003). This is because they do not share the same values and beliefs (pluralist), and sometimes they may not even share common interests in addition to the conflicting values (Jackson, 2003). Based on Jackson's SOSM, soft systems approaches may be suitable for handling these problem contexts depending on the level of complexity. These approaches create a space where participants can debate, disagree and also engage even where there is conflict in beliefs or worldviews (Jackson, 2003).

The intention behind the system's intervention could also inform which approach is better in dealing with the problem context. This point is elucidated in Reynolds (2011), where systems approaches are categorised by their philosophical underpinnings and differences in *ontology*, *epistemology,* and *intention.* To this end, three categorisations for systems approaches were identified, and these are (Reynolds, 2011):

1) **Hard systems** characterised by realism, positivism and the intention to control (Jackson, 2003). Example approaches include *general systems theory, cybernetics, operations research, systems engineering, socio-technical systems, systems analysis, system dynamics, etc.*
2) **Soft systems** characterised by nominalism, constructivism, interpretivism and an intention to explore purposes and appreciate different views. Examples include *inquiring*

systems design, soft systems methodology, strategic assumption surface testing, interactive planning, interactive management, cognitive mapping and strategic options development, etc.

3) **Critical systems characterised** by nominalism, constructivist or critical idealism, and an intention to emancipate participants from coercion. Examples include *community operational research, liberating systems theory, interpretive systemology, systemic intervention, total systems intervention* [classified under creative holism in Jackson (2003), based on its strength in combining multiple systems approaches], *etc.*

Since the IS project environment in the South African public sector can be characterised by complexity and pluralism, and the goal of this study is to explore the dominant risks in these projects, the soft systems approach may be more effective for the following reasons:

1) There is some evidence in IS literature (Matavire *et al.*, 2010; Hendriks, 2013; Albertus *et al.*, 2015; Aladwani, 2016; Meyer *et al.*, 2017b) to suggest that social and organisational factors contribute to risks in the South African public sector;
2) There is literature to suggest that organisational "soft" side has an impact on the technological "hard" side (Xia and Lee, 2004; Carvalho and Rabechini Junior, 2015);
3) Complexity in pluralist environments is influenced by divergent stakeholder beliefs, perceptions, values and cognitive dissonance (Jackson, 2003; Tuan, 2004; Reynolds, 2011). As such, the conventional hard systems approach may not be adequate when dealing with complex problems in pluralist environments because it relies heavily on a single observer point of view, usually, an authoritative expert modelling the problem situation, which in turn promotes a neutral value-free image (Tuan, 2004; Reynolds, 2011).

Given the above points and the persistence of challenges in IS projects, a move towards soft systems approaches in modelling IS project complexity as it relates to project risks may be beneficial in uncovering emergent problems and effective in creating sustainable projects. The next section provides a brief overview of systemic approaches and promotes Interactive Management as a suitable methodology to effect such a change.

3.2.2. Overview of Selected Systemic Approaches

3.2.2.1. Systems Dynamics (SD) modelling —hard systems approach

Systems dynamics, developed by Jay W. Forrester, is an approach to simulate complex systems behaviour over time. The approach uses internal feedback loops, stocks and flows to simulate non-linearity in systems behaviour (Reynolds and Holwell, 2010: 18). An influence diagram is constructed by the systemic interrelationships between the feedback loops, which in turn, become the predictor of system behaviour (Jackson, 2003: 67). Jackson (2003: 68) indicates that a systems dynamics approach aims to *"provide managers with an understanding of the structure of complex problems so they can intervene to ensure behaviour that fits with their goals".* However, the approach is criticised as ineffective in the study of social systems because of its objectivity, which fails to capture the subjective interpretations of social actors within the system (Jackson, 2003).

3.2.2.2. Soft Systems Methodology (SSM) —soft systems approach

SSM, developed by Peter Checkland, is an approach for solving poorly structured problems. In this methodology people are active subjects and the problem situation is structured through seven stages (Platt and Warwick, 1995; Jackson, 2003: 181-209; Reynolds and Holwell, 2010: 191-242; Reynolds, 2011), which are: (1) identification of the unstructured problem; (2) expression of the problem situation as a rich picture; (3) construction of root definitions for the relevant human activity systems; (4) developing conceptual models derived from the root definitions; (5) doing a comparative analysis of the conceptual models with reality to highlight possible changes; (6) debating changes emerging from the comparative analysis; and (7) taking action to improve the problem situation. Although this method is well suited for pluralist complex problem situations because of its effectiveness in capturing different worldviews, it has been criticised as ineffective in dealing with conflict in some environments because the methodology makes no attempt at relating worldviews to social situations of power (Jackson, 2003; Reynolds, 2011).

3.2.2.3. Critical Systems Heuristics (CSH) —emancipatory systems approach

CSH, developed by Werner Ulrich, is an emancipatory approach that incorporates a critical dimension to planning and decision making (Jackson, 2003). It supports reflective practice by posing twelve boundary questions based on (1) four *sources of influence* [motivation, control, knowledge and legitimacy]; (2) boundary judgements involving *social roles* [beneficiary, decision-maker, expert, witness], *specific concerns* [purpose, resources, expertise, emancipation], and *key problems* [measure of improvement, decision environment, guarantor, worldview] (Reynolds and Holwell, 2010). Reynolds and Holwell (2010: 245) indicate that the main reasons for using CSH are*: "(1) making sense of situations by understanding assumptions and appreciating the bigger picture; (2) unfolding multiple perspectives by promoting mutual understanding; and (3) promoting reflective practice by analysing situations and changing them.* Although the CSH approach is lauded for its fitness of application in coercive environments, it is criticised as being too idealistic, neglecting structural aspects of social systems, and as depended on situations in which forums for debate are in operation (Jackson, 2003). As such, the approach may be inadequate in dealing with problems where serious debate is required since power structures in social systems are likely to lead to the closure of debate (Jackson, 2003).

3.2.2.4. Interactive Management (IM) —soft systems approach

IM, developed by John N. Warfield, is a systemic approach created for the management of complexity in organisations (Warfield and Cárdenas, 1994: 1). The IM approach uses collaborative teamwork to define and resolve highly complex issues and problems that cannot be readily solved by organisations (Warfield and Cárdenas, 1994; Alexander, 2002). A mechanism central in IM is Interpretive Structural Modelling (ISM) (Tuan, 2004). ISM is a computer-assisted interactive learning process that transforms inadequately expressed mental models of systems into well-defined structural models or digraph (Sushil, 2012). The learning process centres around participation and can be facilitated by conducting a structured intervention with a group of participants representing different stakeholder perspectives. The participants can be taken through the four phases of the IM methodology, which are (Warfield and Cárdenas, 1994; Tuan, 2018):

1) **Idea generation:** In the idea generation phase, the system elements or components of the underlying issues are solicited from the participants. Ideally, the participants should be diverse enough to represent different stakeholders affected by the issue. The ideal number of participants for the IM workshop is between 6 to 12 participants. The ideas are solicited by asking a triggering question on the issue, to which the stakeholders must respond.

2) **Idea clarification:** This phase is for clarifying the generated ideas. There may be some instances where stakeholders use different terminology to describe similar concepts. Some ideas may need consolidation, rephrasing or splitting so that the participants can develop a shared understanding of the system elements.
3) **Idea structuring:** This phase leads to the construction of a digraph comprising of the system elements or ideas consolidated in the previous phase. The digraph is constructed by making a pair-wise comparison of all the system elements based on a contextual relationship as a knowledge-base (Sushil, 2012). The contextual relationship is established by defining how a pair of elements relate to one another in the context of the problem being explored. For example, the problem being explored might be related to determining how element X *significantly gives rise to* element Y. *'Significantly give rise to'* would be the contextual relationship between X and Y in this case. The entire process of pair-wise comparisons is facilitated with the aid of a computer program. The computer program uses a binary matrix algorithm comprising of the system elements. The participants must be in mutual agreement that the contextual relationship exists between two elements under comparison. If the relationship exists between two elements "1" will be entered in each cell of the binary matrix. If no relationship exists "0" is entered. The computer program constructs the digraph by making transitive inference on the relation between system elements. To illustrate this point, using the *'significantly give rise to'* relationship, if X significantly gives rise to Y, and Y significantly gives rise to Z, it can be inferred that X significantly gives rise to Z.
4) **Interpretation:** The interpretation phase involves reviewing the generated digraph comprising of the system elements structured by the contextual relationship. The IM intervention facilitator interprets the digraph to the participants. If the participants feel that some relationships between elements should change, the pair-wise comparison can be executed again. This would typically involve reverting back to the earlier phases of the IM process. That way, interaction and iterative learning can be facilitated through IM so that the participants can develop a shared understanding of specific issues. An action plan to solve the problem under investigation can be formulated.

Of the reviewed systemic methods herein, the hard systems approach (Systems Dynamics) is deemed as an approach that would be ineffective with the pluralist environments characterising IS project environments. As such, soft systems approaches are recommended as suitable for dealing with pluralism. Although Soft Systems Methodology was characterised as an approach that could potentially address pluralism, its failure to relate worldviews to social situations of power could render it ineffective in handling conflict. On the other hand, Critical Systems Heuristics has been described as too idealistic in the literature (Jackson, 2003), which could render it ineffective as it ignores the power structures in social systems. The Interactive Management approach is, therefore, appraised as a suitable methodology for addressing all the dimension of IS project complexity (Alexander, 2002; Tuan, 2004), in a pluralist environment because:

1) It offers the structural advantages of a hard systems approach such as Systems Dynamics, but is not limited by the social structures that exist in organisations.
2) It incorporates different stakeholder perspectives in addressing an issue, the same advantages offered by Soft Systems Methodology, without ignoring social situations of power.
3) Because it allows for collaborative teamwork participation in the decision-making process, it has the ability to emancipate participants from situations where deliberations might flounder due to a lack of consensus (Alexander, 2002).

The approach was also applied successfully in the study of IS project risks in Zimbabwe by Kanjanda and Tuan (2020). A discussion of how the IM methodology was applied in this study is provided in the next section.

3.3. RESEARCH DESIGN

Broadly speaking IM processes can be grouped into four stages comprising of–Planning, Workshop, Follow-up and Implementation (Alexander, 2002). Planning mainly focuses on preparation for the IM workshop and identifying all the components required to make the workshop a success (Warfield and Cárdenas, 1994). The workshop focuses on the structured IM conversation, where the participants are led by a facilitator in a structured intervention (Warfield and Cárdenas, 1994; Alexander, 2002). During the workshop stage, further iteration of the earlier phases may be required, or a suitable action plan may be developed to address the issues being dealt with. These further steps can be addressed in the follow-up and implementation stages (Alexander, 2002). The primary focus of this study is on the planning, and workshop stages with the objective and aim of identifying dominant IS project risks and structuring them. As such, the implementation stage or phase of IM falls outside the scope of this research. In the context of this study, the planning stage includes conceptualising the research problem, designing a questionnaire to identify relevant stakeholders and obtaining ethics clearance to conduct the IM workshop. The questionnaire initiated the main IM processes (or phases) considered in this research, which are idea generation, idea clarification, idea structuring and interpretation. The IM process, as applied in the context of this research, is described in the sub-sections that follow. The research findings on each of the steps followed are discussed in the next chapter in elaborate detail.

3.3.1. Planning

3.3.1.1. Ethics clearance

This study was approved by the University of Cape Town Faculty of Engineering and Built Environment after the submission and review of a research proposal and sample questionnaire for the study. The approval of ethics in research for the study is included in Annexure A of this research report.

In addition to ethics clearance, informed consent had to be obtained from each of the participants prior to the IM workshop. A consent form signed by each participant was required. The consent form template sent to the participants is provided in Annexure D of this research report.

3.3.1.2. Study questionnaire design

The purpose of the questionnaire was to identify relevant stakeholders for the IM workshop intervention. The process for identifying relevant IM intervention stakeholders was adopted from Tuan (2018) who adopts a proposal by Manson and Mitroff which recommends identifying stakeholders who are:

(1) affected by a strategy;

(2) who have an interest in the strategy;

(3) who can implement the strategy, and

(4) care about it.

Furthermore, as a strategy for reducing the IM workshop duration (due to time constraints), the questionnaire was designed to elicit the ideas to be discussed during the IM workshop. As such, the study questionnaire comprised of two sections. Section 1 dealt with background questions on the participants IS project experience in the South African public sector. Section 2 solicited IS project risks perceived as dominant by the participants in order to initiate the idea generation process. The questionnaire was designed using Survey Monkey, and the template is provided in Annexure B of this research report.

3.3.2. IM Phases

3.3.2.1. Idea generation phase

Idea generation was intended to solicit the main ideas on the issue from the participants. In this phase, the participants were presented with a context of the problem and asked a triggering question to solicit the ideas (Warfield and Cárdenas, 1994). The triggering question included in the study questionnaire was:

'In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa?'

The participants were given the same definition of risk to ensure they had the same contextual understanding of IS project risks. The details of this are provided in the next chapter.

3.3.2.2. Idea clarification phase

The purpose behind the idea clarification phase was to clarify the ideas generated in the previous phase of the IM process. During the IM workshop, the IS project risks generated using the questionnaire were consolidated into a single list for the participants in order to: identify, rephrase or remove vague project risks; and split or consolidate similar risks. This was done in order to create a shared understanding of the generated IS project risks. The clarified risks (ideas) became the main system elements that were structured with the aid of software.

3.3.2.3. Idea structuring phase

A digraph of the risks was generated using Interpretive Structural Modelling (ISM) with the aid of a computer software program. The structuring is based on the use of a contextual relationship as a knowledge-base. In this study, the contextual relationship was based on *'significantly give rise to'*. This led to the contextual question —'In the context of IS risk management in the South African public sector does "risk X" *significantly give rise* to "risk Y"?'. A pair-wise comparison of all the IS project risks was conducted in this way. Furthermore, the computer program made transitive inference on the relationship between identified project risks.

3.3.2.4. Interpretation phase

The generated ISM digraph was interpreted to the participants. The participants were informed that if they felt that some of the relationships depicted in the digraph should change or need more clarity, the IM process could revert to the earlier phases as required. This part is supposed to be iterative and collaborative until the participants develop a shared understanding of the generated ISM model.

. . .

Chapter 4 - Research Findings and Discussion

This chapter presents the research findings from the IM workshop, starting with the stakeholder identification process of the study, followed by an in-depth discussion of findings from each of the IM phases.

4.1. STAKEHOLDER IDENTIFICATION AND QUESTIONNAIRE RESPONDENTS

The rationale behind using IM in this study is to identify the dominant risks that are primary sources of challenges that significantly give rise to the underperformance of IS projects, more specifically in the South African public sector. The success of the methodology in achieving this objective largely depends on identifying relevant stakeholders to participate in the IM workshop. The stakeholder identification process for this IM study followed the suggestions by Manson and Mitroff as outlined in Tuan (2018), which involves the identification of stakeholders who are (1) affected by a strategy; (2) have an interest in it; (3) involved in its implementation and; (4) care about it. The first section of the study questionnaire, which addressed the IS project experience of respondents was developed with these points in mind.

It was initially envisaged that the questionnaire would be distributed to the wider group of stakeholders who are involved in the implementation of IS projects in the South African public sector, who would then attend an IM workshop and participate in a facilitated discussion to identify the dominant risks in IS projects. However, the IM study took place during the peak period of the coronavirus (COVID-19) pandemic. As such, it was not possible to convene an IM workshop in which the stakeholder participants could attend physically for the facilitated dialogue. The IM workshop had to be conducted virtually. To ensure that the virtual discussions could be facilitated with ease, the questionnaire was distributed to stakeholders who work for the same organisation in various roles essential to the successful implementation of IS projects in the public sector. The intention of the study was not to uncover IS project risks in a specific organisation, but rather to highlight the main sources of risks in the South African public sector. As such, the name of the organisation and identities of participants will not be provided in this report for confidentiality reasons guaranteed to the participants when their consent to participate in the IM workshop was sought out.

A total of six valid questionnaire responses were received from an initial target of nine respondents invited to participate in the workshop. The respondents were invited based on the roles they play in implementing IS projects within their organisation. The number of valid responses was in line with the recommendation made by Warfield and Cárdenas (1994) that the ideal number of participants for an IM workshop is between six and twelve participants. The remaining three respondents were excluded from the workshop on failure to complete the questionnaire in full or provide consent to participate in the IM workshop. A general description of the six respondents (IM participants) to the questionnaire and the organisation they work for is provided in Table 4-1 below. Full questionnaire responses provided by each participant can be found in Annexure C. Table 4-1 can be used as a guide to identify each of the questionnaire respondents. It is highly stressed that the reader should not regard the IM workshop participants as a sample size for this study. The use of the word 'sample' for an IM study is inappropriate because the aim of IM is not to generalise (Kanjanda and Tuan, 2020), but to solve complex issues in a specific context involving the interests of the participants.

Table 4-1: Description of IM workshop participants

#	Description of Organisation or IM workshop Participant	Participant Profile
Organisation X	The participants work for a research organisation (Organisation X) funded by the Ministry of Science and Innovation of the South African government. Organisation X's core function and mandate is the development of Information Systems for government departments and other research institutions in the public sector of South Africa. At the time of the IM workshop, Organisation X ran a portfolio of nine IS projects on behalf of the South African government. The functional units in the organisation that are responsible for the implementation of IS projects are differentiated into: (1) Data Management, (2) Data Science, (3) Systems Development and (4) IT Infrastructure Management. The managers of the Data Management and Data Science units are primarily responsible for the functional management of their units as well as project management, with support from various team members. The managers in the Systems Development and IT Infrastructure management are involved in functional management and executing project	See below for Organisation X's participant profiles

	directives from project requirements gathered by the Data Management and Data Science team	
Participant 1 (P1)	P1 (Questionnaire Respondent #4 in Annexure C) had three years of experience (1-5 years) in the implementation of IS projects in the public sector. P1 is employed in the Data Management unit and identified as a "Project Member" in the context of this study. P1's primary responsibility is to engage with end-users of the systems developed by Organisation X and attend to data management requests. P1 therefore, does not have a lot of decision-making authority but rather affected by decisions made in the implementation of IS projects within Organisation X.	Affected by IS risk management strategy
Participant 2 (P2)	P2 (Questionnaire Respondent #6 in Annexure C) had five years (1-5 years) of experience in the IS public sector. P2 is employed as a Data Analyst in the Data Management unit of Organisation X and identified as "Systems Developer or Analyst" in the context of this study. P2's primary involvement in the implementation of IS is on execution of project directives, and therefore does not have a lot of decision-making authority, but rather affected by the decisions.	Affected by IS risk management strategy
Participant 3 (P3)	P3 (Questionnaire Respondent #3 in Annexure C) had more than ten years of experience in the implementation of IS projects, all of which were in the public sector. P3 is the Data Science Manager and is responsible for managing a programme of 5 projects in Organisation X. Therefore, in the context of this study P3 identified as a "Project Manager". Furthermore, as both manager of a functional unit within organisation X and project manager, P3 has a lot of decision-making authority in the implementation of IS and is representative of an IM participant who has multiple interests in the organisation's project outcomes.	• Implements IS risk management strategy • Has an interest in IS risk management strategy • Cares about IS risk management strategy
Participant 4 (P4)	P4 (Questionnaire Respondent #1 in Annexure C) had five years (1-5 years) of experience in the implementation of IS projects. P4 is employed as a Data Scientist and is primarily responsible for engaging with the external stakeholder community and	• Affected by IS management strategy

	gathering user requirements for Organisation X. P4 also manages sub-projects within the Data Science unit and therefore identifies as a "Project Manager". P4 can exercise discretion in making project decisions, but most of those decisions require approval from P3. In the context of this study, P4 can also represent the interest of end-users given the stakeholder engagement responsibilities undertaken by the role within the organisation.	• Has an interest in IS risk management strategy • Cares about IS risk management strategy
Participant 5 (P5)	P5 (Questionnaire Respondent #5 in Annexure C) had more than 20 years of experience (> 10 years) in the implementation of IS projects in both the public and private sectors. P5 is employed as a Senior Systems Developer within Organisation X. P5 does not have a lot of decision making authority in the functional management of the Systems Development unit, but has a high level of influence in the execution of highly technical IS projects within Organisation X based on experience. Furthermore, P5's experience gives him the ability to understand the nuances involved in the implementation of IS projects in both the public and private sectors. P5 also has experience working in international IS projects and therefore understands what makes the local context (South Africa) different. For the context of this study, P5 does not have decision-making authority in Organisation X but can influence decisions made by the organisation.	• Affected by IS risk management strategy • Cares about IS risk management strategy
Participant 6 (P6)	P6 (Questionnaire Respondent #2 in Annexure C) had 15 years (>10 years) of experience in the implementation of IS projects; all spent in the public sector. P6 manages the Systems Development unit of Organisation X and takes the lead on all systems engineering decisions made by the organisation.	• Implements IS risk management strategy • Cares about IS risk management strategy

The questionnaire responses provided by the participants are discussed in the next section, which addresses the Idea Generation phase of the study.

4.2. IDEA GENERATION

The Idea Generation phase was initiated through the distributed study questionnaire, particularly Section 2 of the study questionnaire which was intended to solicit the dominant IS project risks in the South African public sector by posing a triggering question. The triggering question posed to the participants was:

'In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa?'

The participants were given a definition of risk to ensure that they had a similar understanding of the term as applied in the context of this study. Risk was defined as '*the possibility that a particular threat will adversely impact the outcome of an IS project by exploiting a vulnerability in the project* environment' (Committee on National Security Systems, 2010). Out of a possible total of thirty-six risk factors, the participants identified thirty-four risks because one participant only provided four risks. The participants had to provide a description for each risk they identified so that similar risks could be merged, and redundant risks could be excluded during the Idea Clarification phase of the IM workshop. The consolidated risks are listed in Table 4-2. The "Identified Risk" and "Description" columns in Table 4-2 list the unedited risks. These risks were either excluded, retained as is, or merged during the Idea Clarification phase. This process is discussed in the next section.

Table 4-2: IS project risks identified by IM workshop participants

#	Identified Risk	Description	Clarified Risk	Amendments after Clarification
R1	Insufficient marketing	-	-	Excluded
R2	Lack of expertise	Public sector clients are limited in their knowledge to define what Information System they require, an iterative process can assist them in learning what they require, but pushes projects past deadlines and agreed budgets	-	Excluded
R3	Lack of long-term planning or project continuity	-	-	Excluded
R4	Employee turnover	-	-	Excluded

R5	Lack of sustained long-term investment	Lack of sustained long-term investment in national entities developing information systems and data portals	Lack of sustained long-term investment	Retained as is
R6	Long term funding (5-10-15 years)	Operation Phakisa is one example where long term funding has allowed for new systems to be developed sustainably. Very few IT system projects set up by government departments have the advantage of something like this.	Lack of sustained long-term investment	Merged with "Lack of sustained long-term investment."
R7	Funding strategy	The longevity of funding for maintenance/expansion after a project is completed. There is rarely funding available to maintain a project by the project team once it has been handed over to the government department.	Lack of sustained long-term investment	Merged with "Lack of sustained long-term investment."
R8	Lack of coordination of IS projects by different government departments	Lack of coordination of IS projects by different government departments (i.e. siloed developed)	Lack of coordination of IS projects by different government departments	Retained as is
R9	User feedback after completion of the project not leading to updates or changes to the project	-	Lack of consultation with users	Merged with "Lack of consultation with users."
R10	Lack of consultation with users	Lack of consultation with users (top-down IS solutions are developed)	Lack of consultation with users	Retained as is
R11	Viewing IS projects as standalone, self-contained endeavours that simply need to be matched with available financial and HR resources.	Successful IS projects require long-term investment in the technical capacity of an organisation.	Lack of long-term investment in the technical capacity of an organisation.	Rephrased
R12	Lack of long term partnership between supplier/service provider and Funder	Government departments are notoriously bad at systems development and don't realise they need long term partnerships where the capability exists.	Lack of long term partnership between supplier/service provider and Funder	• Retained as is • Description edited to remove organisational identifier.

R13	Funding priorities	Project funding is not aligned with stakeholder needs as defined in legislation. Thus, even when funding is available, and a system is built, it is not what is needed.	Project funding is not aligned with stakeholder needs	Rephrased
R14	Lack of long-term planning	Lack of long-term planning (i.e. data management plans not in place or investment in ageing software solutions)	Lack of long-term planning	Retained as is
R15	Not offering competitive salary packages.	An organisation will achieve better IS project outcomes with a few, highly paid top developers than a large number of mid-level and junior developers. However, to attract and retain top developers requires that the organisation compete with the private sector on the developer job market.	Lack of ability to attract highly skilled employees	Rephrased and merged with another identified risk
R16	Hiring highly skilled employees	BEE Hiring policies in government restrict whom you can hire, coupled with an already limited talent pool of skilled IT people in South Africa	Lack of ability to attract highly skilled employees	Rephrased and merged with another identified risk
R17	Limited ability to retain skilled professionals	Limited ability to retain skilled professionals (software developers) in the public sector	Limited ability to retain skilled professionals	Retained as is
R18	Retaining highly skilled team members	Contracts are often obtained when expertise exists from previous projects. These individuals do move on and sometimes leave gaps in the organisation's previous capability set	Limited ability to retain skilled professionals	Merged with "Limited ability to retain skilled professionals."
R19	ICT infrastructure	Lack of ICT infrastructure in government for project maintenance/expansion. When a project is successful and needs to be expanded to accommodate memory or processing load, no money is available to expand existing hardware, and the system falls over.	Lack of ICT infrastructure	Rephrased
R20	Not using formal project management processes	Not using formal project management processes such as PRINCE	Not using formal project management processes	Retained as is

R21	Positions remaining vacant for long periods	As positions remain empty, the responsibility is shifted onto other employees slowing the progress of the project and increasing the risk of employee turnover	Positions remaining vacant for long periods	Retained as is
R22	Absence of good technical management and systems engineering	-	Absence of good technical management and systems engineering	Retained as is
R23	Budget cuts	A project's funding timeline can be limited if the budget is not spent	Budget cuts	Retained as is
R24	Excessive red tape	Slows down access to resources (software and hardware) which slows down the project progress often pushing projects past agreed deadlines and budgets	Excessive red tape	Retained as is
R25	Insufficient input from users prior to starting the project	-	Inadequate stakeholder engagement	Rephrased
R26	Politics between employees and/or Management	Politicking is rife in the Public Sector and slows projects down as people are fighting over authority or political clout instead of working on the project to completion	Internal organisational politics	Rephrased. The element was later excluded from the structuring set after voting. The participants felt this was redundant for their context, given the other identified risks.
R27	ICT personnel	Lack of ICT personnel in government to manage and maintain and update completed systems. Longer-term funding strategies are considered unnecessary because internal ICT personnel should be able to take care of the system. However, once the project has been handed over to the government stakeholder, they do not have the people they need on staff to maintain the system.	Lack of in-house ICT capabilities	Rephrased

R28	Lack of open data and sharing of data between national entities	-	Lack of open data and sharing of data between national entities	Retained as is
R29	User training	Lack of structured stakeholder training on systems to instruct use. Because it is expensive to get all of the stakeholders in one room, it is difficult to organize a training session about a single system; thus, the training is mostly ineffective due to cognitive overload.	Lack of structured stakeholder training on systems to instruct use	Rephrased
R30	User testing	Lack of user testing as part of the design process. Assuming that funding can be found for needed project testing with stakeholders, testing is not done, resulting in unusable systems.	Lack of user testing as part of the design process.	Rephrased
R31	Limited funding	Projects are only funded for a period of time, and the system is expected to last past its funding.	Limited funding	Retained as is
R32	Insufficient funds for longevity	-	Limited funding	Merged with "Limited funding."
R33	Poor recruitment processes	Screening of candidates for highly technical roles requires involvement and oversight by staff with deep technical knowledge and experience. Approaching recruitment as a box-ticking exercise can - and does, in my experience - lead to suboptimal systems development and the accumulation of problems that need fixing further down the line	Poor recruitment processes	Retained as is
R34	Outsourcing of IS projects	The focus will always be on finishing a project using the least effort, rather than engineering a system to be robust, scalable and maintainable beyond the initial project lifespan.	Outsourcing of IS projects	Retained as is

The remaining phases of the IM methodology (Idea Clarification, Idea Structuring and Interpretation) were all carried out during the IM workshop phase. After consolidating all the questionnaire responses, the participants were invited to a virtual IM workshop which was facilitated by the author of this research report. The duration of the workshop was about six hours and was initiated by giving the participants a contextual overview of the IM methodology. Although the workshop duration was relatively long, a lot of time was saved because the participants knew one another and felt comfortable to engage in debate without fear of offending one another. Furthermore, it was explained that they could withdraw from participation at any time during the workshop if they felt uncomfortable. The participants were shown the full list of consolidated risks as provided in the questionnaire responses in order to finalise the Idea Generation phase. The participants indicated that the IM workshop could proceed to the next phase when asked if they wanted to add any additional IS project risks that were not included in the list prior to the start of Idea Clarification phase.

4.3. IDEA CLARIFICATION

The Idea Clarification phase began with a review of all the risks generated from the IM questionnaire. Some risks were merged, others rephrased while others were excluded after the clarification phase. The details of this process are outlined in Table 4-2 in the previous section. A total of twenty-four risks were left on completion of the Idea Clarification phase. The twenty-four risks are listed in Table 4-3 and were considered the main system elements for structuring during the IM workshop. It should be noted that although some of these risks such as *"lack of sustained long-term investment"* and *"lack of long-term investment in the technical capacity of an organisation"* may sound similar, the participants could not agree to merge them because they felt that definitions provided expressed or encompassed different aspects of IS project risks.

Table 4-3: IS project risks retained after the Idea Clarification phase of IM

#	Risk	Description
1	Absence of good technical management and systems engineering	-
2	Budget cuts	A project's funding timeline can be limited if the budget is not spent.
3	Excessive red tape	Slows down access to resources (software and hardware) which slows down the project progress often pushing projects past agreed deadlines and budgets.

4	Inadequate stakeholder engagement	-
5	Internal organisational politics	Politicking is rife in the Public Sector and slows projects down as people are fighting over authority or political clout instead of working on the project to completion.
6	Lack of ability to attract highly skilled employees	An organisation will achieve better IS project outcomes with a few, highly paid top developers than a large number of mid-level and junior developers. However, to attract and retain top developers requires that the organisation compete with the private sector on the developer job market. In addition, supply chain management policies in government restrict whom you can hire, coupled with an already limited talent pool of skilled IT people in South Africa.
7	Lack of consultation with users	Lack of consultation with users (top-down IS solutions are developed).
8	Lack of coordination of IS projects by different government departments	Lack of coordination of IS projects by different government departments (i.e. siloed development).
9	Lack of ICT infrastructure	Lack of ICT infrastructure in government for project maintenance/expansion. When a project is successful and needs to be expanded to accommodate memory or processing load, no money is available to expand existing hardware, and the system falls over.
10	Lack of in-house ICT capabilities	Lack of ICT personnel in government to manage and maintain and update completed systems. Longer-term funding strategies are considered unnecessary because internal ICT personnel should be able to take care of the system. However, once the project has been handed over to the government stakeholder, they do not have the people they need on staff to maintain the system.
11	Lack of long-term partnership between supplier/service provider and Funder	Government departments are notoriously bad at systems development and don't realize they need long term partnerships where the capability exists.
12	Lack of long-term investment in the technical capacity of an organisation	Successful IS projects require long-term investment in the technical capacity of an organisation.
13	Lack of long-term planning	Lack of long-term planning (i.e. data management plans not in place or investment in ageing software solutions)
14	Lack of open data and sharing of data between national entities	-

15	Lack of structured stakeholder training on systems to instruct use	Lack of structured stakeholder training on systems to instruct use. Because it is expensive to get all of the stakeholders in one room, it is difficult to organize a training session about a single system; thus, the training is mostly ineffective due to cognitive overload.
16	Lack of sustained long-term investment	Lack of sustained long-term investment in national entities developing information systems and data portals
17	Lack of user testing as part of the design process.	Lack of user testing as part of the design process. Assuming that funding can be found for needed project testing, testing with stakeholders is not done, resulting in unusable systems.
18	Limited funding	Projects are only funded for a period of time, and the system is expected to last past its funding.
19	Limited ability to retain skilled professionals	Limited ability to retain skilled professionals (software developers) in the public sector
20	Not using formal project management processes	Not using formal project management processes such as PRINCE
21	Poor recruitment processes	Screening of candidates for highly technical roles requires involvement and oversight by staff with deep technical knowledge and experience. Approaching recruitment as a box-ticking exercise can - and does, in my experience - lead to suboptimal systems development and the accumulation of problems that need fixing further down the line
22	Outsourcing of IS projects	The focus will always be on finishing a project using the least effort, rather than engineering a system to be robust, scalable and maintainable beyond the initial project lifespan.
23	Positions remaining vacant for long periods	As positions remain empty, the responsibility is shifted onto other employees slowing the progress of the project and increasing the risk of employee turnover
24	Project funding is not aligned with stakeholder needs	Project funding is not aligned with stakeholder needs as defined in legislation. Thus, even when funding is available, and a system is built, it is not what is needed.

The remainder of the IM workshop was facilitated through the use of free ISM software produced and maintained by the Warfield Intellectual Property Trust. The software is available for free download and runs on Microsoft Windows Operating Systems (Warfield IP Trust, 2020). The purpose of using the software was to conduct the Idea Structuring phase of IM by running the ISM algorithm to structure the identified IS project risks and examine the interrelationships between them. The software can also be used for all the phases of IM, not just Idea Structuring. One important use of the software lies in the voting procedure, which can be used to solicit the participants' perception of the relative importance of identified elements. As such, during the workshop, each of the participants was asked to rank five IS project risks (top five) from the twenty-four elements (risks) by order of importance. The voting process does not take into account the relationships between elements. The results from the votes by each participant during the IM workshop are shown in Table 4-4. After the voting process is complete, the ISM software assigns a weighted vote to each system element that received a vote. A higher weighted vote is assigned to elements which received the highest number of votes and high ranking from the participants. The software assigns the weighted votes based on how the participants ranked the risks identified during the Idea Generation phase according to their perception. For each vote, the risks were assigned a score between 1 and 5, with 5 being assigned to the highest-ranked risk by a participant and 1 assigned to the lowest-ranked risk. As an example using the votes by the first participant (P1) as shown in Table 4-4, the scores for each risk are [**#8** = 5; **#24** = 4; **#16** = 3; **#7** = 2; **#20** = 1]. The total weighted vote for each risk is then calculated by adding the sum of all scores assigned by the whole group. Using risk **#8** from Table 4-4, the weighted vote can be calculated by adding the votes by each participant. The participants who included risk **#8** in their voting are P1, P3, and P4. The weighted vote would then be calculated as follows:

Weighted vote for risk **#8** = 5 + 2 + 5 = 12

The vote count and weighted votes for each of the twenty-four risks (system elements) are shown in Table 4-5. Risks that did not get a vote were assigned a weighted vote of zero.

Table 4-4: IM participant votes on important IS project risks

#	Vote on IS Project Risks by Relative Importance	Risks
P1	*Lack of coordination of IS projects by different government departments; Project funding is not aligned with stakeholder needs; Lack of sustained long-term investment; Lack of consultation with users; Not using formal project management processes*	8, 24, 16, 7, 20
P2	*Lack of sustained long-term investment; Lack of ability to attract highly skilled employees; Lack of long-term investment in the technical capacity of an organisation; Positions remaining vacant for long periods; Lack of consultation with users*	16, 6, 12, 23, 7
P3	*Lack of consultation with users; Lack of sustained long-term investment; Lack of long-term planning; Lack of coordination of IS projects by different government departments; Lack of long-term investment in the technical capacity of an organisation*	7, 16, 13, 8, 12

P4	*Lack of coordination of IS projects by different government departments; Project funding is not aligned with stakeholder needs; Lack of sustained long-term investment; Lack of consultation with users; Lack of long-term planning*	8, 24, 16, 7, 13
P5	*Lack of sustained long-term investment; Limited ability to retain skilled professionals; Lack of long-term partnership between supplier/service provider and Funder; Lack of long-term investment in the technical capacity of an organisation; Lack of long-term planning*	16, 19, 11, 12, 13
P6	*Lack of long-term partnership between supplier/service provider and Funder; Lack of long-term investment in the technical capacity of an organisation; Lack of sustained long-term investment; Lack of ICT infrastructure; Not using formal project management processes*	11, 12, 16, 9, 20

Table 4-5: Vote count and weighted voted for each system element/ IS project risk

#	Risk	Vote Count	Weighted Votes	Rank by Weighted Votes	Participant
1	Absence of good technical management and systems engineering	0	0	-	-
2	Budget cuts	0	0	-	-
3	Excessive red tape	0	0	-	-
4	Inadequate stakeholder engagement	0	0	-	-
5	Internal organisational politics	0	0	-	-
6	Lack of ability to attract highly skilled employees	1	4	8	P2
7	Lack of consultation with users	4	10	3	P1, P2, P3, P4
8	Lack of coordination of IS projects by different government departments	3	12	2	P1, P3, P4
9	Lack of ICT infrastructure	1	2	10	P6
10	Lack of in-house ICT capabilities	0	0	-	-
11	Lack of long-term partnership between supplier/service provider and Funder	2	8	5	P5, P6
12	Lack of long-term investment in the technical capacity of an organisation	4	10	4	P2, P3, P5, P6

13	Lack of long-term planning	3	5	7	P3, P4, P5
14	Lack of open data and sharing of data between national entities	0	0	-	-
15	Lack of structured stakeholder training on systems to instruct use	0	0	-	-
16	Lack of sustained long-term investment	6	23	1	P1, P2, P3, P4, P5, P6
17	Lack of user testing as part of the design process.	0	0	-	-
18	Limited funding	0	0	-	-
19	Limited ability to retain skilled professionals	1	4	9	P5
20	Not using formal project management processes	2	2	11	P1, P6
21	Poor recruitment processes	0	0	-	-
22	Outsourcing of IS projects	0	0	-	-
23	Positions remaining vacant for long periods	1	2	12	P2
24	Project funding is not aligned with stakeholder needs	2	8	6	P1, P4

Only twelve of the twenty-four elements received votes during the voting and ranking process. If the dominant IS project risks were ranked by order of importance based only on the voting, the list would only comprise of:

1) Lack of sustained long-term investment;
2) Lack of coordination of IS projects by different government departments;
3) Lack of consultation with users;
4) Lack of long-term investment in the technical capacity of an organisation;
5) Lack of long-term partnership between supplier/service provider and Funder;
6) Project funding is not aligned with stakeholder needs;
7) Lack of long-term planning;
8) Lack of ability to attract highly skilled employees;

9) Limited ability to retain skilled professionals;
10) Lack of ICT infrastructure;
11) Not using formal project management processes; and
12) Positions remaining vacant for long periods.

If one were to go with the above-ranked list, it would appear that “Lack of sustained long-term investment” is the most important and dominant risk in the context of this study. However, since the ranking does not take the interrelationships between all the project risks into account, this may not be the case. The Idea Structuring phase of the IM workshop illustrated this to the participants through the application of the ISM algorithm to structure all the system elements and examination of the interrelationships between them.

It should be noted that the participants decided to exclude risk #5 *“Internal organisational politics”* from structuring after the voting process because they felt it was too ambiguous and was not relevant to their context. It was initially included because of anecdotal evidence rather than personal experience.

4.4. IDEA STRUCTURING

During the Idea Structuring phase, the participants were asked to examine the relationship between IS project risks at a time to see if a significant relationship exists between them. A contextual question was posed to the participants in order to allow them to vote on whether a significant relationship existed between the examined risks. The contextual question in this instance was:

‘In the context of IS risk management in the South African public sector, does “risk X” *significantly give rise* to “risk Y”? This is shown in Figure 4-1, an image extracted from the ISM software during the workshop.

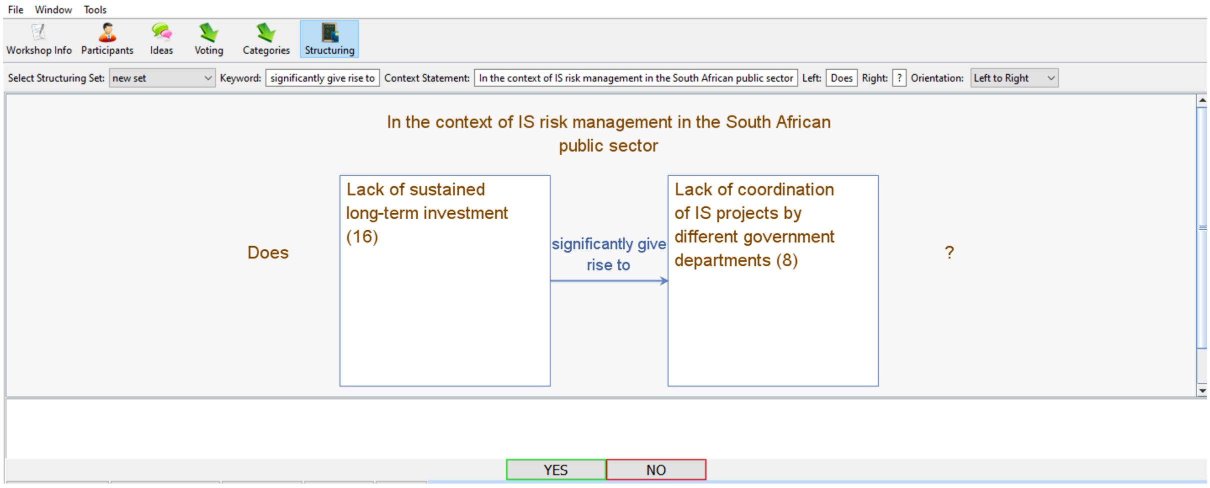

Figure 4-1: Contextual question posed to the participants during Idea Structuring.

The phrase *'significantly give rise to'* was used as the contextual relationship between risks for the pair-wise comparison. Twenty-three IS project risks (excluding element 5 for a reason stated in the previous section) were loaded into the ISM software for the pair-wise comparisons.

For each pair-wise comparison, the participants had to be in mutual agreement on whether a relationship existed between the risks being compared for structuring. If a significant relationship existed between two risks, the facilitator clicked 'Yes', if not the 'No' button was clicked. If the participants were not in agreement, they were encouraged to debate on the reasons why they thought a significant relationship between project risks existed or not. If they were still in disagreement after stating reasons why the relationship existed or not, the participants were asked to vote in order to establish a majority response (at least 4 out of six votes) before moving on. The ISM software uses a binary matrix comprising of the system elements, in this case, project risks. If the relationship exists between two risks "1" is entered in each cell of the binary matrix. If no relationship exists "0" is entered. An image of this process extracted from the ISM software during the workshop is shown in Figure 4-2.

The pair-wise comparisons during the Idea Structuring phase took approximately 4 hours to complete. A total of 117 out of a possible 506 pair-wise comparisons were discussed before the binary matrix depicted in Figure 4-2 was extracted. The full sequence of pair-wise comparisons that produced the binary matrix is shown in Table 4-6. The ISM software computes the remaining comparisons through transitive inference. It is worth reiterating that the *'significantly give rise to'* contextual relationship used in the study is transitive. If risk X significantly gives rise to risk Y, and risk Y significantly gives rise to risk Z, it can be inferred that risk X significantly gives rise to risk Z.

Table 4-6: Pair-wise comparisons of identified IS project risks

1) 16 → 8 (Yes)	21) 7 → 19 (No)	41) 1 → 9 (No)	61) 1 → 4 (No)	81) 20 → 14 (No)	101) 17 → 4 (Yes)
2) 8 → 16 (Yes)	22) 6 → 19 (Yes)	42) 9 → 1 (No)	62) 23 → 4 (Yes)	82) 14 → 4 (No)	102) 13 → 18 (Yes)
3) 8 → 7 (No)	23) 19 → 6 (Yes)	43) 7 → 1 (No)	63) 20 → 4 (Yes)	83) 14 → 1 (No)	103) 18 → 9 (Yes)
4) 7 → 8 (No)	24) 13 → 9 (Yes)	44) 23 → 1 (Yes)	64) 24 → 4 (Yes)	84) 13 → 15 (Yes)	104) 18 → 20 (Yes)
5) 8 → 12 (Yes)	25) 9 → 13 (No)	45) 20 → 1 (Yes)	65) 13 → 10 (No)	85) 15 → 9 (No)	105) 18 → 13 (Yes)
6) 12 → 8 (Yes)	26) 9 → 19 (Yes)	46) 13 → 2 (No)	66) 10 → 23 (No)	86) 10 → 15 (No)	106) 18 → 21 (Yes)
7) 12 → 11 (Yes)	27) 19 → 9 (Yes)	47) 2 → 23 (Yes)	67) 10 → 9 (Yes)	87) 23 → 15 (No)	107) 21 → 9 (Yes)
8) 11 → 12 (Yes)	28) 13 → 20 (Yes)	48) 2 → 13 (Yes)	68) 10 → 24 (No)	88) 7 → 15 (No)	108) 21 → 20 (Yes)
9) 11 → 24 (No)	29) 20 → 13 (No)	49) 2 → 24 (No)	69) 10 → 20 (No)	89) 3 → 15 (Yes)	109) 21 → 18 (No)
10) 24 → 11 (No)	30) 20 → 9 (No)	50) 13 → 3 (No)	70) 3 → 10 (Yes)	90) 14 → 15 (No)	110) 21 → 17 (Yes)
11) 7 → 24 (Yes)	31) 9 → 20 (No)	51) 3 → 23 (Yes)	71) 2 → 10 (Yes)	91) 20 → 15 (Yes)	111) 21 → 14 (No)
12) 24 → 7 (No)	32) 24 → 20 (No)	52) 3 → 13 (No)	72) 10 → 4 (No)	92) 15 → 4 (No)	112) 21 → 23 (Yes)
13) 11 → 13 (Yes)	33) 7 → 20 (No)	53) 3 → 24 (Yes)	73) 10 → 1 (No)	93) 15 → 1 (No)	113) 18 → 22 (Yes)
14) 13 → 11 (Yes)	34) 13 → 23 (Yes)	54) 3 → 20 (No)	74) 13 → 14 (Yes)	94) 13 → 17 (Yes)	114) 22 → 9 (Yes)
15) 13 → 6 (Yes)	35) 23 → 9 (Yes)	55) 3 → 7 (No)	75) 14 → 9 (No)	95) 17 → 9 (No)	115) 22 → 20 (No)
16) 6 → 13 (No)	36) 23 → 13 (No)	56) 13 → 4 (Yes)	76) 10 → 14 (No)	96) 23 → 17 (No)	116) 10 → 22 (Yes)
17) 24 → 6 (No)	37) 9 → 23 (No)	57) 4 → 9 (No)	77) 23 → 14 (No)	97) 17 → 1 (No)	117) 9 → 22 (Yes)
18) 7 → 6 (No)	38) 23 → 20 (No)	58) 9 → 4 (No)	78) 7 → 14 (No)	98) 7 → 17 (Yes)	
19) 13 → 19 (Yes)	39) 13 → 1 (Yes)	59) 3 → 4 (Yes)	79) 14 → 20 (No)	99) 3 → 17 (No)	
20) 19 → 13 (No)	40) 1 → 23 (No)	60) 7 → 4 (Yes)	80) 3 → 14 (Yes)	100) 20 →17 (No)	

On completion of the pair-wise comparison process, a digraph which shows the interrelationships between all the risk retained after the Idea Clarification phase was extracted from the binary matrix. This digraph is depicted in Figure 4-3 and discussed in the next section which deals with the Interpretation Phase of IM.

16	8	7	12	11	24	13	6	19	9	20	23	1	2	3	4	10	14	15	17	18	21	22
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
1	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0	1	1	1
1	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0	1	1	1
1	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0	1	1	1
1	1	0	1	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0
1	1	0	1	1	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0
1	1	0	1	1	0	1	0	0	0	1	1	1	1	1	0	0	0	0	0	1	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1	0	0	0	1	1	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	1	0	0
1	1	0	1	1	0	1	0	0	0	1	0	0	1	1	0	0	0	1	0	1	1	0
1	1	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
1	1	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0
1	1	0	1	1	0	1	1	1	1	0	1	0	1	1	0	1	0	0	0	1	1	1

Figure 4-2: Binary matrix from the Idea Structuring phase of the IM workshop

4.5. INTERPRETATION

The digraph from the ISM software was reproduced using free software for systems diagrams available at https://app.diagrams.net/ in order to make the arrows depicting relationships between system elements legible. All the arrows in Figure 4-3 represent the *"significantly give rise to"* contextual relationship. For example, 'lack of user consultation' can be interpreted as a risk that significantly gives rise to 'lack of user testing as part of the design process' and 'project funding is not aligned with stakeholder needs', and so forth. The ISM digraph (Figure 4-3) revealed that there are five hierarchical levels of public sector IS project risks in the context of this study. More specifically, the project environment in which the IM workshop participants implement their IS projects.

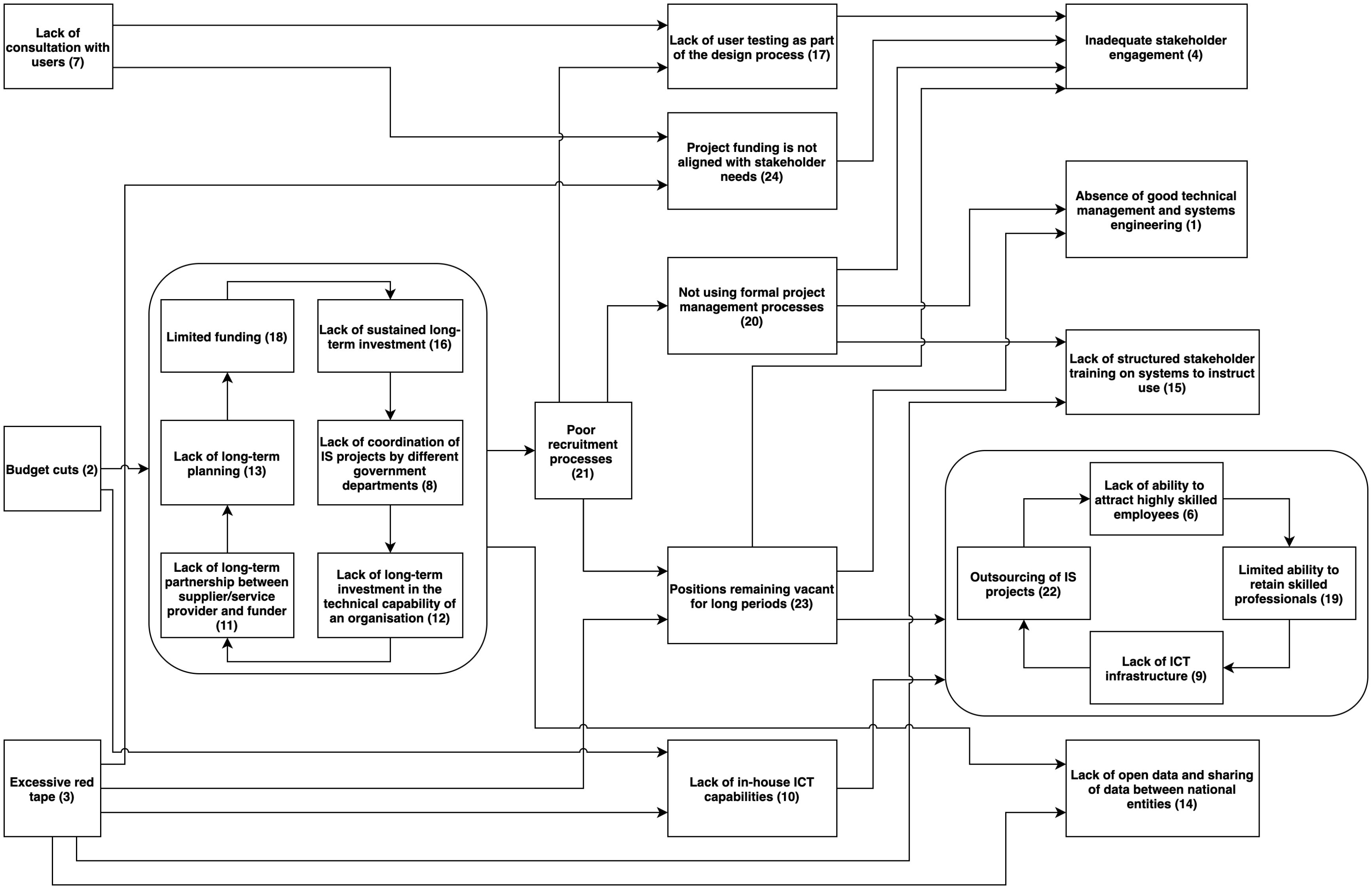

Figure 4-3: Interpretive Structural Modelling digraph of IS project risks in the South African public sector

Interpretation of first level risks

The first level of the ISM digraph reveals three out of the twenty-three structured IS project risks are the primary drivers of IS project underperformance. These are:

1) Budget cuts;
2) Excessive red tape; and
3) Lack of consultation with users.

The risks on the first level are not caused by any of the other risks, but give rise to them instead. This means that the above three risks have to be prioritised and addressed first if they exist in an environment; otherwise, any risk management strategy implemented for this particular context will most likely be ineffective.

Out of the three risks, 'budget cuts' seems to be the most important or dominant because it significantly gives rise to all the other project risks, with the exception of the other risks in the first level (i.e. 'excessive red tape' and 'lack of consultation with users'). Of the other risks from the first level, 'lack of consultation with users' significantly gives rise to 'lack of user testing as part of the design process' and 'project funding is not aligned with stakeholder needs', which both give rise to 'inadequate stakeholder engagement'. 'Excessive red tape' has a direct relationship with the following risks:

1) Project funding not being aligned with stakeholder needs;
2) Positions remaining vacant for a long time;
3) Lack of in-house ICT capabilities;
4) Absence of good technical management and systems engineering; and
5) Lack of open data and sharing of data between national entities.

However, one should note that 'excessive red tape' will also give a significant rise to any other risk connected to the five risks listed above in some way.

Interpretation of second level risks

The second level of risks in the hierarchy consists of six risks, which are:

1) Limited funding;
2) Lack of sustained long-term investment;

3) Lack of coordination of IS projects by different government departments;
4) Lack of long-term investment in the technical capability of an organisation;
5) Lack of long-term partnership between supplier/service provide and funder; and
6) Lack of long-term planning

One should note that the risks in the second level result in a loop, meaning that there is no starting point as all the risks significantly give rise to each other. Ignoring any of them while attempting to contain the others might result in a resurgence. Thus, it would not help to connect 'budget cuts' to a specific risk in the loop, so the arrow is connected to the entire loop instead. Furthermore, these risks significantly give rise to all other project risks in the third, fourth and fifth level with the exception of 'Lack of in house ICT capabilities' in the fourth level. This shows that any of the second level risks should be prioritised relative to the third, fourth and fifth level risks.

Interpretation of the third level risk

The third level only has one risk, which is 'poor recruitment processes'. This risk gives rise to three other project risks in the fourth level, which are:

1) Positions remaining vacant for long periods of time;
2) Not using formal project management processes; and
3) Lack of user testing as part of the design process.

Initially, the participants thought that 'poor recruitment processes' should not be related to these three risks in the fourth level, but in the end, they agreed that the interrelationship made sense because poor recruitment processes is a symptom of incompetence and organisational inefficiencies, both of which could lead to these risks.

Interpretation of fourth level risks

The fourth level consists of:

1) Lack of user testing as part of the design process;
2) Project funding is not aligned with stakeholder needs;
3) Not using formal project management processes;
4) Positions remaining vacant for long periods;

5) Lack of in-house ICT capabilities.

The fourth level risks give rise to all the risks in the fifth level with the exception of "Lack of open data and sharing of data between national entities.

Interpretation of fifth level risks

The fifth level of risks include:

1) Inadequate stakeholder engagement;
2) Absence of good technical management and systems engineering;
3) Lack of structured stakeholder training on systems to instruct use;
4) Lack of ability to attract highly skilled employees; Limited ability to retain skilled professionals; Lack of ICT infrastructure; Outsourcing of IS projects; and
5) Lack of open data and sharing of data between national entities.

The risks from the fifth level are unlikely to give rise to risks identified in the previous levels of in the ISM digraph hierarchy. These are still important but should not be prioritised over first, second, third and fourth level risks, because any risk management strategy that ignores these will most likely be ineffective. One should also note that 'lack of ability to attract highly skilled employees'; 'limited ability to retain skilled professionals'; 'lack of ICT infrastructure'; and 'outsourcing of IS projects' are also in a loop. Thus, it would be ineffective to connect 'positions remaining vacant for a long time' and 'lack of in-house ICT capabilities' to a specific risk in the loop because there is no starting point.

Due to the long duration of the workshop, the participants did not have enough of an opportunity to critique and comment on the ISM digraph, but they were satisfied that it gave a broad overview on how risks in their environment are interrelated. They were given an extra week as an opportunity to object to the research findings via email correspondence to the author. No objections were received. Thus, the diagraph was used as is. In order to evaluate the usefulness of the results from the IM processes, the risks identified were compared with those from the literature reviewed in this study. The findings from the comparisons are provided in the next section.

4.6. COMPARISON OF IDENTIFIED RISKS WITH REVIEWED LITERATURE

The comparison of risks identified through IM with literature sources in this study is summarised in Table 4-7. It should be noted that the research findings were only compared with the top risks identified by the authors of the literature sources. It is, therefore, not an exhaustive comparison. Furthermore, the comparisons are based on how the IM participants described the risks identified and the description provided by the authors' in the literature, instead of how the risks are phrased in this report. As a result, it can be noticed that the text is not an exact match.

Table 4-7: Comparison of risks identified during IM workshop with risks from the reviewed literature

#	Risk Identified from Research Findings	Similar Risks from Reviewed Literature		Number of Appearances
		Risk	***Author***	
1	Absence of good technical management and systems engineering	Poor IS management competencies	Albertus *et al.* (2015)	4
		Familiarity of the project team and the IS organisation with the target technologies	Lyytinen *et al.* (1998)	
		Straining computer science capabilities	Boehm (1991)	
		Requirement management risks	Ropponen and Lyytinen (2000)	
2	Budget cuts	Unrealistic schedules and budgets	Boehm (1991)	1
3	Excessive red tape	Bureaucracy	Kanjanda and Tuan (2020)	1
4	Inadequate stakeholder engagement	Failure to manage end-user expectations	Schmidt *et al.* (2001)	1
6	Lack of ability to attract highly skilled employees	Lack of required knowledge/skills in the project personnel	Schmidt *et al.* (2001)	1
7	Lack of consultation with users	Non-existent or unwilling users	Alter and Ginzberg (1978)	7
		The ability of a user to specify requirements	Davis (1982)	
		The ability of analysts to elicit and evaluate requirements	Davis (1982)	
		Lack of adequate user involvement	Schmidt *et al.* (2001)	
		Lack of adequate user involvement	Smith *et al.* (2006)	
		User involvement	Marnewick and Labuschagne (2009)	
		Understanding of user's needs	Marnewick and Labuschagne (2009)	

8	Lack of coordination of IS projects by different government departments	Conflict between user departments	Schmidt *et al.* (2001)	2
		Organisational arrangements	Hendriks (2013)	
9	Lack of ICT infrastructure	Lack of resources	Meyer *et al.* (2017b)	2
		Support for innovative technology	Marnewick and Labuschagne (2009)	
10	Lack of in-house ICT capabilities	Lack of capacity	Hendriks (2013)	7
		Lack of resources	Meyer *et al.* (2017b)	
		Personnel shortfalls	Boehm (1991)	
		Lack of required knowledge/skills in the project personnel	Schmidt *et al.* (2001)	
		Insufficient/inappropriate staffing	Schmidt *et al.* (2001)	
		Lack of available skilled personnel	Smith *et al.* (2006)	
		Staffing level	Lyytinen *et al.* (1998)	
11	Lack of long-term partnership between supplier/service provider and Funder			
12	Lack of long-term investment in the technical capacity of an organisation	Technical problems or cost-effectiveness issues.	Alter and Ginzberg (1978)	1
13	Lack of long-term planning	Inadequate planning	Smith *et al.* (2006)	1
14	Lack of open data and sharing of data between national entities			
15	Lack of structured stakeholder training on systems to instruct use			
16	Lack of sustained long-term investment	Sustained interest	Matavire *et al.* (2010)	1
17	Lack of user testing as part of the design process.	Failure to gain user commitment	Schmidt *et al.* (2001)	1
18	Limited funding	Difficulty obtaining financial commitment	Meyer *et al.* (2017b)	2
		Unrealistic schedules and budgets	Boehm (1991)	
19	Limited ability to retain skilled professionals	Lack of available skilled personnel	Smith *et al.* (2006)	1
20	Not using formal project management processes	Formal methodologies	Marnewick and Labuschagne (2009)	1
21	Poor recruitment processes			
22	Outsourcing of IS projects	Shortfalls in externally performed tasks	Boehm (1991)	4
		Shortfalls in externally furnished components	Boehm (1991)	
		Subcontracting risks	Ropponen and Lyytinen (2000)	

		Problems with subcontracting	Albertus *et al.* (2015)	
23	Positions remaining vacant for long periods			
24	Project funding is not aligned with stakeholder needs			

The results from the comparisons revealed that most of the risks identified from research findings also exist in current literature. However, what this also reveals is that some of the most common risks matched in literature (e.g. 'lack of in-house ICT capabilities', which appears 7 times in literature) might not significantly give rise to a lot of risks. This is illustrated in the ISM digraph where 'lack of in-house ICT capabilities' is a level four risk. Conversely, from Table 4-7 and the ISM digraph, it can be observed that a risk such as 'budget cuts', which significantly gives rise to twenty other risks only appeared once in the reviewed literature. Therefore, the IM methodology can contribute to the existing body of knowledge on IS project risks and their management because of its revelation of risks that might not be considered prominent.

Among the first level risks identified in the ISM digraph, 'lack of consultation with users' seems to be the most commonly encountered in the reviewed literature, having been matched with seven other risks. Moreover, the literature sources (Alter and Ginzberg, 1978; Davis, 1982; Schmidt *et al.*, 2001; Smith *et al.*, 2006; Marnewick and Labuschagne, 2009) which mention risks related to 'lack of consultation with users' span different decades, suggesting that the risk has a high level of persistence in IS implementations. Of the other two first level risks, 'budget cuts' was only matched with 'unrealistic budgets and schedules' from the literature sources. Although there could be multiple risks associated with project finances from the reviewed literature, the lack of explicit risk attribution to budget cuts suggests that there is some level of ambiguity in the risk identification process. This should be concerning to IS project managers in the context of this study, given the prominence of 'budget cuts' as a source of risk. The final first level risk in the ISM digraph, 'excessive red tape', was matched with another first level risk (bureaucracy) from a different IM study conducted by Kanjanda and Tuan (2020) proving its dominance in IS projects under different contexts.

An additional observational from Table 4-7, also reveals that there are six other risks that were not found in the top-risks from the reviewed literature. These are:

1) Lack of long-term partnership between supplier/service provider and funder;
2) Lack of open data and sharing of data between national entities;
3) Lack of structured stakeholder training on systems to instruct use;
4) Poor recruitment processes;
5) Positions remaining vacant for long periods; and
6) Project funding is not aligned with stakeholder needs.

The six unique risks listed are not necessarily an original finding from this study because the literature review was not completely exhaustive. Their discovery does reveal that the application of the IM methodology might lead to further insights that are not readily available from the extant IS risk management literature.

. . .

Chapter 5 - Conclusions

5.1. REVIEW OF FINDINGS IN RELATION TO RESEARCH OBJECTIVES

This study was aimed at developing a systemic model of the most dominant risks in IS projects implemented in the South African public sector and identifying the interrelationships that exist between these risks. The aim was formulated to address the problem described by the following statement:

> *The complexity of public sector IS projects is multi-faceted. Moreover, public sector IS projects implemented in developing countries are more complex because of contextual project risk archetypes inherent in these environments, but the interrelationships that exist between these risks have received very little attention. This results in persistently high project failure rates, which have a negative impact on the sustainability of IS projects in resource-poor developing countries*

To achieve this aim, three key questions ware proposed. These questions were:

1) *What are the dominant risk factors that significantly give rise to the under-performance of IS projects in the South African public sector?*
2) *Are the risks factors that dominate public sector IS projects in South Africa interrelated?*
3) *Which of the identified risks are the drivers of persistent IS project under-performance?*

The literature review conducted in order to find suitable approaches for addressing the above questions revealed that: (1) social and organisational factors contribute to risks in the South African public sector (Matavire *et al.*, 2010; Hendriks, 2013; Albertus *et al.*, 2015; Aladwani, 2016; Meyer *et al.*, 2017b); (2) the organisational "soft" side has an impact on the technological "hard" side (Xia and Lee, 2004; Carvalho and Rabechini Junior, 2015); and complexity in some environments can be influenced by divergent stakeholder beliefs, perceptions, values and cognitive dissonance (Jackson, 2003; Tuan, 2004; Reynolds, 2011). As such, the IM approach was appraised as a suitable methodology to address the research questions given the underlying complexities in IS project environments.

The research questions led to the three objectives below. A reflection on how each objective was achieved is also provided.

1) *Identify dominant risks affecting the performance of IS projects implemented in the South African public sector.*

The application of IM in this research led to the identification of twenty-three dominant risks affecting the performance of IS projects in the South African public sector. The questionnaire responses from the six IM workshop participants produced a total of thirty-four risks factors (Table 4-2), which were later reduced to twenty-four risks factors (Table 4-3) after the Idea Clarification phase of IM was completed. After further deliberations, the participants decided to exclude an additional risk factor ['Internal organisational politics (5)'] from the Idea Structuring phase of the IM process followed in this study, hence the identification of twenty-three dominant risks factors.

2) *Identify significant interrelationships that exist between these risks.*

The idea structuring phase of the IM workshop revealed that interrelationships exist between the identified project risks. ISM software developed and maintained by the Warfield Intellectual Property Trust was used to structure the twenty-three dominant risk factors identified by the participants. A digraph showing the interrelationships between the risks was produced. The interrelationships are depicted in Figure 4-3. The ISM digraph produced during the IM workshop structured the risks into five hierarchical levels. The digraph also revealed the existence of feedback loops in the second and fourth levels of the ISM model.

3) *Identify the persistent drivers of IS project under-performance from the identified risks.*

From these levels, the persistent drivers of IS project under-performance could be identified. The digraph shows *'budget cuts', 'excessive red tape'* and *'lack of consultation with users'* to be primarily responsible for IS project under-performance in the context of this study. These three risks significantly give rise to all the other risks identified in this study, but their origin is not directly connected to any other risk.

5.2. REFLECTION ON FINDINGS FROM COMPARISON WITH REVIEWED LITERATURE

The comparison of risks identified through the application of IM with those from the reviewed literature revealed that some risks are not easily identifiable in the existing literature. Thus, this study also contributes to existing knowledge on IS research. A total of six risks found in this study were not easily identifiable in the reviewed literature (see section 4.6.). Of these six risks, *'Lack of open data and sharing of data between national entities'* is a very uncommon risk which might be unique to public sector IS organisations similar to the one the participants work for, given the fact that they specialise in implementing data-driven IS projects. Thus, the IM methodology could prove useful in expanding the current breadth of IS knowledge on public sector organisations, if repeated with a broader group of participants from different organisations.

The literature reviewed in this report was not just restricted to the IS literature on public sector IS organisations, nor was it strictly restricted to South Africa. Since similarities were found between IS project risks identified through IM and those from literature, it can be inferred that public sector IS projects might be riskier, given the additional risks that were identified in this research. This is in line with the statistics summarised in the Introduction chapter in Table 1-1, which outline that IS project failure is more prevalent in the public sector, with approximately ±85% of projects failing (Heeks, 2003; Taherdoost and Keshavarzsaleh, 2015) against the ±70% industry average (Flyvbjerg and Budzier, 2011; Standish Group, 2015).

5.3. RECOMMENDATION FOR FURTHER RESEARCH

The ISM digraph produced by applying the IM methodology revealed the interrelationships that exist between the risks identified by the participants. Applying other systemic approaches to explore the interrelationships between IS project risks in a similar context may help corroborate the findings of the study. Likewise, repetition of the IM methodology multiple times in the same context is also recommended if one wants to test the findings. There are several pathways that can be followed to test the findings of this research. The first step would be validating the results by conducting a follow-up phase of IM.

The follow-up phase may involve iteration of the IM processes with the same group of participants. This can be initiated by repeating the Idea Structuring phase in order to see if the responses to the pair-wise comparison of risks remain consistent, thus generating similar digraphs. Once some level of consistency is achieved, the organisation would have more confidence in the specific risks that should be managed in their particular context. This should allow them to update their risk management strategy and set up action plans for monitoring the risks identified.

Further steps that can be taken is changing the diversity of participants to see if additional risks come up. This will not only help reduce the likelihood of groupthink but also broaden the scope of application of the findings. By repeating the IM processes with participants from other organisations, new insights can be gained from the identification of risks that are not prevalent in the project environment of the first group.

Lastly, once there is a sufficient level of confidence on what the most dominant risks are in the IS project organisation or the public sector, other systemic methods such as systems dynamics could be used by the risk managers to model the interrelationships that exist between identified risks. This would give them more control when they develop risk management strategies to ensure that the strategies fit with their goals.

5.4. RESEARCH LIMITATIONS

The scope of this research was limited to only focus on risks encountered in the implementation of public IS projects in South Africa. As such, the broader context of IS project risks and general underperformance of IS projects were not thoroughly explored in this research. For this reason, the following limitations apply to the study findings:

1) The focus on the public sector placed a limitation because stakeholders from the private sector may have different views on IS project risks that are also relevant to public IS projects. An attempt to counteract this limitation was to invite participants who have also had exposure to IS projects in both the public and private sectors. Only one (Participant 5) out of the six participants had such experience. As a result, the findings which are based on the views of participants may be too narrow and inapplicable in a broader context.

2) Only six participants took part in the IM workshop. Although this was well within the recommended number of participants for an IM intervention, having a broader group of stakeholders might have led to the identification of additional risks.
3) The participants selected for an IM intervention cannot be considered as a population sample (Tuan, 2018). The study findings are a way to gain insights on the complexity IS project risks in the context of the South African public sector. As such, broad generalisations cannot be made about the findings.
4) Since all projects are unique, the risks explored in this study are not exhaustive but open-ended and limited by the experience of IM intervention participants.
5) A complete IM process includes a follow-up phase which deals with the implementation of actions to deal with issues uncovered during the workshop. This study only focused on the planning and IM workshop stages. As such, it will not be determined whether the insights gained by the participants during the IM intervention led to the implementation of successful projects in their organisation.

. . .

References

Aladwani, A.M. (2016) Corruption as a source of e-Government projects failure in developing countries: A theoretical exposition. *International Journal of Information Management*, **36**(1), 105-112.

Albertus, R., Ngwenyama, O. and Brown, I. (2015) A critical discourse analysis of governance issues affecting public private partnership contracting for information systems implementations: A South African case study. *In*, *Proceedings of the 2015 Annual Research Conference on South African Institute of Computer Scientists and Information Technologists*, 1-10.

Alexander, G.C. (2002) Interactive management: an emancipatory methodology. *Systemic Practice and Action Research*, **15**(2), 111-122.

Alter, S. and Ginzberg, M. (1978) Managing uncertainty in MIS implementation. *Sloan Management Review (pre-1986)*, **20**(1), 23.

Anthopoulos, L., Reddick, C.G., Giannakidou, I. and Mavridis, N. (2016) Why e-government projects fail? An analysis of the Healthcare.gov website. *Government Information Quarterly*, **33**(1), 161-173.

APM (2012) *APM body of knowledge*. 6th ed. Buckinghamshire: Association for Project Management.

Baccarini, D. (1996) The concept of project complexity—a review. *International Journal of Project Management*, **14**(4), 201-204.

Bakhshi, J., Ireland, V. and Gorod, A. (2016) Clarifying the project complexity construct: Past, present and future. *International Journal of Project Management*, **34**(7), 1199-1213.

Bhuiyan, S.H. (2010) E-government in Kazakhstan: Challenges and its role to development. *Public Organization Review*, **10**(1), 31-47.

Bloch, M., Blumberg, S. and Laartz, J. (2012) *Delivering large-scale IT projects on time, on budget, and on value* [Online]. New York, U.S: McKinsey & Company. Available: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/delivering-large-scale-it-projects-on-time-on-budget-and-on-value [Accessed 03 January, 2020].

Boehm, B.W. (1991) Software risk management: principles and practices. *IEEE Software*, **8**(1), 32-41.

Bosch-Rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H. and Verbraeck, A. (2011) Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and Environmental) framework. *International Journal of Project Management*, **29**(6), 728-739.

Carlo, J., Lyytinen, K. and Boland, R. (2004) Systemic risk, information technology artifacts, and high reliability organizations: A case of constructing a radical architecture. *ICIS 2004 Proceedings*, 56.

Carvalho, M.M.d. and Rabechini Junior, R. (2015) Impact of risk management on project performance: The importance of soft skills. *International Journal of Production Research*, **53**(2), 321-340.

Committee on National Security Systems (2010) National information assurance glossary. In: *CNSS Instruction No. 4009*, USA: Committee on National Security Systems.

Cooper, D.F., Bosnich, P., Grey, S., Purdy, G., Raymond, G., Walker, P. and Wood, M. (2014) *Project risk management guidelines: managing risk with ISO 31000 and IEC 62198*. Second ed. Chichester, West Sussex: Wiley.

Davis, G.B. (1982) Strategies for information requirements determination. *IBM systems journal*, **21**(1), 4-30.

Dunović, I.B., Radujković, M. and Škreb, K.A. (2014) Towards a new model of complexity-the case of large infrastructure projects. *Procedia-Social and Behavioral Sciences*, **119**, 730-738.

Dwivedi, Y.K., Wastell, D., Laumer, S., Henriksen, H.Z., Myers, M.D., Bunker, D., Elbanna, A., Ravishankar, M. and Srivastava, S.C. (2015) Research on information systems failures and successes: Status update and future directions. *Information Systems Frontiers*, **17**(1), 143-157.

Elkadi, H. (2013) Success and failure factors for e-government projects: A case from Egypt. *Egyptian Informatics Journal*, **14**(2), 165-173.

Floricel, S., Michela, J.L. and Piperca, S. (2016) Complexity, uncertainty-reduction strategies, and project performance. *International Journal of Project Management*, **34**(7), 1360-1383.

Flyvbjerg, B. and Budzier, A. (2011) *Why your IT project may be riskier than you think* [Online]. Brighton, Massachusetts, U.S: Harvard Business Publishing. Available: https://hbr.org/2011/09/why-your-it-project-may-be-riskier-than-you-think [Accessed 03 January, 2020].

Geneca (2017) *Why up to 75% of software projects will fail* [Online]. Illinois, U.S: Geneca. Available: https://www.geneca.com/why-up-to-75-of-software-projects-will-fail/ [Accessed 03 January, 2020].

Geraldi, J., Maylor, H. and Williams, T. (2011) Now, let's make it really complex (complicated): A systematic review of the complexities of projects. *International Journal of Operations & Production Management*, **31**(9), 966-990.

Goldfinch, S. (2007) Pessimism, computer failure, and information systems development in the public sector. *Public administration review*, **67**(5), 917-929.

Gupta, S.K., Gunasekaran, A., Antony, J., Gupta, S., Bag, S. and Roubaud, D. (2019) Systematic literature review of project failures: Current trends and scope for future research. *Computers & Industrial Engineering*, **127**, 274-285.

Heeks, R. (2001) *Building e-governance for development: A framework for national and donor action*. Vol. 12, *i-Government Working Paper Series*, Manchester.

Heeks, R. (2002) Information systems and developing countries: Failure, success, and local improvisations. *The information society*, **18**(2), 101-112.

Heeks, R. (2003) *Most e-government-for-development projects fail: how can risks be reduced?* Vol. 14, *i-Government Working Paper Series*, Manchester: Institute for Development Policy and Management, University of Manchester.

Heeks, R. (2006) Health information systems: failure, success and improvisation. *International journal of medical informatics*, **75**(2), 125-137.

Hendriks, C.J. (2013) Integrated Financial Management Information Systems: Guidelines for effective implementation by the public sector of South Africa. *South African Journal of Information Management*, **15**(1), 1-9.

Hidding, G.J. and Nicholas, J. (2009) Reducing IT project management failures: A research proposal. *In*, *42nd Hawaii International Conference on System Sciences*. IEEE, 1-10.

Jackson, M.C. (2003) *Systems thinking: creative holism for managers*. Chichester: Wiley.

Javani, B. and Rwelamila, P.M.D. (2016) Risk management in IT projects–A case of the South African public sector. *International Journal of Managing Projects in Business*, **9**(2), 389-413.

Joseph, N. (2017) Conceptualising a multidimensional model of information communication and technology project complexity. *South African Journal of Information Management*, **19**(1), 1-14.

Kanjanda, T. and Tuan, N.-T. (2020) A Systemic Exploration of the Risk Factors in Zimbabwean Information Technology Projects. *Systemic Practice and Action Research*, **33**(1), 77-93.

Lyytinen, K., Mathiassen, L. and Ropponen, J. (1998) Attention shaping and software risk—a categorical analysis of four classical risk management approaches. *Information Systems Research*, **9**(3), 233-255.

Marnewick, C. and Labuschagne, L. (2009) Factors that influence the outcome of information technology projects in South Africa: An empirical investigation. *Acta Commercii*, **9**(1), 78-89.

Matavire, R., Chigona, W., Roode, D., Sewchurran, E., Davids, Z., Mukudu, A. and Boamah-Abu, C. (2010) Challenges of eGovernment project implementation in a South African context. *Electronic Journal of Information Systems Evaluation*, **13**(2), 153.

McFarlan, W. (1982) Portfolio approach to information systems. *Journal of Systems Management*, **33**(1), 12-19.

McFarlan, W. (1989) *Portfolio approach to information systems*. IEEE Press.

Meyer, I., Marais, M., Ford, M. and Dlamini, S. (2017a) An exploration of the integration challenges inherent in the adoption of ICT in an education system. *In*, *International Conference on Social Implications of Computers in Developing Countries*. Springer, 463-474.

Meyer, I., Marais, M., Ford, M. and Dlamini, S. (2017b) An exploration of the integration challenges inherent in the adoption of ICT in an education system. *In:* Choudrie, J., Islam, M., Wahid, F., Bass, J. and Priyatma, J. (Eds.), *Information and Communication Technologies for Development. ICT4D 2017*. Springer, Cham, Vol. 504, 463-474.

Neto, I., Kenny, C., Janakiram, S. and Watt, C. (2005) *Look before you leap: The bumpy road to e-development*. *E-development: From excitement to effectiveness*, Washington, D.C.: The World Bank

Platt, A. and Warwick, S. (1995) Review of soft systems methodology. *Industrial Management & Data Systems*, **95**(4), 19-21.

PMI (2017) *A guide to the project management body of knowledge*. 6th ed. Newtown Square, Pennsylvania: Project Management Institute.

Public Accounts (SCOPA) (2018) *National Treasury Integrated Financial Management System (IFMS) forensic report: hearing* [Online]. Parliamentary Monitoring Group. Available: https://pmg.org.za/committee-meeting/27742/ [Accessed 03 January, 2020].

Remington, K. and Pollack, J. (2016) *Tools for complex projects*. New York: Routledge.

Reynolds, M. (2011) Critical thinking and systems thinking: towards a critical literacy for systems thinking in practice. *In:* Horvath, C.P. and Forte, J.M. (Eds.), *Critical Thinking*, pp. 37–68. New York, USA: Nova Science Publishers.

Reynolds, M. and Holwell, S. (2010) *Systems approaches to managing change: a practical guide*. London: Springer.

Ropponen, J. and Lyytinen, K. (2000) Components of software development risk: How to address them? A project manager survey. *IEEE transactions on software engineering*, **26**(2), 98-112.

Schmidt, R., Lyytinen, K., Keil, M. and Cule, P. (2001) Identifying software project risks: An international Delphi study. *Journal of Management Information Systems*, **17**(4), 5-36.

Senescu, R.R., Aranda-Mena, G. and Haymaker, J.R. (2013) Relationships between project complexity and communication. *Journal of Management in Engineering*, **29**(2), 183-197.

Shenhar, A.J. and Dvir, D. (2007) *Reinventing project management: the diamond approach to successful growth and innovation*. Harvard Business Review Press.

Sherer, S.A. and Alter, S. (2004) Information systems risks and risk factors: Are they mostly about information systems? *Communications of the Association for Information Systems*, **14**(1), 2.

Smith, D., Eastcroft, M., Mahmood, N. and Rode, H. (2006) Risk factors affecting software projects in South Africa. *South African Journal of Business Management*, **37**(2), 55-65.

South African National Treasury (2019) *Integrated Finacial Management System* [Online]. Pretoria, South Africa: South African National Treasury. Available: http://www.ifms.gov.za/ [Accessed 03 January, 2020].

Standish Group (2015) *CHAOS report 2015* [Online]. Standish Group International, Inc. Available: https://www.standishgroup.com/sample_research_files/CHAOSReport2015-Final.pdf.

Sushil, S. (2012) Interpreting the interpretive structural model. *Global Journal of Flexible Systems Management*, **13**(2), 87-106.

Taherdoost, H. and Keshavarzsaleh, A. (2015) A theoretical review on IT project success/failure factors and evaluating the associated risks. *Mathematical and Computational Methods in Electrical Engineering*.

Taherdoost, H. and Keshavarzsaleh, A. (2018) *Managing successful IT project; marketing perspective*. *Recent Advances on Computational Science and Applications*.

Taylor, H., Artman, E. and Woelfer, J.P. (2012) Information technology project risk management: bridging the gap between research and practice. *Journal of Information Technology*, **27**(1), 17-34.

Teklemariam, M.A. and Mnkandla, E. (2017) Software project risk management practice in Ethiopia. *The Electronic Journal of Information Systems in Developing Countries*, **79**(1), 1-14.

Tuan, N.-T. (2004) On the complex problem: a study of interactive management. *Kybernetes*, **33**(1), 62-79.

Tuan, N.-T. (2018) A systemic inquiry into the AIDS epidemic in the Western Cape of South Africa through interactive management. *Systemic Practice and Action Research*, **31**(4), 421-435.

Vidal, L.-A., Marle, F. and Bocquet, J.-C. (2011) Using a Delphi process and the Analytic Hierarchy Process (AHP) to evaluate the complexity of projects. *Expert systems with applications*, **38**(5), 5388-5405.

Warfield IP Trust (2020) *ISM software* [Online]. Warfield Intellectual Property Trust. Available: https://www.jnwarfield.com/ism-software.html [Accessed 02 October, 2020].

Warfield, J.N. and Cárdenas, A.R. (1994) *A handbook of interactive management*. Ames: Iowa State University Press

White, D. (1995) Application of systems thinking to risk management. *Management Decision*, **33**(10), 35-45.

Williams, T.M. (1999) The need for new paradigms for complex projects. *International Journal of Project Management*, **17**(5), 269-273.

Xia, W. and Lee, G. (2004) Grasping the complexity of IS development projects. *Communications of the ACM*, **47**(5), 68-74.

Annexures

ANNEXURE A: APPROVAL OF ETHICS IN RESEARCH

ANNEXURE B: RESEARCH QUESTIONNAIRE

ANNEXURE C: QUESTIONNAIRE RESPONSES

ANNEXURE D: CONSENT FORM

ANNEXURE A: APPROVAL OF ETHICS IN RESEARCH

Application for Approval of Ethics in Research (EIR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

ETHICS APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data. The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook** (available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/ebe/research/ethics1

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Leo Chiloane
Department		Construction Economics and Management
Preferred email address of applicant		chlpoe001@myuct.ac.za
If Student	Your Degree: e.g., MSc, PhD, etc.	MSc
	Credit Value of Research: e.g., 60/120/180/360 etc.	60
	Name of Supervisor (if supervised):	Dr. Nien-Tsu Tuan
If this is a researchcontract, indicate the source of funding/sponsorship		
Project Title		A systemic exploration of information systems project risks in the South African public sector

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

APPLICATION BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Leo Chiloane	Signature Removed	31/03/2020
SUPPORTED BY	Full name	Signature	Date
Supervisor (where applicable)	NIEN-TSU TUAN	Signature Removed	31 March 2020

APPROVED BY	Full name	Signature	Date
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section 1; and for all Undergraduate research (Including Honours).	Louie van Schalkwyk	Signature Removed	30 June 2020
Chair: Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the questions in Section 1.	Louie van Schalkwyk	Signature Removed	30 June 2020

Page 1 of 1

ANNEXURE B: RESEARCH QUESTIONNAIRE

Interactive Management Questionnaire

Dear Participant

I am a student in the Department of Construction Economics and Management at the University of Cape and would like to invite you to take part in an Interactive Management study, the results of which will contribute to a research project for a Masters degree in Project Management. A description of the study is provided in the consent form sent with this questionnaire.

Please sign the consent form and complete the sections that follow if you agree to participate.

Section 1: Information Systems (IS) Project Experience

* 1. How many years of work experience do you have in IS or the Public Sector?

- ◯ < 1 year
- ◯ 1 - 5 years
- ◯ 5 - 10 years
- ◯ > 10 years

* 2. Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

- ◯ A. Business or Functional Unit Manager
- ◯ B. Product Owner
- ◯ C. Project Manager
- ◯ D. Systems Developer or Analyst
- ◯ E. Project Team Member (select this option if you had a role in a project, but options A-D do not apply)
- ◯ F. Not Applicable

* 3. Was risk management conducted in the IS projects you have been a part of?

- ◯ Yes
- ◯ No

4. If answered Yes to the previous question, please provide the risk management technique(s) used.

* 5. Have you ever completed a Project Management/IS related qualification or training programme?

- ◯ Yes
- ◯ No

Section 2: Identification of Information Systems Project Risks

Please answer the question below to identify IS project risks in the public sector of South Africa.

Risk in the context of this study is defined as the possibility that a particular threat will adversely impact the outcome of an IS project by exploiting a vulnerability in the project environment.

* 6. In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.

Example:

Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	
Risk 2	
Risk 3	
Risk 4	
Risk 5	
Risk 6	

ANNEXURE C: QUESTIONNAIRE RESPONSES

#1

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, September 15, 2020 9:40:05 AM
Last Modified:	Tuesday, September 15, 2020 10:08:50 AM
Time Spent:	00:28:45
IP Address:	102.182.251.164

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

1 - 5 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

C. Project Manager

Q3

Was risk management conducted in the IS projects you have been a part of?

No

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

Respondent skipped this question

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

No

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	Funding priorities - Project funding is not aligned with stakeholder needs as defined in legislation. Thus, even when funding is available and a system is built, it is not what is needed.
Risk 2	User testing - Lack of user testing as part of the design process. Assuming that funding can be found for a needed project testing with stakeholders is not done resulting in unusable systems.
Risk 3	User training - Lack of structured stakeholder training on systems to instruct use. Because it is expensive to get all of the stakeholders in one room, it is difficult to organize a training session about a single system thus the training is mostly ineffective due to cognitive overload.
Risk 4	Funding strategy - Longevity of funding for maintenance/expansion after a project is completed. There is rarely funding available to maintain a project by the project team once it has been handed over to the government department.
Risk 5	ICT personnel - Lack of ICT personnel in government to manage and maintain and update completed systems. Longer-term funding strategies are considered unnecessary because internal ICT personnel should be able to take care of the system. However, once the project has been handed over to the government stakeholder they do not have the people they need on staff to maintain the system.
Risk 6	ICT infrastructure - Lack of ICT infrastructure in government for project maintenance/expansion. When a project is successful and needs to be expanded to accommodate memory or processing load, no money is available to expand existing hardware and the system falls over.

#2

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, September 15, 2020 3:46:58 PM
Last Modified:	Tuesday, September 15, 2020 4:21:34 PM
Time Spent:	00:34:36
IP Address:	196.24.60.253

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

> 10 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

D. Systems Developer or Analyst

Q3

Was risk management conducted in the IS projects you have been a part of?

Yes

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

* Scoping risk management: using a spiral based software development process to ensure built system meets identified requirements.
* Project management governance structures as defined by PRINCE project management guidelines

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

Yes

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	Retaining highly skilled team members (Contracts are often obtained when expertise exists from previous projects, these individuals do move on an sometimes leave gaps in the organisations previous capability set)
Risk 2	Hiring highly skilled employees (BEE Hiring policies in government restrict who you can hire, coupled with an already limited talent pool of skilled IT people in South Africa)
Risk 3	Long term funding (5-10-15 years): Operation Phakisa is on example where long term funding has allowed for new systems to be developed sustainably. Very few IT system projects set up by government departments have the advantage of something like this.
Risk 4	Lack of long term partnership between supplier/service provider and Funder; Gov. departments are notoriously bad at systems development, and don't realize they need long term partnerships where capability exists (such as parastatals like CSIR/NRF-SAEON)
Risk 5	Not using formal project management processes such as PRINCE
Risk 6	Absence of good technical management and systems engineering

#3

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Wednesday, September 16, 2020 1:19:15 PM
Last Modified:	Wednesday, September 16, 2020 1:29:37 PM
Time Spent:	00:10:21
IP Address:	41.193.49.107

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

> 10 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

C. Project Manager

Q3

Was risk management conducted in the IS projects you have been a part of?

No

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

Respondent skipped this question

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

Yes

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	**Lack of sustained long-term investment in national entities developing information systems and data portals**
Risk 2	**Lack of long-term planning (i.e. data management plans not in place or investment in ageing software solutions)**
Risk 3	**Limited ability to retain skilled professionals (software developers) in public sector**
Risk 4	**Lack of open data and sharing of data between national entities**
Risk 5	**Lack of coordination of IS projects by different government departments (i.e. siloed developed)**
Risk 6	**Lack of consultation with users (top down IS solutions are developed)**

#4

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Tuesday, September 22, 2020 1:19:07 PM
Last Modified:	Tuesday, September 22, 2020 1:36:44 PM
Time Spent:	00:17:36
IP Address:	102.132.218.159

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

1 - 5 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

E. Project Team Member (select this option if you had a role in a project, but options A-D do not apply)

Q3

Was risk management conducted in the IS projects you have been a part of?

No

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

Respondent skipped this question

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

No

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	Lack of longterm planning or project continuity
Risk 2	Insufficient funds for longevity
Risk 3	Insufficient marketing
Risk 4	Insufficient input from users prior to starting the project
Risk 5	User feedback after completion of the project not leading to updates or changes to the project
Risk 6	Employee turnover

#5

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, September 28, 2020 9:49:16 AM
Last Modified:	Monday, September 28, 2020 10:50:35 AM
Time Spent:	01:01:18
IP Address:	196.24.60.253

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

> 10 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

D. Systems Developer or Analyst

Q3

Was risk management conducted in the IS projects you have been a part of?

No

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

Respondent skipped this question

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

Yes

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	**Poor recruitment process. Screening of candidates for highly technical roles requires involvement and oversight by staff with deep technical knowledge and experience. Approaching recruitment as a box-ticking exercise can - and does, in my experience - lead to suboptimal systems development, and the accumulation of problems that need fixing further down the line.**
Risk 2	**Outsourcing of IS projects. The focus will always be on finishing a project using the least effort, rather than engineering a system to be robust, scalable and maintainable beyond the initial project lifespan.**
Risk 3	**Viewing IS projects as standalone, self-contained endeavours that simply need to be matched with available financial and HR resources. Successful IS projects require long-term investment in the technical capacity of an organisation.**
Risk 4	**Not offering competitive salary packages. An organisation will achieve better IS project outcomes with a few, highly paid top developers than a large number of mid-level and junior developers. However, to attract and retain top developers requires that the organisation compete with the private sector on the developer job market.**
Risk 5	-
Risk 6	-

#6

COMPLETE

Collector:	Web Link 1 (Web Link)
Started:	Monday, September 28, 2020 6:50:39 PM
Last Modified:	Monday, September 28, 2020 7:08:48 PM
Time Spent:	00:18:09
IP Address:	165.255.93.65

Page 2: Section 1: Information Systems (IS) Project Experience

Q1

How many years of work experience do you have in IS or the Public Sector?

1 - 5 years

Q2

Which of the following roles best describes your core involvement or oversight in the implementation of IS projects in the public sector?

D. Systems Developer or Analyst

Q3

Was risk management conducted in the IS projects you have been a part of?

No

Q4

If answered Yes to the previous question, please provide the risk management technique(s) used.

Respondent skipped this question

Q5

Have you ever completed a Project Management/IS related qualification or training programme?

No

Page 3: Section 2: Identification of Information Systems Project Risks

Q6

In your view, what do you perceive to be the six most dominant risk factors that can lead to IS project failure in the public sector of South Africa? Please provide the risk and a short description.Example:Employee turnover - Demand for IT skills in South Africa has a high impact on the ability to retain high-end talent on projects. Project team members vacating their positions before project completion dates increase the likelihood of project failure.

Risk 1	Budget cuts - A project's funding timeline can be limited if the budget is not spent.
Risk 2	Politics between employees and/or Managment - Politicking is rife in the Public Sector and slows projects down as people are fighting over authority or political clout instead of working on the project to completion
Risk 3	Positions remaining vacant for long periods - As positions remain empty the responsibility is shifted onto other employees slowing progress of the project and increasing the risk of employee turnover
Risk 4	Excessive red tape - Slows down access to resources (software and hardware) which slows down the project progress often pushing projects past agreed deadlines and budgets
Risk 5	Limited funding - Projects are only funded for a period of time and the system is expected to last past its funding.
Risk 6	Lack of expertese - Public sector clients are limited in their knowledge to define what Information System they require, an iterative process assist them in learning what they require, but pushes projects past deadlines and agreed budgets

ANNEXURE D: CONSENT FORM

Information Sheet and Consent Form

A Systemic Exploration of Information Systems Project Risks in the South African Public Sector

Researcher: Leo Chiloane

Dear Participant

I am a student in the Department of Construction Economics and Management at the University of Cape and would like to invite you to take part in an Interactive Management study, the results of which will contribute to a research project for a Masters degree in Project Management.

Information About the Study

The purpose of this study is to explore Information Systems (IS) project risks in the public sector of South Africa, which often result in persistent underperformance of IS projects. Exploring the dominant risks in these projects might provide more insights into the leading causes of the persistently high project under-performance.

The study will be conducted through the application of Interactive Management (IM). IM is a systemic approach created for the management of complexity. The IM approach uses collaborative teamwork to define and resolve highly complex issues and problems that cannot be readily solved by organisations. It is an interactive learning process that transforms inadequately expressed mental models of systems into well-defined structural models. The learning process centres around participation and is facilitated by conducting a structured intervention with a group of participants representing different stakeholder perspectives. Your participation in this intervention would be highly appreciated.

Study Participation

For this research, your participation in the intervention will be facilitated in two parts. First, I would like to request you to complete a questionnaire to identify IS project risks you perceive more dominant. A workshop phase, in which you and other participants may be invited to will then follow.

The purpose of the workshop is to create a shared understanding of the risks identified. An Interpretive Structural Model of the most dominant risks will be developed to identify interrelationships that exist between them. Invitations to the workshop will be sent out after the responses to the questionnaire have been collated. The workshop will be held virtually via videoconferencing.

Please note that you will only be expected to respond to the questionnaire and participate in the discussion during the workshop phase. Nothing beyond this will be required.

Anonymity, Confidentiality and Risk of Harm

The questionnaire responses will be appended to the dissertation. The questionnaire does not contain any questions with personal and institutional identifiers. Furthermore, questionnaire responses with sensitive information will be redacted. If you would like to review the questionnaire before signing this consent form, you are welcome to do so.

Due to the participatory and collaborative nature of the IM workshop phase, there is a built-in weakness with regards to anonymity and confidentiality. All workshop participants will hear the discussion. Furthermore, the conversation during the workshop phase will be recorded, and the information shared will be used to compile the research findings chapter of the dissertation. The workshop recording will be stored securely and disposed of after the dissertation is assessed.

Withdrawal from Participation

If invited to the workshop phase, your participation will be voluntary. Should you wish to withdraw from participating, you will be able to do so at any time.

Ethical Considerations

Ethics clearance for the study has been granted by the University of Cape Town Faculty of Engineering and the Built Environment. Queries for further information can be directed to me via email at CHLPOE001@myuct.ac.za.

Name: ....

Date: .... **Signature:**..