Implications of Software as a Service Adoption for IT Workers' Roles and Skill Sets from a Sociomateriality Perspective

By

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List of Abbreviations

AD	Active directory
ADSL	Asymmetric digital subscriber line
API	Application programming interface
ASP	Application service provision
AUTEC	Auckland University of Technology Ethics Committee
CPU	Central processing unit
CRM	Customer relationship management
ERP	Enterprise resource planning
GADS	Google active directory synchronisation
GAE	Google Apps for Education
GCB	Government Computer Bureau
GT	Grounded theory
GTM	Grounded theory method
HaaS	Hardware as a service
HR	Human resources
IaaS	Infrastructure as a service
IS	Information system
IT	Information technology
LDAP	Lightweight directory access protocol
PaaS	Platform as a service
PSIC	Punctuated sociotechnical information system change
PST	Personal storage table
ROI	Return on investment
RPC	Remote procedure calls
SaaS	Software as a service

SETI	Search for Extra-Terrestrial Intelligence
SLA	Service level agreement
TEC	Tertiary education council
VOIP	Voice over Internet protocol

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Dedication

This thesis is dedicated to my late father Mr Haita Ramadhani Mbuba, who encouraged me to work hard in life and reach the full potential I was designed to reach. Thank you, father, and may your soul rest in peace.

Statement of Original Authorship

‘I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in acknowledgments), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.’

Signature	Date
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Declaration

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Abstract

This study broadly seeks to explain the implications of software as a service (SaaS) for information technology (IT) workers from a sociomateriality perspective. SaaS is a cloud computing model based on IT capabilities of a utility model that enhances the scalability of computing resources at a lower cost than on-premise IT systems. Unlike the on-premise IT system, through the SaaS model, customers no longer need to purchase software licences. Instead, they can subscribe to and access software via an Internet connection. Based on these potential benefits, customers, particularly large organisations such as tertiary institutions for whom IT may not be their core functional systems, are migrating their on-premise IT systems to the SaaS model. However, this may have effects on the roles and skill sets of IT workers, as support and future developments of SaaS shifts to the SaaS service provider. Researchers have raised concerns about these implications and predicted that cloud adoption would change IT workers' roles and diminish their jobs, leading to job losses worldwide, as IT departments within organisations lose control of IT resources. Similarly, studies report that IT workers believe by turning IT resources and support to a cloud service provider pose significant risks to their roles and skill sets. However, these anecdotal claims are not supported by substantial empirical and theoretical evidence.

Researchers have called for more studies on these implications and the associated human management issues. Previous information system studies on the changing IT workers' skill sets related to cloud computing adoption are rather generic in that there is a scarcity of in-depth conceptual and empirical analyses to ascertain how these implications are related to SaaS adoption in particular. Therefore, the migration process of IT from on-premise to the SaaS model presents an ideal environment in which to not only understand the implications for IT workers but to contrast the features

of the insights offered into how human and technology or human and material agencies interact in work practices. Sociomateriality literature claims that human and material become constitutively entangled in work practices. However, less is known about how human and material interact, and at what level these interactions happen. Therefore, this research draws empirical data from IT implementation projects related to moving on-premise IT systems to a SaaS system, to explain the implications of a SaaS system for IT workers, and employs the concepts of sociomateriality to help explain how human and technology interact in work practices.

To narrow the scope, diversity, and context of the research focus, the current study draws empirical data from four case studies of tertiary institutions in New Zealand that migrated their on-premise email systems to a SaaS system such as Google Apps for Education (GAE) or hosted Office 365 (O365). This approach addresses the main research questions posed in this thesis: why the migration of an on-premise IT system to SaaS changes the roles and skill sets requirements for IT workers; what implications there are for functions of the IT department; and how IT workers interact with these technologies from a sociomateriality perspective. In answering these questions and build an in-depth understanding, this study employs a punctuated sociotechnical information system change (PSIC) model as a tool for analysing and displaying the empirical data. In addition, the research applies the concepts of sociomateriality to provide in-depth explanations of the interactions between human and technology. An interpretive approach is adopted, with 17 participants interviewed from four case studies. The participants included IT workers and IT managers who participated in the SaaS migration process.

The findings suggest that the SaaS model has some effects on IT workers' roles and skill sets, and IT workers interact with technology at different abstract levels. First, the research shows the split of IT workers into two categories: systems engineers (IT

workers with deep IT knowledge coupled with IT or engineering academic background) and IT technicians (IT workers without any IT or engineering academic background). The study suggests that systems engineers are coping well with the need to use programming tools in supporting virtual systems in the SaaS environment, whereas IT technicians are unable to or struggle to adapt to the new skill sets requirements. Second, IT workers' roles are evolving into the third and fourth level of IT systems support in the SaaS environment, moving away from the traditional first and second roles. The third issue is that the security specialist's role has been introduced or reinforced within the IT department, to support the new SaaS environment. Consequently, the fourth issue shows that the functions of the IT department are transforming into a brokering role.

In addition, through the sociomateriality lens, the findings reveal insights into the interactions between human and material. In particular, the findings suggest that this interaction occurs at three levels of abstraction: materiality, virtual and at the spirit of technology. In this study, the term materiality defines the arrangement of an artefact's physical and digital materials that accord affordances to human and endures across time and space. The virtual realm of technology relates to technological features that are malleable and changes in system use. Unlike the materiality of technology, virtual features are inherent to the technology but depend on the context and use of technology. The spirit of technology refers to its strategic goals. The empirical data captured during this research suggest that IT technicians interact well with the materiality realm, whereas systems engineers interact with both the materiality and virtual realms of technology. In contrast, IT managers interact with the spirit of the technology, by aligning the essence of the technology with the strategic goals of their organisation. Implications for theory and practice are discussed.

Chapter 1: Introduction

1.1 Introduction

This chapter introduces the research motivation; the problem addressed, and analytical approach undertaken in this study. Broadly, this explanatory study is positioned around information system (IS) studies seeking to explain how human and technology interact, especially during the implementation of information technology (IT) and changes in work practices (Markus & Robey, 1988; Orlikowski, 1992). The main objective is to explain the implications of software as a service (SaaS), a cloud computing model for IT workers from a sociomateriality perspective (Leonardi, 2012; Orlikowski, 2009). More specifically, this study seeks to explain why the migration of an on-premise IT system to SaaS alters the roles and skill sets requirements for IT workers, as well as the implications of this for the functions of IT departments, and how IT workers interact with these technologies from a sociomateriality perspective. For this reason, this study builds on the sociomateriality perspective in understanding the interplay between human and technology (Orlikowski, 2007; Orlikowski & Scott, 2008). Section 1.2 discusses the concept of sociomateriality in the context of the SaaS model.

The SaaS model is one of the service levels of cloud computing technologies (Mell & Grance, 2011). As discussed in Chapter 2, the IS literature indicates that cloud computing has brought some transformations to the IT industry, making SaaS available to customers and shaping the way IT hardware is designed and purchased (Ross, 2011; Xin & Levina, 2008). In the current study, cloud computing refers to both applications delivered as services over the Internet and infrastructure in data centres that enable these services (Wyld, 2010). The hardware and software in the data centre accessed via the Internet are referred to as a cloud (Armbrust et al., 2009). There are four basic types of cloud service levels: hardware as a service (HaaS), infrastructure as a service (IaaS), platform as a service (PaaS) and SaaS. Section 2.2 discusses the definitions of these service levels. The cloud service levels are based on capabilities in a utility model that enhance the reliability and scalability of the computing resources at relatively low cost compared to on-premise IT systems (Carraro & Chong, 2006). Here, the on-premise IT system is defined as a 'software service model in which customers purchase permanent licences of the commercially available software' their IT workers maintain the application and its associated infrastructure (Xin & Levina, 2008, p. 5). Consequently, organisations, such as tertiary institutions where IT is not their core functional systems may decide to adopt cloud services for economic reasons and to keep up with IT innovations (Wyld & Juban, 2010).

1.1.1 Economic Reasons for Cloud Service Adoption

Wyld and Juban (2010) argue that because of economic recession worldwide, large organisations in which IT systems are not their core system (e.g. tertiary institutions, government organisations) are shifting to more cloud-based applications. Cloud-based applications bring new capabilities to communicate, collaborate and conduct research to faculty staff and students and can reduce costs of IT infrastructure, human resources (HR) and support from IT departments (Wyld & Juban, 2010). Despite the enormous potential of cloud technologies, as cost-effective, easy-to-deploy computing solutions in an era of tight budgets and accelerated programme and policy changes, some organisational implications are inevitable (Thom & McCarthy, 2010). Researchers and practitioners have raised concern about the impact of cloud computing adoption on organisational and HR issues (Long, 2010; Swabey, 2010; Wyld, 2010; Wyld & Juban, 2010). For example, Swabey (2010) predicts that cloud adoption will change IT roles and diminish IT blue collar jobs leading to job losses worldwide, as IT departments within an organisation lose control of IT resources. Long (2010) reports that in 2009, the City of Los Angeles moved its email system to a cloud service system hosted by the Google email system. As a result, nine IT worker positions were eliminated, and other workers were redeployed to operations and customer support roles, leaving fewer IT workers to manage the new system. Similarly, IT workers believe that handing over IT resources and support to a cloud service provider poses significant risks to their roles and skill sets (Gardner, 2009; Wyld, 2009).

However, these anecdotal claims do not have strong empirical support showing that cloud computing or in particular, the adoption of a SaaS system, will result in the reduction of IT workers' roles. This study seeks to fill this gap in the literature by examining why SaaS adoption changes IT workers' roles and skill sets requirements.

1.1.2 IT Innovations Trends

The SaaS model is changing the way software is acquired and used (Benlian, Hess, & Buxmann, 2009). Through the SaaS model, customers no longer have to purchase software licences. Instead, they need only subscribe to and access software via an Internet connection. As a result, adoption of the SaaS model pushes software providers to change their business model from product-based to on-demand service-based provision models (Carraro & Chong, 2006). The SaaS model has evolved from an application service provision (ASP) model. Examples of ASP include traditional enterprise resource planning (ERP) packages from SAP, Oracle, and Microsoft Great Plains. ASP models have three critical features that distinguish them from the SaaS model. First, customers rent access to commercially customised software from a service provider. Second, the price is based on usage; therefore, customers face no upfront capital. Third, a customer-specific instance of an application is located offsite and is delivered over the network. However, customers might still be able to customise their instance of the application on the service provider's server to some extent. A key issue surrounding ASP adoption has become the degree of customisation desired by the customer, and the resulting efficiency loss by the service provider. In early 2000, the

ASP model was reinvented into the SaaS model, which relies on a different architecture (Carraro & Chong, 2006). ASP architecture differs from that of the SaaS model in four important ways. First, the SaaS model constraints customers' options for customisation of the main functionality. Second, it gives more control to the service provider for future development. The third feature is that the SaaS model supports service-oriented multi-tenancy, which is the ability of a software application (single instance) to support multiple customers or clients (Carraro & Chong, 2006). A SaaS service provider runs a single instance that serves every customer, with configurable settings providing a unique customisable feature set for each customer (Carraro & Chong, 2006). Finally, the SaaS model allows for the separation of maintenance responsibilities between the SaaS service provider and the customer. Hence, the SaaS model no longer requires any customer-specific investment by the service provider. Examples of SaaS systems range from office and collaboration (e.g. Google Apps, cloud-hosted O365) to CRM (e.g. e.Salesforce.com) and ERP via the cloud, such as SAP Business ByDesign (Wyld, 2010). Organisations adopt the SaaS model based on these promised benefits, which might have implications for IT workers' work practices, and this is what the current study seeks to examine.

1.1.3 Changes in Work Practices Brought by SaaS Adoption

Despite the promised benefits that the SaaS model provides, the IS literature regards the SaaS model as a disruptive innovation (Bandulet et al., 2010; Lyytinen & Rose, 2003). Although it changes not only certain aspects of a software business model, such as introducing a new pricing model, the change to an entire business model is possible. Disruptive innovations challenge existing models and processes and demand that the current knowledge needs to be re-evaluated and adapted to the new setting (Christensen, 2006). The SaaS model challenges work practices in software business models and how a software application is delivered, accessed, purchased, supported and governed by an adopting organisation (Lyytinen & Rose, 2003). These challenges expose the organisation to additional cost, technical, security, privacy, HR and organisational changes that are not usually associated with ASP (Keller & Hüsig, 2009). According to Gartner, the global public cloud services market will jump by 16.5% in 2016 from 2015 to US$204 billion—of which 80% accounts for SaaS businesses—as organisations continue to migrate their on-premise IT systems to cloud-based solutions (Corkern, Kimmel, & Morehead, 2015). Thus, there is a need for research that examines the implications of the SaaS model for an adopting organisation.

Previous IS studies on the SaaS model have discussed cost analysis of SaaS (Bandulet et al., 2010; Chou & Chou, 2007); technical, security and privacy issues (Wyld, 2010); and drivers of SaaS adoption (Arinze & Anandarajan, 2010; Benlian et al., 2009). Findings on the changing IT workers' skill sets associated with cloud computing adoption (e.g. see Ross (2011) are rather unclear in that there is a scarcity of in-depth conceptual and empirical analyses to ascertain how these implications are associated with SaaS adoption in particular. Puzzled by the lack of clarity in the IS literature, practitioners and managers may fail to understand the consequences of adopting the SaaS model (Hall, 2008; Lynch, 2008). Based on the literature, the current study assumes that there are some effects of SaaS on IT workers. However, in-depth analysis is necessary to develop a deeper understanding of these implications, which include changes in roles and skill sets of IT workers (Wyld, 2010). Researchers have called for more studies on these implications and associated HR management issues (Ross, 2011; Wang, Rashid, & Chuang, 2011). For these reasons, the current study aims to fill the gap in the literature by examining why the migration of an on-premise IT system to the SaaS model changes the roles and skill sets requirements for IT workers. The current study draws empirical data from case studies of tertiary institutions, to narrow the diversity and scope of the research.

The remainder of the chapter contains four main sections as follows. The next section discusses sociomateriality, a theoretical lens adopted in this study and discussed further in Section 2.4. This discussion leads to the formulation of the research purpose, questions, and approach in Section 1.3. Section1.4 explains the rationale for the study, and Section 1.5 discusses the ethics approval of this research. Finally, the last three sections define key terms, outline the structure of the study and summarises the information presented in this chapter.

1.2 The Sociomateriality Perspective

Information systems offer a conceptual challenge given the complex interactions between human and technology in work practices (Barad, 2007; Leonardi, 2012; Orlikowski, 2007). IS researchers have encountered this challenge in studying the relationship between human and *materiality*, or social life and technology, and how this contributes to changes in work practices (Leonardi, 2012; Orlikowski, 2007; Orlikowski & Scott, 2008); the term materiality refers to 'the arrangement of an artefact's physical and/or digital materials into particular forms that endure across differences in place and time' (Leonardi, 2013, p. 69).

Examples of artefacts in workplaces include office desks, chairs, computers, IT infrastructure, operating systems, and system applications. In this endeavour, therefore, IS scholars have coined the term *sociomateriality*, which describes the constitutive interaction of the human and material agencies in work practices (Orlikowski, 2007). Human agency refers to the ability to form and realise one's goals (Giddens, 1984), and the material agency describes the capacity for non-human entities to act in the absence of sustained human intervention (Leonardi, 2012). Also, Leonardi describes sociomateriality as the 'enactment of a particular set of activities that meld materiality with institutions, norms, discourses, and all other phenomena we typically define as social' (Leonardi, 2012, p. 12). For example, the interactions of human and material agencies in workplaces may include the scenario of a person using an office computer connected to the organisation's network and the Internet. In this example, the materiality of technology includes hardware, software, Internet web pages, the flow of information on the network, and the Internet. Work activities may include interactions with office applications and browsing web pages loaded onto a Windows operating system. At the same time, a worker could be talking to a friend using a smartphone and being informed of their physical activities by a wearable health device. Such constitutive interaction, or sociomateriality of human and technology, presents a challenge in studying the interactions of human and material in work practices (Orlikowski & Scott, 2008). Sociomateriality has its roots in sociotechnical system thinking (Mumford, 2006), actor–network theory (Latour, 2005) and practice theory (Cecez-Kecmanovic et al., 2014). Two ontologies guide the sociomateriality perspective: *relational ontology* (Barad, 2007; Orlikowski & Scott, 2008) and *substantiality ontology* (Leonardi, 2012). Relational ontology of sociomateriality assumes that 'social and material are inherently inseparable' (Orlikowski & Scott, 2008, p. 456). It challenges the separation of materials from human or technology from social life. The relational ontology, therefore, represents a shift from understanding people and technologies, each characterised by specific properties and boundaries that interact and mutually influence each other in the performative nature of practices when they are enacted and re-enacted (Cecez-Kecmanovic et al., 2014). In contrast, substantiality ontology takes the notion of 'substances of various kinds (things, beings, essences)' as self-subsistent entities that come pre-formed and involve themselves in dynamic relations (Emirbayer, 1997, p. 282). According to the substantiality view, materiality is inherent to the technology and independent of its use and the context in which it is used (Barley & Leonardi, 2008). Leonardi (2012) argues that once the technology is built, its materiality is fixed unless some subsequent redesign is undertaken. When IT is implemented in an organisational context, technology's materiality becomes necessary because users react to the technology's materiality, which is the materiality they perceive as bounded and stable when translating it from the realm of the artefactual into the realm of the social (Leonardi, 2013).

The current study thus employs the substantiality ontological stance in explaining the intertwining of human and technology, and how this bring changes in work practices (Leonardi, 2013). However, the sociomateriality literature is unclear about the level of abstraction at which human and material agencies interact (Leonardi, 2013; Orlikowski, 2009; Orlikowski & Scott, 2008). Chapter 2 discusses this lack of clarity in the sociomateriality literature. In the context of this study, changes in work practices include changes in roles, tasks, routines and skill requirements of IT workers (Orlikowski, 2007). This study, therefore, draws on the sociomateriality perspective and empirical data from IT implementation projects of moving on-premise IT systems to the SaaS model, to examine the implications for IT workers. The next section discusses the research problem, purpose, and approach adopted in this research.

1.3 Research Problem

The main objective of this study is to explain the implications of SaaS for IT workers from a sociomateriality perspective. As indicated earlier, the research problem addressed in this study seeks to explain why the migration of an on-premise IT system to SaaS changes the roles and skill sets requirements for IT workers, as well as the implications of this for functions of the IT department, and how IT workers interact with these technologies from a sociomateriality perspective. The migration process of IT from on-premise system to the SaaS model, therefore, presents an ideal platform to understand why SaaS has an effect on IT workers' roles and skills; examine the contrast in functional features of the systems; and shed light both on practice and theoretically on how human and technology interact in work practices (Orlikowski, 2007). Thus, to gain managerial insights, this study investigates the changes in roles and skill sets of IT workers and the implications of this for the functions of IT departments when on-premise IT systems migrate to the SaaS model. The study examines how human and technology interact from the sociomateriality perspective. In particular, the study seeks to explain the level at which human and technology interact, which is an unclear concept in the sociomateriality literature.

Concerning the research methodology, this study takes the process approach and employs a punctuated sociotechnical information system change (PSIC) process model (Lyytinen & Newman, 2008) in guiding the research. The PSIC model guides this study through visual maps by analysing empirical evidence drawn from interview questions to trace the events and work processes occurring as an organisation moves its on-premise IT system to the SaaS environment (Lyytinen & Newman, 2008). The PSIC model is appropriate for this research because it describes IT implementation and changes in work practices as multi-level and intermittent change, by drawing from theories that narrate IS change as a process. The PSIC process model is discussed further in Chapters 2 and 3.

1.3.1 Research Purpose

In addressing the research problem, the aim of this study involves three main objectives: 1) to build understanding by using a process model (the PSIC model) on the migration process from an on-premise IT system to the SaaS model; 2) to investigate why the migration of an on-premise IT system to the SaaS model changes the roles and skill sets requirements for IT workers, and the implications of this for functions of IT departments; 3) to explain how human and technology interact in work practices from a sociomateriality perspective.

1.3.2 Research Questions

Based on the above objectives, three research questions guide this study:

1. What happens in the process of migrating an on-premise IT system to the SaaS model?
2. Why does the migration of an on-premise IT system to the SaaS model change the roles and skill sets requirements for IT workers and what are the implications of this for the functions of IT departments?
3. How does the interaction between human and technology influence work practices and organisational change, when an on-premise IT system migrates to the SaaS model?

The research questions are based on the assumptions that SaaS adoption has some effects on IT workers and functions of the IT department (Ross, 2011). And that the interactions between human and technology influences work practices and organisational change (Leonardi, 2013; Orlikowski & Scott, 2008).

1.3.3 Research Approach

This study employs an interpretive, multi-case study strategy to collect and analyse empirical data, which is appropriate within the theoretical and practical constraints of this study. Myers indicates that case study research in the IS field employs:

> *Empirical evidence from one or more organisations where an attempt is made to study the phenomena in context. The empirical data uses multiple sources; most data comes from interviews and documents. (Myers, 2011, p. 76)*

For this reason, the case study research strategy is recommended for research that aims to develop an in-depth understanding or uncover new emerging insights of phenomena in real-life situations (Myers, 2011). More specifically, the case study approach is appropriate when an objective of the study is to understand how and why the event occurs, especially when the researcher has little or no control over the events, and the focus is on a real-life, complex social phenomenon (Yin, 2011). Hence, the case research strategy enables this study to address the research problem, meet the expectations of the research purpose, and answer the research questions. In this study, the unit of analysis is the project of migrating an on-premise IT system to the SaaS environment, and the primary data collection method is through semi-structured interviews supported by evidence from other sources, such as organisational and project documentation. This research selected case studies from four tertiary learning institutions located in New Zealand, where the on-premise email and calendaring system migrated to the SaaS environment such as Google Apps for Education (GAE) or hosted O365. The philosophical assumptions guiding the current research follow the interpretive ontology and epistemology. Here, the ontological assumption is concerned with the question of what is the nature of the social reality being investigated or the worldview guiding the study (Orlikowski & Baroudi, 1991). Interpretive ontology emphasises the importance of multiple and subjective meaning through which humans construct social realities (Lincoln, Lynham, & Guba, 2011). The epistemology assumption is concerned with the question of what is the relationship between the researcher and the researched, or what represents knowledge or evidence of the social reality. Epistemologically, interpretive research assumes that valid knowledge is a social construct arising from how people perceive their world as they try to understand a phenomenon through the meanings and values that people assign to it (Walsham, 2001). Thus, this interpretive research is premised on the subjectivity epistemology belief that the researcher creates an understanding through the interaction with the subject of the investigation (Lincoln et al., 2011).

1.4 Research Rationale

The rationale for undertaking this research is based on three aspects: 1) the literature gap it seeks to fill; 2) the researcher's personal experience of how the SaaS model is changing the working environment of IT workers; 3) the contributions to the theory and practice this study offers to the body of knowledge.

1.4.1 Literature Gaps on the Implications of SaaS

As discussed earlier, the main objective of this study is to explain the implications of SaaS for IT workers from a sociomateriality perspective. Managerial and theoretical literature gaps are the motivation behind this study. From the managerial viewpoint, SaaS implications for IT workers may include widespread layoffs of IT hardware workers. Moreover, IT departments may lose control of IT systems, leading to more of a focus on data security and service provider management, as IT systems support moves to cloud service providers (Carraro & Chong, 2006; Wyld, 2009, 2010). However, these anecdotal claims do not have strong empirical support; hence, there is a lack of in-depth IS study that investigates, in particular, the implications of SaaS for the roles and skill sets requirements for IT workers in the adopting organisation.

From a sociomateriality perspective, the migration of an on-premise IT system to the SaaS model provides a useful environment for understanding the interactions between human and technology in work practices (Orlikowski, 2007). However, the sociomateriality literature is unclear on the abstract level of interactions between human and technology, or between human and material agencies (Leonardi, 2013; Orlikowski, 2007; Orlikowski & Scott, 2008). Moreover, the sociomateriality lens has not sufficiently examined and linked technological and organisational changes in work practices in the SaaS context, which is part of the aim of the current study (Orlikowski, 2007).

1.4.2 Personal Experience

The 18 years personal experience of the researcher, working in various roles in the IT industry, including as a systems analyst, IT manager, and systems coordinator, partly motivated the undertaking of this study. I recall in the early 2000s working as a systems analyst for the Government of Botswana at the Government Computer Bureau (GCB). My colleagues and I were mainly assigned to support thin-client user desktop computers, running on old Windows operating systems, such as Windows 95, and participating in various IT projects. External consultants were supporting the government's finance system, which by then was running on the mainframe computer architecture. A few years later, these mainframe systems become obsolete, and the finance system got upgraded to subsequent versions of newer operating systems (e.g. Microsoft Windows NT/2000 and Linux systems), regarded as mature client–server architectures; the systems were further moved to Windows 2003/2008 systems, and so forth. At that time, GCB, now known as the Department of Information Technology (Government_of_Boswana, 2016), was extending its role by employing more IT workers and deploying them into various government departments. Up until 2009, the roles and skill sets required to support these systems were similar, apart from the need to upskill to the corresponding Windows versions. However, the advent of virtualization technologies in IT, and then maturity in the cloud computing architecture—especially the SaaS model—changed the landscape of the IT working environment (Creeger, 2010). These changes have been a major concern among IT workers in general, more especially because of some challenges brought by the SaaS model to traditional work activities performed on client–server architecture. Thus, after examining the IS literature, I identified an interesting research problem to be pursued further in understanding these challenges from the managerial and theoretical perspectives.

1.4.3 Contributions of the Study

Theoretical and practical contributions of this study are discussed below.

Theoretical Contributions

This study presents both theoretical and methodological contributions. On theory, it employs a sociomateriality lens in examining the interaction between human and IT and provides insights into the ongoing debate on how human interact with technology (Jones, 2014; Leonardi, 2013; Orlikowski & Scott, 2008). In particular, this study examines the levels at which human and material agencies interact, a concept that is unclear in the sociomateriality literature. Methodologically, this research builds on the work of Lyytinen and Newman (2008) and operationalises the PSIC model to develop an understanding of the implementation of a SaaS system and its implications for IT workers and organisational change. In particular, empirical findings from this research contribute to new knowledge—to understand the migration process of on-premise IT system to the SaaS model, and implications of this for the skill sets and roles of IT workers, and for the functions of IT departments (Lacity et al., 2010).

Implications for Practice

This research provides a range of managerial implications to IT workers and managers on potential opportunities, risks, and sociotechnical changes for an organisation, so they can prepare appropriate resources to address them.

1.4.4 Setting the Scene: Four Case Studies

As discussed earlier, large organisations such as tertiary institutions for which the IT system is not their core system have embraced the use of SaaS systems such as GAE and hosted O365 systems (Wyld & Juban, 2010) because in these institutions, migrating on-premise IT system to the SaaS model provides improved real-time collaboration and research capabilities at reduced cost, while providing a better level of computing services to faculty members (Wyld & Juban, 2010). There is a need in these institutions to reduce overheads at a time when public and private institutions are coping with significant budget shortfalls, the massification of higher education, globalisation effects, the advent of the knowledge society and increases in IT capabilities (Altbach, Reisberg, & Rumbley, 2010). On massification, governments worldwide demand expansion of enrolments, while tertiary institutions are coping with financial struggles to meet the need for expanded infrastructure and a larger teaching staff (Altbach et al., 2010). Globalisation has shaped the world through factors such as an integrated global economy, new IT innovations, and the rise of English as the universal language of scientific communication. These factors of globalisation have increased student mobility worldwide (Altbach et al., 2010), which has affected the tertiary education sector. Institutions have implemented a variety of policies and programmes in response to globalisation factors. These policies include setting up branch campuses overseas, internationalising curricula, engaging in international partnerships and employing the latest IT innovations to enhance real-time collaboration and research capabilities, as well as better computing powers at a reduced cost (Altbach et al., 2010).

Tertiary Education Institutions and the SaaS Model

The SaaS model allows institutions to reduce IT infrastructural costs and tap into the latest IT innovations from commercial cloud service providers via the Internet. In addition, many of these resources are available to them either free or at a reduced cost (Wyld & Juban, 2010). With the SaaS model, students and faculty staff take advantage of the ability to undertake research and collaborate with international researchers from anywhere and on any device using SaaS applications. Other benefits that SaaS provides to its customers include no upfront investment cost required, the elasticity of computing resources, service provider support and upgrades, rapid response to markets, usage metred as a utility, resource pooling and the ability to add computing resources as needed (Mell & Grance, 2011). Organisations adopt the SaaS model based on these potential benefits. However, these benefits may have implications for IT workers and organisational change, including changing IT workers' roles and skill sets requirements; layoffs of IT hardware workers; IT departments losing control over IT systems and focusing more on data security; and service provider management, as IT systems support moves to cloud service providers (Carraro & Chong, 2006). The migration of an on-premise IT system to the SaaS model is therefore proven to be useful in understanding how technological changes influence changes in IS work practices (Orlikowski, 2007). The current study selected cases from among tertiary institutions in New Zealand that had an on-premise email system that migrated to a similar SaaS email system, to control the diversity of various types of SaaS systems. The cases migrated to similar type of a strategic SaaS (Section 2.2.5 discusses the SaaS types).

New Zealand Tertiary Institution Case Studies

New Zealand is located on islands in Oceania in the South Pacific Ocean, southeast of Australia. It is a developed economy, enjoying political and social stability. The New Zealand economy is based on exports of agricultural products, dairy, and IT products and services. In addition, it is a country of choice for many tourists and attracts international students into its internationally renowned tertiary education system, thus contributing to the economy. New Zealand tertiary institutions include universities, institutes of technology and polytechnics, and private training establishments. There are eight universities, 18 institutes of technology and polytechnics, and three private institutions (TEC, 2014). Funding for tertiary education in New Zealand is through a combination of government subsidies and student fees. Due to government budget shortfalls, student fees help to bridge the budget gap, especially those from international students. For example, direct fees revenue alone from international students at New Zealand's tertiary institutions accounted for NZ$404 million in 2012, up from NZ$318 million in 2008 (TEC, 2014). As a result, many tertiary institutions have adopted advanced technologies to create a conducive teaching and learning environment for all students and enhance research and collaboration with international researchers from anywhere in the world. These technologies include teaching and learning platforms such as Blackboard or Moodle, and cloud-hosted email and collaboration systems such as GAE or hosted O365. In particular, this study approached eight tertiary institutions in

New Zealand to establish if they had similarly adopted cloud computing technologies suitable for this research. In the end, the study selected four institutions, forming four cases of migration of an on-premise email system to the SaaS model, either GAE or cloud-hosted O365. The four case studies form the primary source of empirical data for this research. For privacy reasons, and to keep the institutions anonymous, the cases are codenamed ALPHA, BETA, CHITA, and DELTA. Chapters 4–8 provide detailed descriptions and data analysis of these cases.

1.5 Ethics Approval

This study involves human participants and their personal and organisational knowledge. The Auckland University of Technology Ethics Committee (AUTEC) granted ethics approval before the commencement of the collection of empirical evidence (see Appendix A). A Participant Information Sheet (Appendix B) and a Consent Form (Appendix C) were provided to participants before commencing data collection using the semi-structured interview questions shown in the Interview Protocol in Appendix D. The Participant Information Sheet —explains the objective of the study and how a participant was identified to be part of this research, and the Consent Form—requests for permission from the participant to take part in the research.

1.6 Definitions of Key Terms

To improve the readability of this thesis, definitions of some key terms are provided with respect to technology and IT. These terms include materiality, sociomateriality, human, and material agencies, practice, and IT workers.

1.6.1 Materiality

The matter is what constituent material of which technology is designed, and form is the portion of the material of an artefact that provides affordances and constraints to human. The combination of material and form is what is known as materiality (Leonardi, 2012). In this case, materiality does not refer to materials that create technology or the physicality of an artefact. Instead, materiality refers to ’the arrangement of an artefact’s physical and/or digital materials into particular forms that endure across differences in place and time ‘(Leonardi, 2013, p. 69). Thus, materiality identifies features of technology available to all users in the same way (Leonardi, 2012).

1.6.2 Sociomateriality

The term *sociomateriality* is the fusion of two words: social and materiality. Sociomateriality reminds us of two points. The first is that all materiality is social, as it is created through social processes and used in social contexts. Second, all social action is possible because of some materiality of an artefact (Leonardi, 2012). Therefore, sociomateriality is different from materiality in that it changes the analysis from materials and forms, to the development and use of materials and forms. Hence, while materiality defines the property of technology, sociomateriality refers to the ‘enactment of a particular set of activities that meld materiality with institutions, norms, discourses, and all other phenomena we typically define as social’ (Leonardi, 2012, p. 12). Moreover, by the same reasoning, the term *sociomaterial* reminds us that social practices shape the materiality of a technology and its effects.

1.6.3 Human and Material Agencies

Leonardi discusses how social and material become entangled (2012). He suggests that human agency and material agency become interlocked in sequences that produce outcomes such as technologies (e.g. communication networks) or organisations (e.g. roles, status) in which the ability to form and realise one’s goals defines the human agency (Giddens, 1984). The human agency perspective suggests that people’s work is not determined by the technologies they employ. Rather, studies show that even in most constraining technologies, human agents can exercise their discretion to shape the effects that those technologies have on their work (Boudreau & Robey, 2005). The human agency, therefore, is ’coordinated human intentionality formed in partial response to perceptions of technology's material agency' (Leonardi, 2012, p. 42) because people often enact their human agency in response to technology's material agency. Moreover, the term 'material agency' explains the capacity for non-human entities to act in the absence of sustained human intervention (Leonardi, 2012). Artefacts such as ITs represent a particular kind of cultural object that produces effects and can realise the intentions of humans (e.g. designers of technology), but that they cannot act according to their biological or cultural needs. This is because non-human entities or artefacts like IT exercise agency through their performativity; in other words, through the things artefacts do that user cannot entirely control (Leonardi, 2012).

1.6.4 Practice

The boundary between the human and the material is known as the space of work practice. For this reason, practice is the space in which the human and material become constitutively entangled (Orlikowski, 2010). According to Giddens' (1984), practice is the medium and outcome of institutional structures that guide individuals' processes of interpretation and evaluation, and hence, their activities. However, less is known about how humans and material interact and at what abstraction level of work practice these interactions happen.

1.6.5 IT Workers

These include IT technicians, system engineers and so on, who engage in systems development, support, and maintenance of IT. This study did not use the term IT professionals (Joseph et al., 2010) — regarded as IT workers with professional IT certifications or formal higher education training in IT or engineering background. Rather IT workers include IT technicians who may or may not have formal IT or engineering education background but gained on-job experience in IT support and maintenance.

1.7 Thesis Structure

Chapter 1 Introduction

This chapter explains the research problem, purpose, questions, rationale, approach, and outlines the contributions of this study. Figure 1-1 summarises the ensuing chapters in this thesis.

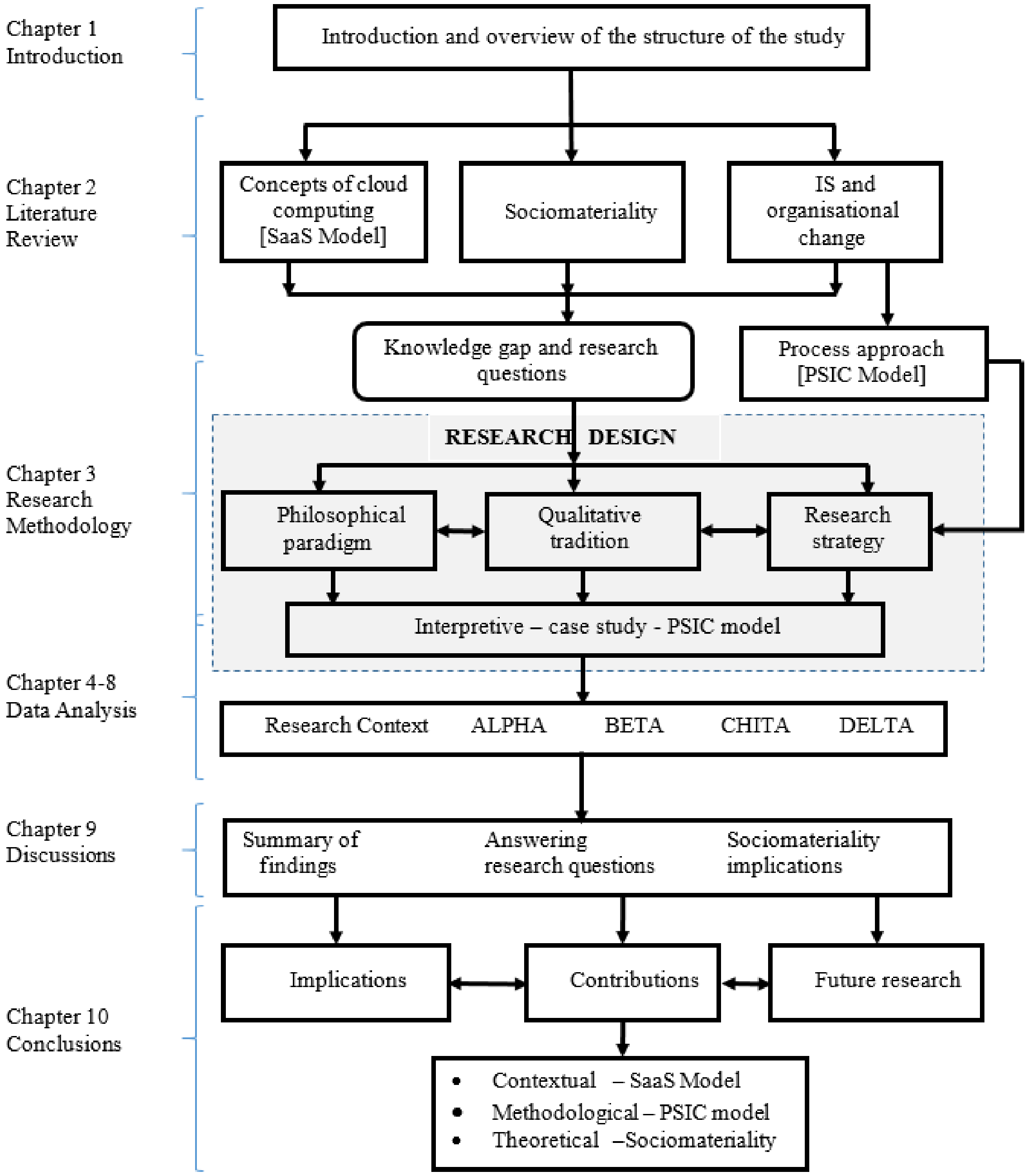


Figure 1.1. Flow chart of the main ideas and structure of the study.

Chapter 2 Literature Review

This chapter reviews relevant literature on concepts of cloud computing, the background of sociomateriality, IS and organisational change. The aim of reviewing the literature is to identify knowledge gaps and formulate the research questions for this study. In addition, the chapter introduces the PSIC process model used in data analysis and discusses various theoretical principles employed in this study for providing an in-depth understanding of these changes.

Chapter 3 Research Methodology

The chapter presents the research design and explains the justification for the philosophical assumptions guiding this study and the selection of case studies used as a source of empirical data in this research. Other discussions include case study design, data collection procedure, presentation, and analysis of the data.

Chapter 4 Overview of Research Cases

This chapter describes the PSIC visual map analysis approach and provides an outline of the research cases, codenamed as ALPHA, BETA, CHITA, and DELTA.

Chapters 5–8 Research Case Analyses

Chapters 5–8 present within-case analyses of the four cases following the PSIC visual map analysis approach. In particular, this study follows the punctuation, horizontal and vertical analysis methods.

Chapter 9 Discussion

This chapter discusses the answers to the research questions in relation to the empirical data, and existing IS literature.

Chapter 10 Conclusions

This chapter summarises the findings and explains the theoretical, contextual, and methodological contributions of the study. In the end, the chapter outlines limitations of the study and concludes with a discussion of future research opportunities.

1.8 Chapter Summary

This chapter has introduced the background to the study, including the research problem, purpose, and objective. In addition, it highlighted the research methodology in guiding this study and contributions to knowledge. Specifically, this study seeks to explain SaaS implications for IT workers from a sociomateriality perspective, and draws empirical data from IT projects of moving on-premise IT systems to the SaaS model. This is designed to answer the main research questions addressed in this thesis; that is, to explain why the migration of an on-premise IT system to SaaS changes the roles and skill sets requirements of IT workers, the implications of this for functions of IT departments, and how IT workers interact with these technologies from a sociomateriality perspective. In answering these questions and building an in-depth understanding, this research employs the PSIC model as a sensitising tool for analysing and displaying the empirical data. In addition, the study reflects on the sociomateriality literature to provide in-depth explanations for how IT workers interact with these technologies. The chapter ended by highlighting the anticipated theoretical and practical contributions of this research.

Chapter 2: Literature Review

2.1 Introduction

As introduced in the previous chapter, this explanatory study investigates the relationship between IS implementation and organisational change in the context of cloud computing (Markus & Robey, 1988). In particular, this study focuses on the implications of SaaS for IT workers from a sociomateriality perspective. The interaction between human and technology has been a major concern in IS research (Markus & Silver, 2008; Orlikowski, 1992; Orlikowski & Iacono, 2001; Orlikowski & Robey, 1991; Walsham, 1993). Figure 2-1 summarises the flow of the main ideas in this chapter.

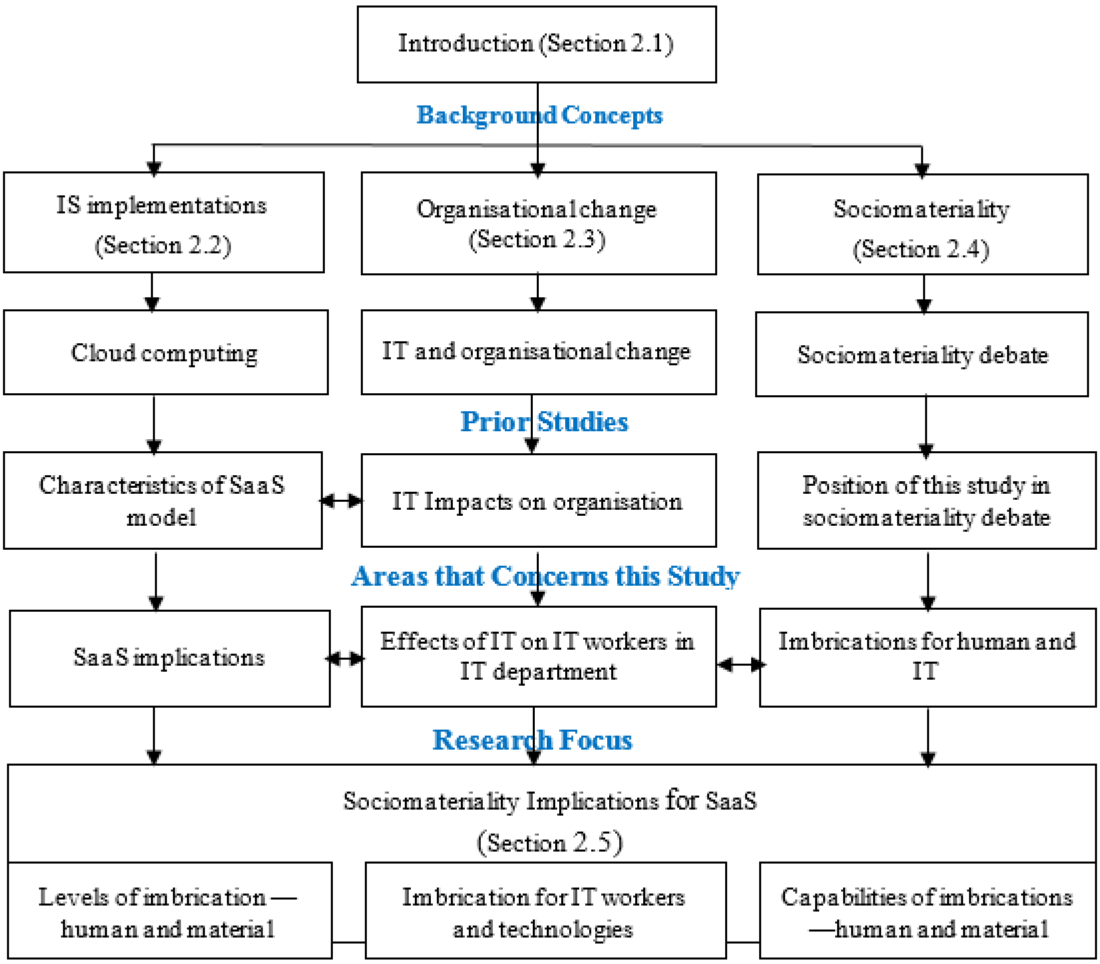


Figure 2-1. Flow chart of the main ideas in this chapter.

Following this research objective, this chapter reviews the IS literature and highlights the focus areas of this study: First, it provides some background concepts relating to IS implementation and the implications of SaaS adoption for human and organisational change. Second, the chapter discusses organisational change and the effects of IT on IT workers in IT departments. Third, it discusses relevant theoretical background on IT effects. In particular, this study adopts a sociomateriality lens to explain the interactions between IT workers and IT. Finally, this chapter summarises the sociomateriality implications of SaaS as the focus area of this research.

2.2 Information Systems Implementation

Davis (1974) defines an IS as an integrated man–machine system. Therefore, IS is a social product interacting with a human in work activities. For this reason, Boland (1987) explains that designing an IS is a 'moral problem because it puts one party, the system designer, in the position of imposing order on the world of another' (p.12). Thus, IS has some effects on people, and Lyytinen (1989) sees the IS implementation process as an instrument for organisational change. Figure 2-2 illustrates the interplay of people, IT and an organisation's characteristics (Orlikowski, 1992).

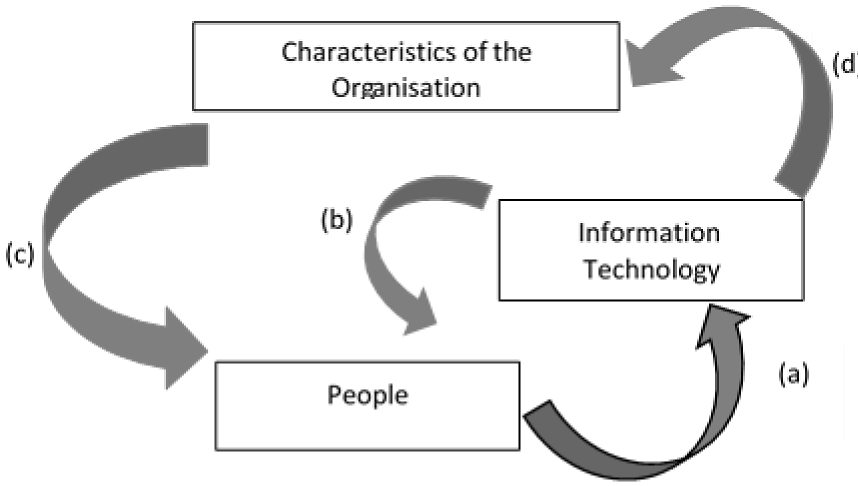


Figure 2-2. Interplay: people and IT (adapted from Orlikowski [1992, p. 410]).

As indicated in Figure 2-2, Orlikowski (1992) argues that people produce ISs (a), and this change the way people work and act (b). ISs are also included in the continuous loop of the interaction between the organisation and its workers (c and d). The current study thus seeks to examine the interplay between IT and people, and how this changes the organisation. Previous IS studies that discuss the interaction of IT and people, and how this affects organisations, include studies on adoption of the Internet (Carlo, Lyytinen, & Rose, 2011), e-commerce (Iivari & Janson, 2003), eGovernment (Lemuria, 2008), mobile technology in the supply chain (Doolin & Ali, 2008), electronic data interchange (Iacovou, Benbasat, & Dexter, 1995) and cloud computing (Cusumano, 2010), and more recently the integration of cloud computing and the Internet of Things (Botta et al., 2016). In particular, the present study examines the implications of cloud computing adoption for IT workers and changes in functions of IT departments. The following sections discuss the main concepts of cloud computing, in particular, the implications of SaaS for human and organisational change

2.2.1 Concepts of Cloud Computing

Cloud computing has the potential to change the IT industry in the way computing resources are developed, managed, and delivered to the adopting organisation (Wyld, 2010). Mell and Grance (2010, p. 6) define cloud computing as a 'model for enabling ever-present, convenient, on-demand network access to a shared pool of configurable computing resources (such as networks, servers, storage, applications, and services) that can be rapidly accessed and released with minimal service provider interaction'. Cloud computing has five essential characteristics, four types of deployment models and four service levels (Figure 2-3).

The main concepts of cloud computing are discussed in the following sections.

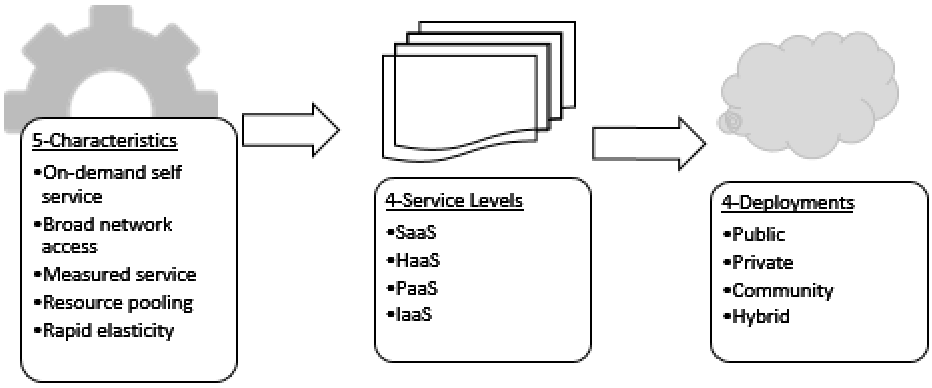


Figure 2-3. Main concepts of cloud computing (Mell & Grance, 2011a, pp. 2-3).

2.2.2 Characteristics of Cloud Computing

According to Mell and Grance (2011), cloud computing has five essential characteristics. The first is *on-demand self-service.* With this mode of service, a customer can unilaterally and automatically call up any amount of computing capabilities, such as server time and network storage, as needed, without requiring human interaction with the service provider. It does not need any delays in reconfiguration by taking advantage of this capability. The second is *broad network access,* which means that cloud computing services are available over the Internet and accessed through standard browsers used by client platforms such as mobile phones, tablets, laptops, and workstations. The third characteristic of cloud computing is the ability to perform *resource pooling.* Here, resource pooling describes how cloud computing resources are pooled to serve multiple customers in a so-called multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to customer demand (Mell & Grance, 2010). There is a sense of location independence, in that the customers have no knowledge of the exact location of the provided resources, but they may be able to specify location at a higher level of abstraction, such as based on a country, state, or data centre. Examples of resources include storage, processing, memory and network bandwidth (Mell & Grance, 2011).

The fourth characteristic is *rapid elasticity*. Rapid elasticity explains how computing capabilities easily increase or decrease to meet the actual demand for service (Mell & Grance, 2010). To the customer, computing capabilities appear to be unlimited and can be appropriated in any quantity at any time. The fifth characteristic of cloud computing is *measured services*, which describes how cloud systems automatically control and optimise resource use by leveraging a metring capability at some level of abstraction appropriate to the type of service, such as storage, processing, bandwidth and active user accounts (Mell & Grance, 2010). Resource usage, therefore, can be monitored, controlled, and reported, providing more transparency for both the provider and customer of the utilised service (Mell & Grance, 2010). Because of this capability, cloud providers can charge for usage of resources and provide what is only needed to meet the demand. These capabilities apply to various types of cloud computing deployment models.

2.2.3 Cloud Computing Deployment Models

Cloud computing deployment models fall into four categories: public, private, community and hybrid cloud models (Mell & Grance, 2010). The public cloud infrastructure is available to the public and owned by organisations selling cloud services. An example of a public cloud is the Amazon Elastic Compute Cloud (Amazon EC2). In this case, Amazon EC2 provides globally shared infrastructure through which companies can host and run their mission-critical applications (Iyer & Henderson, 2010; Mell & Grance, 2010). A private cloud infrastructure is operated solely for an organisation. The organisation or a third party manages the private cloud and may exist on or off premise. Lack of technological maturity, privacy and security concerns about public clouds have led some companies to implement private clouds (Mell & Grance, 2010). Some examples of private clouds are Sun Cloud, Google App Engine, and IBM Blue Cloud (Hemalatha et al., 2014).

A community cloud provides an infrastructure that is shared by several organisations, supporting a particular community with shared concerns. A participating organisation or a third party may manage a community cloud. The Search for Extra-Terrestrial Intelligence (SETI) project accessible at http://setiathome.berkeley.edu is an example of a community cloud. The goal of the SETI project is the detection of intelligent life outside earth (Stanoevska-Slabeva, Wozniak, & Ristol, 2010). SETI sponsors use a dedicated software that enables home computers to connect to a grid and uses additional processing cycles for listening to signals from outer space. In the future, unique needs, such as those concerned with security compliance, could motivate the development of specialised clouds for healthcare and financial services (Iyer & Henderson, 2010). The last cloud computing deployment model is a hybrid cloud, which comprises two or more distinct cloud infrastructures (private, community, or public) that remain unique entities but that are bound together by standardised or proprietary technology for enabling data and application sharing. Large companies that face difficulties with a single cloud for their legacy systems and have unique needs tend to opt for a hybrid solution (Mell & Grance, 2010). Cloud computing has different types of service levels.

2.2.4 Cloud Computing Service Levels

Cloud computing has four main service levels: SaaS, PaaS, IaaS and HaaS, described in Table 2-1. These service levels are based on the concept of a *utility model* in computing and have capabilities that enhance *reliability*, *scalability* and rapid *elasticity* (Iyer & Henderson, 2010).

The utility model explains the on-demand delivery of infrastructure, applications, and business processes in a secure manner and the shared, scalable, and standard-based computer environment over the Internet for a fee (Iyer & Henderson, 2010).

Table 2-1

Cloud Computing Service Levels

Cloud computing service level type	Definition	Examples	Reference
Software as a service (SaaS)	Where applications such as those that offer traditional desktop functionality are hosted and delivered online via a web browser	Google Docs, Gmail, Xero, MYOB, SAP, O365	(Esteves & Rong, 2010; Leavitt, 2009; Robinson & Rand, 2011)
Platform as a service (PaaS)	Software platform for system deployment	Google App Engine, Salesforce.com	(Dhar, 2012; Leavitt, 2009; Robinson & Rand, 2011)
Infrastructure as a service (IaaS)	Where a set of virtualised computing resources, such as storage and computing capacity, are hosted in the cloud; customers deploy and run their software stacks to obtain services	Amazon EC2, Salesforce.com, IBM Blue Cloud, 3TERA, OpSource, Jamcracker	(Dhar, 2012; Esteves & Rong, 2010; Leavitt, 2009; Robinson & Rand, 2011; Wyld, 2010)
Hardware as a service (HaaS)	Where the cloud provides access to dedicated firmware via the Internet	XEN, virtual machine ware (VMware)	(Robinson & Rand, 2011; Veverka, 2010)

Under the utility model, customers tap into IT resources and pay for them, as they pay for their electricity or water metred bills (Wyld & Juban, 2010). In computing terms, reliability refers to assured delivery of IT services to the client as expected in the context of a service level agreement (SLA) (Wyld, 2010). Application scalability refers to the ability of a system to acquire dynamically or release computing resources on demand (Mell & Grance, 2010). In addition, these capabilities are provided at relatively low IT infrastructural and labour costs compared with an on-premise IT system (Wyld, 2010). As a result, organisations may decide to adopt cloud computing based on these potential benefits. However, when an organisation moves an on-premise IT system to cloud services such as PaaS, IaaS or HaaS, it will still need IT workers such as hardware and software engineers to manage remote hardware and to install software applications. However, when an organisation opts for SaaS as its cloud strategy, some of the IT responsibilities for hardware and software shift to the cloud service provider. As a result, an organisation may need fewer IT workers, and mainly to configure user access rights in using the applications. Unlike PaaS and IaaS, SaaS will likely have greater implications for the roles and skill sets required by IT workers. For these reasons, this study focuses on the effects of SaaS on IT workers and IT departments of adopting organisations. The IS literature regards SaaS as an IT business model that involves external service providers and has four types of SaaS service deployment (Chou & Chou, 2007; Stuckenberg, Kude, & Heinzl, 2014)

2.2.5 SaaS Deployment Models

The four types of SaaS service deployment are *ad hoc*, *defined*, *managed and strategic* (Chen, 2010). Following Chen (2010), this section explains SaaS deployment types as follows: *ad hoc* service describing when SaaS is used by a client as needed in response to business requirements. The goal of the service provider is to ensure that the service meets the critical functional needs of its customers. The service provider on behalf of the client tracks some service attributes. Examples of *ad hoc* services are Amazon.com and Expedia.com when used by an organisation to facilitate the selling of books and travel tickets, respectively. The SaaS service deployment known as a defined service is when the contract describes the service usage and guarantees the service level capabilities, typically through an SLA. Service quality has a focus on measurable, performance-oriented attributes such as availability and responsiveness. Examples of a defined service type in a SaaS system are Google Apps Enterprise Edition, which defines an SLA that focuses on the availability of services. Another example is SAP's Business ByDesign, which provides SaaS capabilities for ERP-level applications, such as for integrated accounting and customer relationship management (CRM) systems. The third SaaS deployment type is a managed service, which is a defined service with additional commitments agreed upon by the service customer and provider to share the responsibilities of managing the service. Examples of common responsibilities include monitoring service quality and refining the service to meet changing quality requirements. An example of a managed service is the Salesforce.com CRM service, which provides customisation and integration capabilities that allow customers to set up a unique CRM service and share customer-developed applications. Salesforce.com also supports tracking of service issues and commitments.

The last SaaS deployment type is called strategic service, which is a managed service in which both the service customer and provider can identify and agree upon common business values for service delivery—usually defined in a client–service provider partnership (Chen, 2010). Typically, organisations adopt a strategic service based on business value analyses such as cost–benefit analysis, return on investment (ROI), and risk analysis. In addition, the application architecture of this service is designed to be scalable, multi-tenant efficient and configurable (Chen, 2010). An example of a strategic service includes the use of hosted O365 or GAE in an academic institution based on a strategic partnership with Microsoft or Google Corporation, respectively. In this example, the GAE includes email, calendaring, Google Docs, storage drives, sites and other real-time online collaboration tools (Abdullah, Ahmed, & Ahmed, 2012; Bruce & William, 2008). More precisely, the current study focuses on the implications of migrating an on-premise IT system to a strategic SaaS service deployment model such as that provided by GAE or hosted O365, and how this affects IT workers' roles and skill sets requirements. Strategic SaaS deployment has distinct roles and responsibilities for both the SaaS service provider and the adopting organisation. Therefore, understanding the different types of SaaS services helps in explaining the implications of SaaS for IT workers within IT departments that monitor the partnership with the SaaS service provider. The following sections explain some characteristics and challenges of SaaS to gain insights into the implications of SaaS.

2.2.6 Characteristics of the SaaS Model

Carraro and Chong (2006) view SaaS as an IT business model in the software industry offering browser-based software application programs to customers through Internet channels and networks. The SaaS model is a software delivery method in which customers no longer purchase software or run it on their infrastructure as an on-premise IT system; rather they run it from the data centre of a SaaS service provider (Mietzner, Leymann, & Papazoglou, 2008). The structure of the SaaS model relies on its multi-tenant architecture (Mietzner et al., 2008). Thus, to provide efficient and effective services to SaaS clients, SaaS service providers need to design their application architecture as scalable, multi-tenant efficient and configurable (Carraro & Chong, 2006). Application scalability allows SaaS service providers to exploit concurrency of their services and to utilise application resources by scaling up or down according to customer demand (Mell & Grance, 2010). Further, the concept of multi-tenant efficiency requires application architecture to maximise resource sharing among tenants and at the same time to be able to separate customers' data from each other. Hence, application configuration is an important task for SaaS technology, because multiple customers access the same application from the cloud service provider. For these reasons, SaaS architecture must be capable of simplifying the task of application configuration among various customers (Carraro & Chong, 2006). Organisations adopt the SaaS model based on these benefits, but adopting the SaaS model poses some risks and challenges.

The SaaS Model: Risks and Challenges

As highlighted in the previous chapter, risks and challenges associated with the adoption of the SaaS model go beyond what organisations encounter with the use of

ASP models (Heart, 2010). A brief comparison between SaaS and ASP shows that similar to ASP, the SaaS model involves major changes in organisational IT governance. These changes often create employee unrest and resistance (Wu, 2011). Also similar to ASP, the organisation becomes more heavily dependent on a service provider, which is of particular concern when core applications are at stake (Heart, 2010). Also, the SaaS model entails moving organisational applications and data outside a customer's boundaries to the cloud service provider’s data centres, from where they are accessed over the Internet. This arrangement exposes an organisation’s data to various risks ranging from privacy, data protection, ownership, location, and lack of reliable audit standards, to data security procedures. Prior studies identify this last aspect of SaaS as a major impediment to its adoption (Heart & Pliskin, 2001). Thus, these risks may provide a tipping point for organisations to adopt or not adopt the SaaS model. Further, IS studies conclude that the SaaS model is a disruptive innovation for an adopting organisation (Bandulet et al., 2010).

The SaaS Model as a Disruptive Innovation

The enterprise application market regards the SaaS model as a disruptive innovation (Bandulet et al., 2010; Sultan & van de Bunt-Kokhuis, 2012) because the concept fulfils the characteristics of disruptive innovations discussed by Christensen (Christensen, 1997; Christensen et al., 2005; Christensen & Eyring, 2011). Innovation can be either sustaining or disruptive. Sustaining innovations are those that bring improvement to organisation’s products and services (Christensen & Eyring, 2011). Examples of sustaining innovation in IT include the higher storage capacity of hard drives and the improved processing power and speed of microprocessors. In contrast, disruptive innovation presents a new value proposition that either reshapes the existing market or creates a new market (Sultan & van de Bunt-Kokhuis, 2012). Disruptive innovations that reshape existing markets occur when good-enough products and services are bought at lower prices than the counterparts in the market (Sultan & van de Bunt-Kokhuis, 2012). For example, all-in-one computers (that combine the central processing unit [CPU] and the monitor together) sell at lower prices than a CPU and monitor bought as separate units. Disposable cameras are another example of disruptive innovations that shape existing markets. Disruptive innovations that create new markets occur when characteristics of existing products or services (e.g. product, price, complexity) deter potential users because of their complexity or lack of convenience when using the product or accessing the services (Sultan & van de Bunt-Kokhuis, 2012). Mobile phones, voice over Internet protocol (VOIP) and software communications applications such as WhatsApp, Viber and Skype used for texting and calling are examples of new market disruptive innovations. They all create a new telecommunications market by making it easier for people to communicate and share information.

In the same manner, the SaaS model relies on existing innovations such as Internet browsers, virtualisations, and network/Internet connections. In the SaaS environment, some of these innovations are both sustaining and disruptive according to Christensen's definitions (Christensen, 1997; Christensen et al., 2005). Thus, a SaaS system accessible via an Internet browser does not require any installation of an application and hence is a sustaining innovation because SaaS has not replaced the standard use of a web browser. However, the SaaS model reshapes the use of an Internet browser and creates a new market of a new disruption innovation, because they create features that allow a much larger customer base through the delivery of products and services at reduced prices, with better payment options. In particular, SaaS features defining this disruption come from the way a service provider delivers a SaaS system and how the adopting organisation accesses, purchases, supports, and governs the system (Keller & Hüsig, 2009). Usually, a service provider delivers SaaS as a utility model (pay per use) instead of via renewable licences and deploys it on the global scale. Unlike in ASP systems, an adopting organisation accesses SaaS applications using an Internet browser via any mobile or desktop device without degrading its capabilities. Moreover, procurement of SaaS services is no longer tied to the IT department. Rather, any business unit can trial and subscribe to SaaS services. Finally, the SaaS model changes the approach to software support. Instead of seeking support from IT workers in the adopting organisation, customers access SaaS service provider support from data centres, rendering some IT workers jobless (Wyld, 2010). Moreover, adopting the SaaS model has some implications for the functions of the IT department, as the model brings some organisational changes to IT service provision compared to traditional IT outsourcing (Wyld & Juban, 2010). For these reasons, the current study focuses on the adoption of the SaaS model and its disruptive implications for IT workers and the functions of the IT department. The identification of the SaaS model as an emerging disruptive innovation helps in explaining its overall implications for organisational change in sourcing SaaS services (Keller & Hüsig, 2009; Schneider et al., 2014).

The SaaS Model and IT Outsourcing

According to Keller and Hüsig (2009), IT outsourcing is 'the significant contribution by external vendors of the physical and HR associated with the entire or specific component of the IT infrastructure in the user organisation' (p. 336). Using the IS literature, this study compares the implications of traditional IT outsourcing and the SaaS model for organisational change. Past IT outsourcing research shows that organisations outsource for two major reasons. One is cost reduction (i.e. for institutional needs), and the other is to improve IT effectiveness and responsiveness (i.e. IT-driven goals) to market demands (Jayatilaka & Hirschheim, 2009; Kane, 1998). Jayatilaka and Hirschheim (2009) report that IT outsourcing strategies based on institutional needs aim at meeting short-term stock performance or shareholders' goals rather than improving IT performance and hence ignore IT capabilities. The inability to identify IT organisational requirements due to a lack of IT-driven goals results in a loose IT outsourcing contracts, which associate with systems failure. Conversely, IT-driven goals for IT outsourcing strategies aims at improving IT effectiveness, responsiveness and the development of IT capabilities to meet business IT demands. However, blind adherence to IT-driven goals without considering institutional needs for cost-cutting measures can also lead to dissatisfaction by decision makers and stakeholders. Organisations that ignore institutional needs are likely to fail (Jayatilaka & Hirschheim, 2009; Kane, 1998). Eventually, organisations need to change their IT outsourcing strategies because of the failure to meet shareholders' goals due to the poor performance of an IT service provider, and other emergent needs. Organisations may decide to change their strategy by bringing IT systems back on-premise or replacing underperforming service providers (Jayatilaka & Hirschheim, 2009).

Similarly, a traditional outsourcing strategy links with downsizing (Kane, 1998). Downsizing, which has a significant effect on HR management, is an intentional operation that aims to improve organisational efficiency and performance, with implications for the size of the workforce, operation costs and business processes (Farrell & Mavondo, 2005; Kane, 1998). The benefits of downsizing include lower labour costs and overheads, less bureaucracy, faster decision making and increases in productivity. However, organisations may fail to achieve benefits from downsizing because of staff concerns about job security, which decrease morale, trust and productivity in organisations following downsizing (Kane, 1998).

Contrary to traditional IT outsourcing strategies, the SaaS model meets both IT-driven and institutional goals, because it centres on the scalability of IT resources and the economics of computing capabilities (Wyld & Juban, 2010). For these reasons, the SaaS model is a revolutionary IT-driven concept, due to the unprecedented elasticity of resources made possible by the cloud architecture. In computing terms, elasticity refers to the ability of a system to acquire dynamically or release computing resources on demand. Under the SaaS model, organisations that need more computing power have the capacity to scale-up resources upon request, without having to pay a premium for that ability. By meeting institutional goals, an organisation can run computing operations much faster than previously and at no additional cost, because using computing resources of 1000 servers for one-hour costs no more than using one server for 1000 hours in the SaaS model (Armbrust et al., 2009). This unique scalability attribute of the SaaS model allows for computational needs to be addressed more quickly and cheaply than with traditional outsourcing strategies (Wyld & Juban, 2010). SaaS computing capabilities offer free pricing for some products and services such as email, storage, hosting, and applications that are at the forefront of cloud computing (e.g. Google Apps). Due to the cost and operational benefits of cloud computing, organisations may outsource most, if not all of their IT systems to SaaS service providers, creating what have been termed 'server-less organisations' (Wyld & Juban, 2010, p. 4).

2.2.7 Prior Studies on Implications of SaaS

Previous IS studies investigated the impact of SaaS adoption for HR and organisational change (Böhm et al., 2010; Liu et al., 2011; Ross, 2011; Venkatachalam et al., 2014; Wei-Wen, 2011). More specifically, these studies examined areas such as cloud brokers, roles and skill gaps of IT workers, in particular with regard to integration roles and leadership capabilities. These are now briefly discussed.

Cloud Brokering

According to Liu et al. (2011), a cloud broker is an entity that manages the use, performance, and delivery of cloud services, and negotiates relationships between cloud service providers and cloud users. For example, when an organisation implements an on-premise IT system, a project team is formed with systems engineers and programmers with skills in the system being implemented by the organisation. Similarly, when adopting cloud computing technology, an organisation needs a cloud broker in the project team to provide buying advice and to negotiate with a cloud service provider. The aim is to ensure that procurement decisions take into accounts all of the risks and challenges and that the cloud technology is compatible with existing on-premise IT systems for future integration and interoperability.

The IS literature discusses issues around cloud brokers in the SaaS model (Böhm et al., 2010; Overeem & Vreeken, 2014; Venkatachalam et al., 2014). For example, Overeem and Vreeken (2014) examine the consequences of SaaS for the required cloud brokerage competencies between cloud service providers and client organisations. Their study shows that SaaS applications on the customer's side lack focus on SaaS governance about cloud brokerage. Venkatachalam et al., (2014) explore the different roles of SaaS brokers acting between SaaS providers and SaaS users. The factors that motivate their study are that the SaaS model shifts all customizations and the maintenance of customised components to the user side. The implications are that SaaS brokers need skilled IT workers for customisation and to support SaaS users, and thus leverage the full benefits of the SaaS model (Venkatachalam et al., 2014). However, Venkatachalam et al. (2014) do not consider the implications of the SaaS model for IT workers from the side of the adopting organisation. For these reasons, the current study focuses on the issue of brokering of IT workers in the adopting organisation. Böhm et al. (2010) explain some generic roles of cloud intermediaries as part of the large cloud service environment. These include the SaaS service provider, platform provider, market platform, infrastructure provider, consultant, aggregator, integrator, and cloud user (Böhm et al., 2010). The current study considers these cloud intermediaries, particularly a consultant, aggregator, or integrator as some of the specific roles of cloud service brokers. Thus, the changing roles of IT workers in a SaaS environment are necessary— involve shifting from technical to more brokerage roles as they engage with SaaS service providers, and increasingly scan the market for preferred cloud service providers (Ross, 2011).

IT Worker Skill Gaps

Studies on cloud computing adoption and their findings have provided useful insights into the implications and challenges of the SaaS model for IT workers in the adopting organisation (Lyytinen & Rose, 2005; Myers, 2011). In particular, Lyytinen and Rose (2005) review the IS literature on cloud computing and identify three fields on overall IS studies in cloud computing. First, most studies examine the micro-level effect on end users (i.e. employees of a cloud-adopting organisation). A second field examines interrelations between mature IS and IT organisational fits (Lyytinen & Rose, 2005). The third field focuses on micro-level effects on IT workers, which receive less attention by IS scholars and has many areas that remain unexplored; this field is most relevant to the current study. Lyytinen and Rose (2005) suggest that scholars in this field recognise the strategic importance of investigating the effect of cloud computing on IT workers because cloud computing brings major changes such as skill sets requirements of IT workers in the corporate IT structure, which results in a variety of intra-organisational challenges (Carlo, Lyytinen, & Rose, 2012; Hansen, Robinson, & Lyytinen, 2012; Lin & Chen, 2012; Lyytinen & Rose, 2003; Morgan & Conboy, 2013; Ross, 2011; Wei-Wen, 2011).

For example, Ross (2011) investigates changes in IT workers' skill sets associated with cloud computing adoption. According to Ross (2011), IT workers must broaden their skill sets to adopt more strategic leadership and managerial initiatives, including the ability to take risks on behalf of the organisation. However, Ross (2011) examines changes in IT workers' skill sets in cloud computing in a general way, and there remains a scarcity of in-depth empirical analysis to ascertain how these implications associate with SaaS adoption in particular (Ross, 2011). Interestingly, in their study, Morgan and Conboy (2013) indicate that IT managers' fear losing control of their IT environment is an important aspect of the decision-making for or against adopting cloud computing. In addition, IT workers are afraid of losing their jobs when on-premise IT systems migrate to the cloud environment. However, Morgan and Conboy (2013) study examines cloud computing in general and thus recommends future research on the roles of the IT manager and changing skill sets in the future cloud environment. Further, Carlo et al. (2012) suggest future studies that relate to the skills necessary to manage cloud adoption within an organisation. For these reasons, the current study seeks to address these research areas.

Lin and Chen (2012) explore the possible effects and changes that relate to adopting cloud technologies in the existing IS environment. Their study indicates that the gap between existing knowledge, skills and experiences, and cloud computing, affects the costs of training and recruitment, and quality of projects, in terms of time management, system reliability, and stability. However, in their study, there is a lack of focus on understanding whether these IT skill gaps exist in a particular category of the cloud computing service level, such as the SaaS model (Lin & Chen, 2012). Interestingly, focusing on the SaaS model, Wei-Wen (2011) examines factors affecting SaaS adoption and their implications for adopting organisations. Wei-Wen's study shows that adopting organisations acknowledge the need to review their capabilities (i.e. technical and leadership skills) and to evaluate their strategies regarding SaaS adoption, instead of simply following traditional practices (Wei-Wen, 2011). However, Wei-Wen's (2011) study does not provide an in-depth discussion of the capabilities that adopting organisations need.

Thus, despite these studies, there is still a lack of in-depth empirical studies, in particular on the implications of the SaaS model for IT workers of the adopting organisation. The current study, therefore, attempts to fill this gap in the literature by focusing on the implications of the SaaS model for IT workers' skill sets requirements.

Integration Role

Integration allows the interoperability of the SaaS model with other applications using standard application programming interfaces (API) suites (Botta et al., 2016). This allows users to access shared data and other services on both cloud-based and on-premise IT subsystems. However, the challenges of integrating SaaS applications with other systems can be critical. These include security and privacy (Abadi, 2009; Onwubiko, 2010), legal compliance (Muller, 2012) and interoperability issues (Ross, 2011; Stuckenberg et al., 2014).

When an on-premise IT system migrates to the SaaS model, security and privacy concerns arise for various reasons, for example, lack of trust in the cloud service provider, failure in adherence to SLAs, and understanding the physical location of data (Fernandes et al., 2014; Onwubiko, 2010). Accordingly, these concerns require specific attention in addressing them (Subashini & Kavitha, 2011), such as dealing with data and network security; determining and agreeing through the SLA on the data location; working on data separation in hosted data centres; and enforcing security policies on data availability, accessibility and confidentiality (Subashini & Kavitha, 2011). More specifically, because the SaaS model operates as a multi-tenancy application, this can compromise security and lead to sensitive data leakage to other clients using the same application (Abadi, 2009).

Although external regulatory compliance and security certification standards subject cloud service providers to vigorous scrutiny, the literature indicates that even this may not guarantee adherence to legal compliance (Onwubiko, 2010). Regulatory compliance and certification are security initiatives with significant effects on information security practices (Muller, 2012). Moreover, standards regulate how information security management is implemented, managed and conducted (Onwubiko, 2010). For this reason, organisations seeking accreditation must go through a regulatory compliance process. Compliant organisations are perceived to possess necessary drivers to earn trust and hence build business relationships with other organisations (Onwubiko, 2010). Also, moving an on-premise IT system to the SaaS model will be an incremental process for most organisations, leading to the development of hybrid systems (i.e. on-premise mixed with cloud-based systems) and resulting in interoperability challenges (Ross, 2011). As some on-premise IT systems cannot be integrated using the standard API suite, IT workers need to craft SaaS strategic plans and policies around this.

Leadership Capabilities

Migrating an on-premise IT system to the SaaS model means that the cloud service provider takes over managing the organisation's data, processes, and services. Hence, entering into such an alliance requires strong leadership from the SaaS user organisation, to manage and monitor the agreement. The IS literature advises that adopting organisations should have strong leadership when designing cloud strategies (Iyer & Henderson, 2010; Muller, 2012). Iyer and Henderson (2010, p. 117) define a cloud strategy as 'the set of decisions required to create and deploy a network-based information service delivery that results in both cost saving and organisational agility'. Strong leaders thus need to understand what cloud service providers are offering amounting to a competitive advantage to the organisation. For example, IT leaders should evaluate systems for opportunities that arise with the emerging SaaS applications and ensure the business unit complies with the jointly agreed policies (Iyer & Henderson, 2010).

Onwubiko (2010) recommends working on policies and a risk management strategy when evaluating systems to be migrated to the SaaS model, by paying attention to the security and information assurance requirements of the resources. There are three reasons why SaaS users need to pay attention to security and information assurance from cloud service providers. First, most cloud service providers rent data centre computing resources from other cloud providers such Google, Amazon and Microsoft. This dependence means that when a cloud infrastructure is affected, it may influence the availability of the SaaS system. Second, the possibility that a cloud service provider can file for bankruptcy creates significant financial liability for cloud users. Finally, Muller advises that an IT leader needs to be an ‘enterprise leader first, and a technology leader second’ (2012, p. 13) because a business leader helps the organisation to work out what it needs and to outline its long-term strategic goals. In addition, an IT leader should advise the organisation on how to respond to disruptive innovations and focus on things that matter (Muller, 2012).

The current study responds to the call for more cloud computing research into micro-level effects on IT workers and related organisational change (Lyytinen & Rose, 2005; Morgan & Conboy, 2013).

2.3 Organisational Change

Organisational change is the central topic in organisational studies (Armenakis & Bedeian, 1999; Pettigrew, Woodman, & Cameron, 2001; Robey, Anderson, & Raymond, 2013; Robey & Markus, 2008; Tsoukas & Chia, 2002; Van de Ven & Poole, 2005). However, scholars have different ontological and epistemological views on the meaning and how to study organisational change. The ontological question focuses on whether organisations consist of things or processes; and the epistemological question relates to whether a variance or process methods are suitable for conducting organisational research (Van de Ven & Poole, 2005).

2.3.1 Ontological View of Organisations: Things or Processes

On the ontological question, in one hand Whetten (2006) views organisations as consisting of things and argues that researchers need to understand the organisation by looking at organisational subjects such as identity, structure, culture, and performance, which are central to a successful organisation. According to this view, an organisation is a social entity or structure that retains its identity by changing from one state to another over time (Mintzberg, Raisinghani, & Théorêt, 1976). For this reason, Whetten (2006) argues organisational scholars should study organisations as social entities rather than as social processes (Van de Ven & Poole, 2005). On the other hand, Tsoukas and Chia (2002) view organisational change as a process. In this view, an organisation represents a ‘set of processes that maintain the organisation by continuously structuring it and maintaining its boundaries in a field of other processes, that are continually breaking down the organisation and boundaries’ (Van de Ven & Poole, 2005, p. 1380). In this view, organisational change occurs when processes operate in a manner by which an observer regards them as changing the organisation. Examples of studies in this camp include structuration of IT in organisations; it is argued that IT and organisations continuously restructure one another, as technologies are implemented (DeSanctis & Poole, 1994; Orlikowski, 1992; Orlikowski & Robey, 1991).

This study adopts the second view—that organisations are composed of organising processes and that organisational change happens due to the continuous structuring of organisation processes within the organisation’s boundaries (Van de Ven & Poole, 2005). This position is consistent with the context and theoretical stance of the current research, which seeks to understand the migration process from an on-premise IT system to the SaaS model, and its implications for IT workers, as well as explain how IT workers interact with these technologies in the organisational context.

2.3.2 Epistemological View of Organisations: Variance or Process Methods

Two commonly used definitions of organisational change summarise its modes of explanation. The first defines organisational change as an observed difference over time in an organisational entity on selected dimensions (Poole et al., 2000). This definition relates change to a variance theory methodology (via factor studies); where change represents a dependent variable, explained by a set of independent variables that statistically explain variation in the dependent variable of change. The second defines organisational change as a narrative, describing how a sequence of events develops and how change unfolds (Poole et al., 2000). This meaning of change takes an event-driven approach that is often associated with a process theory explanation of the temporal order and sequence, in which change events occur based on a story or historical narrative (Poole et al., 2000). The current study adopts the second definition of organisational change to examine the events of migrating an on-premise IT system to the SaaS model.

The rationale for choosing the process method is twofold. First, this approach is appropriate to answer the main research question of this study, which seeks to understand the process and implications of SaaS model implementation. The second reason is due to the limitations of the variance approach: as indicated by some IS researchers (Markus & Robey, 1988; Newman & Robey, 1992) that variance approaches have little practical utility in explaining deeper insights of IT and organisational change due to their lack of understanding of process implementation features. They only emphasise which factors are associated with outcomes, not how the factors shape those outcomes (Robey, 1994). Consequently, variance approaches to IS implementation, and organisational change have some limitations (Markus & Robey, 1988; Poole et al., 2000). First, they tend to be static rather than longitudinal, and do not account for the dynamics of change and how IS implementation outcomes develop over time (Poole et al., 2000). Second, although precursor variables may represent necessary conditions for a particular outcome to occur, they are not sufficient to explain causality (Markus & Robey, 1988). Third, variance approaches are unable to explain the interactions between various factors studied and contextual elements of phenomena under study (Poole et al., 2000). Fourth, the relationships between precursor variables and outcomes assumed by the variance approach rarely exist in complex, real-world social phenomena (Lyytinen, 1987; Lyytinen & Newman, 2008; Newman & Robey, 1992; Poole et al., 2000). Thus, these limitations and the lack of consistency in the results of variance studies have led some researchers to adopt the process research approach (Barley & Tolbert, 1997; Pentland, 1999; Van de Ven & Poole, 2005).

Process approaches provide an in-depth analysis of events within a specific context over time (see Figure 2-4). In particular, Markus and Robey identify the benefits of process methods (1988): they make possible the identification of new patterns within empirical data (Markus & Robey, 1988). The determination of the critical events, their paths, and their sequences permits pattern generation. The prediction of these patterns over time is another goal of process methods (Markus and Robey, 1988). The relevance of process methods to actual events makes the prediction of patterns applicable to real life (Markus & Robey, 1988).

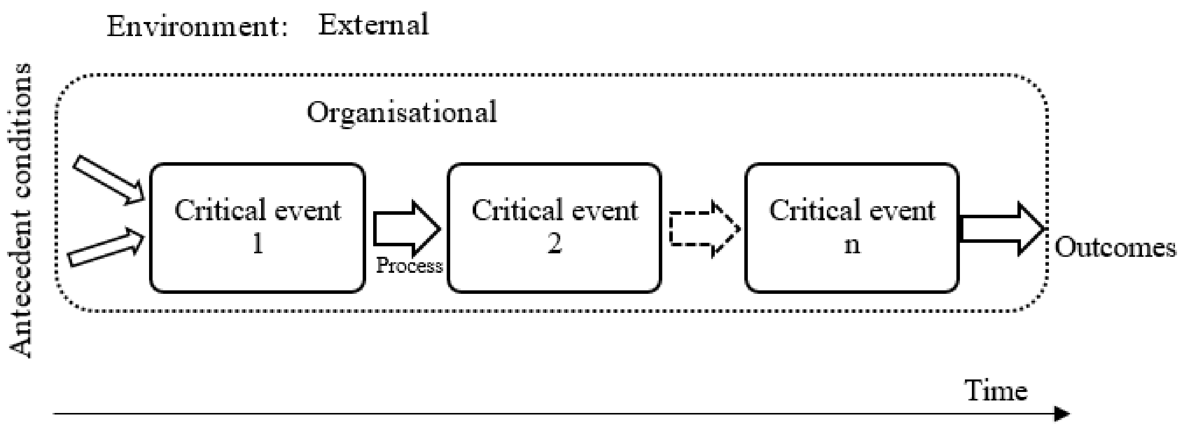


Figure 2-4. Process approaches (adapted from Newman and Robey [1992, p. 252]).

Some IS researchers suggest that variance and process approaches are mutually informative and complementary; that is, that the findings from each study inform each other through other research (Mohr, 1982; Newman and Robey, 1992). In particular, Sabherwal and Robey (1995) discuss this integral feature of the variance and process study in their attempt to reconcile both types of studies. Their study reviews the feasibility and method of reconciliation and the benefits of such reconciliation (Sabherwal & Robey, 1995). For these reasons, theories such as structuration (DeSanctis & Poole, 1994; Giddens, 1991; Orlikowski & Robey, 1991) and sociotechnical theories (Keen, 1981)—although they do not draw on explicit process theories—do help IS researchers provide deeper explanations of IS and organisational changes (Lyytinen & Newman, 2008). Moreover, they have increased our understanding of the recursive dependency between technologies and social structures (Orlikowski & Robey, 1991), and how meanings attached to technologies stabilise (Orlikowski & Robey, 1991) and are institutionalised into business processes (DeSanctis & Poole, 1994). Structuration and sociotechnical theories thus inform this study in understanding IS and organisational change (Giddens, 1984; Orlikowski, 1992, 2000). These theories are now briefly discussed.

The structuration theory is a formal social theory that describes a typical human–structure dualism (Giddens, 1984, 1991). Here, structure means rules and resources that are organised as properties of systems. Thus, structures originate from organisational and technological system settings. The relationship between technological and organisational structures has been of interest to IS researchers (Orlikowski, 1992, 2000; Orlikowski & Robey, 1991). As indicated earlier, people produce and reproduce structures to maintain a system through a structuration process. That is, technology is created and changed by human action, but humans also use it to accomplish some action. Therefore, there is a 'duality' of the structure providing an interplay between the types of structures that are inherent to technologies and the structures that emerge in human action as people interact with these technologies

(Orlikowski, 1992, p. 405). In other words, humans working in a given social context physically construct technology, and through the different meanings they attach to it and the various features they emphasise, humans use a socially constructed technology in their practices (Orlikowski, 1992). Thus, the dual interactions of human and technology bring about IS change. For these reasons, the structuration theory guides this study in the formulation of interview questions and data collection.

The sociotechnical theory describes three components of the organisation: social system, technical system and the environment. The social system consists of the people, the relationships among them and organisational arrangement. The technical system is composed of tools, techniques, and knowledge in the organisation. The environment of the organisation includes policies, supervision, rewards, measurement, and training. The theory affirms that an organisation must design its social and technological systems so that they complement each other’s demands and those of the environment (Lyytinen & Newman, 2008). Lyytinen and Newman expand the sociotechnical theory and outline a PSIC model offering a middle range explanation of IS change (2008). The PSIC is a process model that uses sociotechnical theory to characterise the content and engine of IS change (Lyytinen, Mathiassen, & Ropponen, 1998). More specifically, the PSIC model employs Leavitt’s model (Figure 2-5).

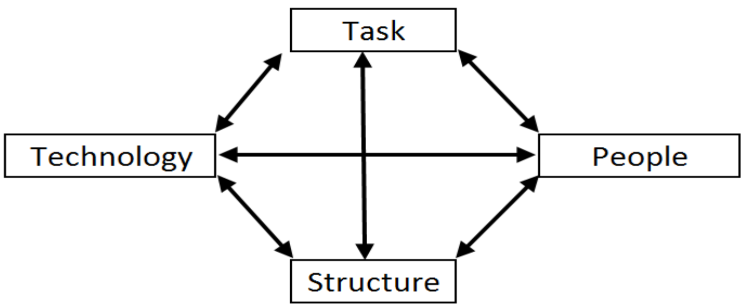


Figure 2-5. Leavitt's sociotechnical model (adapted from Keen [1981, p. 25]).

Leavitt's model views organisational systems as multivariate systems of four interacting and aligned components: task, structure, people, and technology (Lyytinen & Newman, 2008).

The current study uses a PSIC model that incorporates Leavitt's model as the 'sensitising device' (Klein & Myers, 1999, p. 75), to examine changes in an organisation when it introduces a new IT (Lyytinen & Newman, 2008). Chapter 3 discusses the PSIC model in further detail.

2.3.3 IT and Organisational Change

As indicated in previous discussions (Sections 2.3.1 and 2.3.2), this study adopts the view that organisations consist of processes and the use of process research methods (e.g. the PSIC process model) in understanding organisational change. In addition, sociotechnical and structuration theories inform this study in explaining the organisational change. With this understanding, this section reviews prior conceptualisations of IT and the role of IT in organisational change (DeSanctis & Poole, 1994; Orlikowski, 1992), and highlights the position of the current study in the conceptualisation and role of IT in organisational change.

Conceptualisation of the IT Artefact in Organisational Change

IS scholars struggle to agree on the technological and social nature of IT in organisational change (Benbasat & Zmud, 2003; Mingers & Willcocks, 2004). The basis of the struggle is an assumption of duality between the technological and the social (Orlikowski, 1992), or material and human (Poole & DeSanctis, 2004). In this debate, some IS studies still follow either the technological (Benbasat & Zmud, 2003) or social perspective (Mingers & Walsham, 2010; Mingers & Willcocks, 2004; Walsham, 2001). IS studies in technological perspective conceptualise the IT artefact as 'the application of IT to support some task(s) embedded within a structure(s) that itself is embedded within a context(s)–here, the hardware/software design of the IT artefact encapsulates the structures, routines, norms, and values implicit in the rich contexts within which the artefact is embedded' (Benbasat & Zmud, 2003, p. 186), whereas those ascribing to social perspective contend that IT is socially constituted, and embraces many social forces that also play a part in determining the future of the organisation (Walsham, 2001). However, the diverse conceptualisation of IT becomes more complex when explaining the role of IT in organisational change.

Role of IT in Organisational Change

Three major perspectives discuss the role of IT in organisational change: the institutional school, decision making and sociotechnical view. The institutional school views IT as an opportunity for change rather than a causal agent of change (Barley, 1986). The focus for institutionalists is less on the structures within technology, and more on the social evolution of structures within human institutions. According to this perspective, technology does not determine behaviour. Instead, human interactions generate social constructions of technology (Avgerou, 2000). Examples of studies under this perspective include the study of segmented institutions (Kling & Lamb, 1999); social information processing (Fulk et al., 1987) and an institutionalist perspective on IT and organisational change (Avgerou, 2000). However, the institutional school's approach underplays the role of technology in organisational change (DeSanctis & Poole, 1994).

Another view, the decision-making school of thought, has roots in the positivist tradition of research and assumes that decision-making is the original organisational act; it emphasises the cognitive processes that are associated with rational decision-making and adopts a psychological approach to the study of IT and organisational change (DeSanctis & Poole, 1994). Decision theorists agree that technology consists of structures (e.g. data and decision models) that aim to overcome human weaknesses, such as bounded rationality and process loses. Moreover, the application of technology brings productivity, efficiency, and satisfaction to individuals and organisations (DeSanctis & Poole, 1994). The decision-making school characterises that certain effects follow from the introduction of technology. In this view, technology is seen as an exogenous force that constrains the behaviour of individuals and organisations (Myers, 1994). Examples of theoretical approaches from this decision-making perspective include the effects of technology manipulation on outcomes (Orlikowski, 1992) and task–technology fit models (Jarvenpaa, 1989). Decision theory arose from the engineering view of organisation change, which postulates that failure to achieve certain change reflects a failure in the technology and its implementation to the organisation (DeSanctis & Poole, 1994). The problem with the decision-making view is that it ignores organisational issues, such as the different ways in which individuals and organisations actively use technology (Markus & Silver, 2008). Instead, it centres on a cause–effect relationship in which technology is the key driver of change and focuses only on user acceptance of the technology. Also, the research literature provides no empirical evidence that some technological properties consistently lead to either a positive or negative outcome (DeSanctis & Poole, 1994; Myers, 1994).

Finally, the sociotechnical school of thought combines the institutional and decision-making perspectives by incorporating the power of existing social practices with the influence of technologies on shaping interaction and is thought to bring about organisational change (DeSanctis & Poole, 1994). Examples of theoretical approaches in the sociotechnical school perspective include sociotechnical systems theory (Bostrom & Heinen, 1977; Carpentier, 1974; Pasmore et al., 1982), system thinking (Du Plooy, 1998) and the PSIC model, which uses sociotechnical theory to characterise the content and engine of IT and organisational change (Lyytinen & Newman, 2008). One shortcoming of the sociotechnical perspective is that it assumes the organisation is fundamentally harmonious. For these reasons, the current study goes beyond the sociotechnical perspective in seeking to understand the duality between technology and human interaction in work practices in which the technological and social intermingle in various ways (Leonardi & Barley, 2008; Orlikowski, 2007). The current research focuses on the effects of IT on IT workers in IT organisations to understand this interaction. These implications are discussed in the following section.

2.3.4 Effects of IT Changes on IT Workers in IT Departments

IT workers who support, maintain and manage IT products and services within the IT organisation interact more often with technology in work practices (Barley & Leonardi, 2008; Orlikowski, 2007). Therefore, the working environment of IT workers is an appropriate area to help understand human–technology interactions when an organisation introduces a new IS with major changes in system support, maintenance and management, such as the migration of an on-premise IT system to the SaaS model. Based on the literature, the current study focuses on the micro-level effects of the SaaS model on IT workers (Lyytinen & Rose, 2005) (see Section 2.2.7). Thus, the SaaS model brings major changes to the management of IS, which has adverse implications for the role and skill sets of IT workers in the corporate IT structure, as well as various organisational challenges (Lyytinen & Rose, 2005) (Figure 2-6).

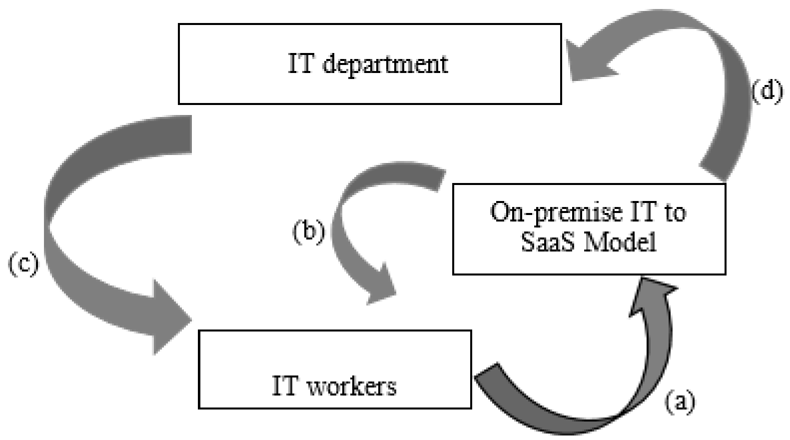


Figure 2-6. IT workers and the SaaS model (adapted from Orlikowski [1992, p. 410]).

Specifically, the current study employs the sociomateriality lens in understanding the interaction between IT workers and technology in the SaaS context, to highlight the level at which human and technology, or human and material agencies interact. In other words, this study seeks to highlight (a) the interactions between IT workers and IT when on-premise IT migrates to the SaaS model, (b) how this changes the skill sets and (c) roles of IT workers, and (d) the implications of this on functions of the IT department from a sociomateriality perspectiveThe following sections provide a background to sociomateriality, followed by a discussion of the sociomateriality implications of the SaaS model.

2.4 Background to Sociomateriality

Orlikowski (2007) attributes the original concept of sociomateriality to the work of Mol (2002) and Mohr (1982). Orlikowski (2007) argues that the ways of dealing with technology or materiality in organisation research are problematic, proposing sociomateriality as an alternative approach that posits materiality as constitutive of everyday life in describing the interactions of human and material artefacts.

Orlikowski's (2007) arguments, however, come as a response to the absence of theorising material artefacts through which work practices perform. This debate is a continuation of the earlier work of Orlikowski and Iacono (2001) that reviews 188 articles published in IS research over a period of 10 years (1990–99) and argues that IS research does not fully engage with the material artefact as its core subject matter. Instead, IS researchers emphasise the theoretical significance of the context within which an unspecified technology operates; or discrete processing capabilities of the artefact as separate from its context or as a dependent variable, which is posited to be affected or changed as IT is developed, implemented or used (Orlikowski & Iacono, 2001). In other words, three unique conceptual positions of IT are evident in IS studies. These conceptual positions are absence presence, exogenous force and emergent process (Orlikowski, 2009). In absence presence, IT is unacknowledged and unaccounted for by IS researchers (Gergen, 2002). Generally, in IS studies, 'artefacts are either absent, black boxed, abstracted from social life, or reduced to surrogate measure' (Orlikowski & Iacono, 2001, p. 130). Hence, IS scholars are faced with the challenge that although technology is everywhere in IS studies, it is absent from the majority of IS research. Barad (2003) reiterates the absence of technology in IS studies, saying that 'Language matters. Discourse matters. Culture matters. However … the only thing that does not seem to matter anymore is matter' (p. 801).

According to Orlikowski (2009), one of the reasons for the absence of materiality in IS studies is that IT is either invisible or irrelevant to IS researchers with an educational background in social, political, economic and institutional analysis. For these researchers, Orlikowski argues further that ontological artefacts tend to disappear into the background or taken for granted (2009). Thus, IS scholars tend to ignore questions about artefacts; consequently, research undertaken according to this view underestimates the role and significance of technological artefacts (Orlikowski, 2009).

The second view of the conceptualisation of IT in IS studies sees technology as an independent external force of organisation change, and as such, technology has significant and predictable effects on human and organisational change, such as governance, work routines, decision-making and organisation performance (Orlikowski, 2009). Such studies regard technology as a discrete object including equipment, machines, and instruments. In such conceptualisation, technology is thus postulated as distinct and separate from human and organisation and proposes to affect directly human behaviours and organisational characteristics (Orlikowski, 2009). Emergence process, the third view of the conceptualisation of IT, argues against the notion that technology is an autonomous external force. Instead, IS scholars that hold this view claim that technology results from the ongoing interactions of 'human choices, actions, social histories, and institutional contexts' (Orlikowski 2009, p.8). According to this view, technology is understood as material artefacts that are socially defined and produced (Walsham, 1995), and is, therefore, relevant to the people engaging with them. The ontological priority, in this case, is ascribed to the roles of human in technological change (Orlikowski 2007, 2009). Thus, IS scholars in this camp, such as Walsham (1995), view technology as socially grounded in historical and cultural contexts, and dependent on specific meanings ascribed by people using it. Orlikowski (2009) adds that the emergence process perspective thus focuses on embedded meanings and activities that are seen to produce an ensemble of technology relationships. For these reasons, Orlikowski (2007, 2009) proposes an alternative view of the conceptualisation of IT, that is a sociomateriality perspective, that considers materiality as integral to organising, arguing that the social and material constitutively entangle in everyday life. In her words when describing the position of constitutive entanglement, Orlikowski (2007) argues that:

> A position of constitutive entanglement does not privilege either humans or technology (in one-way interactions), nor does it link them through a form of mutual reciprocation (in two-way interactions). Instead, the social and the material are considered to be inextricably related there is no social that is not also material, and no material that is not also social. (p. 1437)

2.4.1 The Sociomateriality Debate

Orlikowski and Scott (2008) suggest the sociomateriality research stream that highlights three common themes: 1) a *relational ontology* that sees humans and technologies not as having inherent properties, but as acquiring them through their mutual and emergent entanglement; 2) an emphasis on *performativity*, whereby descriptions of reality do not merely reflect the world as it is, but intervene in it, creating the phenomena they describe; and thus 3) an *orientation to the practices* through which the relations and boundaries between the social and the material are enacted (pp. 455-456). As explained earlier, the relational ontology of sociomateriality assumes that the ‘social and material are inherently inseparable’ (Orlikowski & Scott, 2008, p. 456). It challenges the separation of material from human or technology from social life. In response, some IS scholars argue against the relational ontology stance of sociomateriality (Jones, 2014; Kautz & Jensen, 2013; Leonardi, 2013; Leonardi & Barley, 2008). For example, Jones (2014) argues that it makes no sense in the ontological interpretation that ‘there is no social that is not also material, and no material that is not also social’ (Orlikowski, 2007, p. 1437). With such an understanding, therefore, (Jones, 2014) argues that there will be no need to talk about the social and the material separately from each other if they are one and the same to each other (2014). For that reason, Jones views materiality as integral to human activity, and ‘there is no social action that does not entail material means’ (Jones, 2014, p. 898).

Kautz and Jensen (2013, p. 19) question the relational ontology that assumes the inseparability of the social and the material; if they are in a relationship, ‘why don’t they then have to be separated to be recognised as part of a relation?’ Also, Kautz and Jensen (2013, p. 18) critique four definitions of sociomateriality used by Scott and Orlikowski (2008): ‘the recursive intertwining of human and technology in practice’ (Orlikowski, 2007, p. 1437); ‘the constitutive entanglement of the social and the material in everyday organisational life’ (Orlikowski, 2007, p. 1438); ‘the constitutive intertwining and reciprocal inter-definition of human and material agency’ (Orlikowski, 2009, p. 13); and ‘the ways in which phenomena are “reciprocally and emergently intertwined”’ (Scott & Orlikowski, 2009, p. 4). However, these definitions do not seem to mean the same thing.

In contrast to the relational ontological stance discussed by Orlikowski and Scott (2008), Leonardi (2012) takes a substantial ontology position in understanding the interweaving of human and material agencies. As examined in Chapter 1, substantiality ontology views materiality as inherent to the technology and independent of its use and the context in which technology is used (Barley & Leonardi, 2008). With this understanding, once the technology is built its materiality is fixed unless some subsequent redesign is undertaken (Leonardi, 2012). Moreover, when implemented in an organisational context, technology's materiality becomes necessary, because users react to the technology's materiality. Normally, the materiality of technology is what users perceive as bounded and stable when translating from the realm of the artefactual into the realm of the social (Leonardi, 2013). However, Leonardi (2013) accepts that human agency and material agency are fundamentally related and that it makes no sense to talk about one without talking about the other. In building his arguments, Leonardi (2012, p. 42) defines human agency as 'coordinated human intentionality formed in partial response to perceptions of technology's material agency'. Moreover, he defines material agency, as 'ways in which technology's materiality acts. The material agency is activated as human's approach technology with particular intentions and decides which elements of its materiality to use at a given time' (Leonardi, 2012, p. 42). In other words, the material agency describes the capacity for non-human entities to act on their own, apart from human's intervention. As non-human entities, technologies exercise agency through their 'performativity' (Barad, 2003; Pickering 1995). Performativity explains the things a material agency does that people 'cannot completely or directly control' (Leonardi, 2011, p. 148). Leonardi, quoting Taylor and colleagues (2001, p. 71), argues that although human and material agencies both influence people's actions, their influence is disproportionate because human agency always has a 'head status', whereas material agency has a 'complement status' (Leonardi, 2011, p. 148–150). He goes on to say that people have the goals and capacity (human agency) to confront a technology that does specific things that are not completely in their control (material agency). Therefore, in the enactment of their goals, a human must contend with the material agency of the technology through a process known as imbrication (see Figure

2-7). Here, 'to imbricate means to arrange distinct elements in overlapping patterns so that they function interdependently' (Leonardi 2011, p150). Scholars characterise the interweaving of human and material agencies as the imbrication process (Leonardi, 2011).

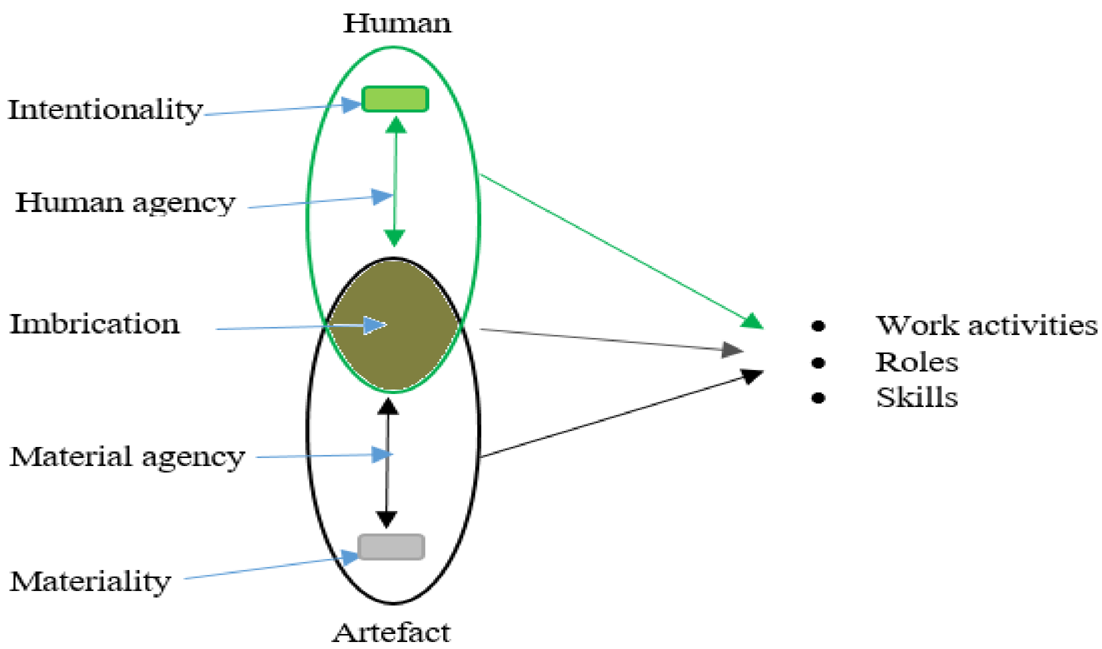


Figure 2-7. Imbrication of human and material (adapted from Leonardi [2012, p. 43]).

With this understanding, therefore, the process of 'imbrication' describes the ways human and material agencies interact to change work practices or alter technologies (Leonardi, 2011, p. 151), as illustrated in Figure 2-7. The human and material agencies imbricate in a space known as *sociomaterial practice* (Leonardi, 2012). In so doing, certain imbrications produce changes in the social subsystem settings, such as roles, skills and work practices, which in turn can bring changes to the person's intentionality or artefact's materiality as indicated in Figure 2-7. According to Leonardi (2011, 2012), changes in work practices and technologies are the result of the changes in a person's intentionality and artefact's materiality respectively. In other words, routines of work practices and technologies are the infrastructure produced by the imbrication of human and material agencies (Leonardi 2011). This mutual shaping of social and technical subsystems, therefore, defines the status of a sociotechnical system (Leonardi, 2012). Accordingly, imbrication is useful in two ways: First, it suggests that human and material agencies are effective at producing outcomes (e.g. an alteration in work practices or technologies) only when they are joined, but their interdependencies do not change their specificity and distinct characters (Leonardi, 2011). In other words, 'people have agency and technologies have agency, but ultimately, people decide how they will respond to technology' (Leonardi, 2011, p. 151). Second, imbrication reminds us that all interactions between human and material agencies produce 'organisational residue', such as alterations in work practices and technologies, and these figurations persist in the absence of their creators (Leonardi, 2011, p. 151).

2.4.2 Prior Sociomateriality Studies

Previous IS studies from the sociomateriality perspective discuss human and technology interactions in work practices (Johri, 2011; Jones, 2014; Wagner, Newell, & Piccoli, 2010). For example, Jones (2014) discusses the adoption of a computer-based clinical IS (CIS) in a hospital critical care unit. His study explores whether the five notions of sociomateriality— 'materiality, inseparability, relationality, performativity and practices' (see Section 2.5)—offer an account of the human and material relationship that may be useful in IS studies (Jones, 2014, p. 897). Related to these five notions of sociomateriality, Jones's (2014) results indicate that a change in materiality from patients' records on horizontal paper to a vertical computer screen contributed to a reorganisation of ward round activities, by introducing a virtual patient in CIS data that became central to care practices. On inseparability, staff viewed the performance of their work as inseparable from technology. In addition, patients' temporary and permanent implanted devices were seen as inseparable to their lives, thus creating a 'human–machine hybridization' metaphor (Jones, 2014, p. 910). On relationality, the work practices were dependent on technology, although they were influenced as the emergent engagement of work and technology; for example, a CIS will recommend drugs when a patient is admitted but does not enforce adherence to protocol. On performativity, patient data in a CIS represents the patient's condition and helps physicians to understand the agency of interventions required. Regarding practices, the perceived changes to the norms of nursing practice evoke emotions (Jones, 2014). However, in Jones's (2014) study, the level at which staff and patients interact with the CIS remains unclear. The current study seeks to highlight this gap in IS research, by examining the level at which human and material agencies interact.

In another study, Johri (2011) examines how IT workers develop practices that allow them to function across different geographic locations. He found the teams developed work practices through sociomaterial bricolage (i.e. using technology and resources available at hand). Johri (2011) explains that the term bricolage describes how people do work using available resources rather than acquiring tools that are not immediately available. Johri's (2011) study observes two facets of technology use in practice: *multiplicity* and *personalisation* of IT. The multiplicity of IT explains the use of multiple communication technologies for interaction—such as emails, blogs, Wiki, intranet, the Internet and instant messaging—and personalisation describes the ability to reach a mutually acceptable norm within a pair and a team that was the primary driver of technology use. Also, Johri (2011) describes that the need to achieve a work–life balance to accommodate different time zones triggers new practices. In Johri's (2011) study, sociomaterial work practices reflect the ingenuity of the workers in how they use the tools (social and material) available to them within a given physical and political context. However, Johri (2011) does not show how IT workers interact with tools, both the social and material. The current study aims to show how human and material agencies interact at different levels.

Wagner et al. (2010) examine human–technology interaction during the adoption of an enterprise system. Findings indicate that human and technology interact in a negotiated practise fashion that depends on *how*, *where* and *when* this interaction takes place. The 'how' describes the sociomaterial assemblages (i.e. humans and material exist in relation to each other). According to Wagner et al. (2010), the enterprise system was configured to legitimate one community's view of best practice, which delegitimised alternative views. Moreover, given that human and material exist only in relation to each other, it is not possible to force the social (of delegitimised alternative views) to work in a preferred way with the new sociomaterial assemblage. The 'where' discusses relationality (i.e. assemblages exist in relation to other assemblages across the organisation, although this does not assume uniformity across practice communities affected by the enterprise system). Accordingly, Wagner et al. (2010)'s findings indicate that different practice communities saw the consequences of the same enterprise system very differently. Finally, the 'when' describes the performativity of an enterprise system (i.e. the sociomaterial assemblage emerges from practice as well as defining how to practice and does not treat the meaning of IT as static but rather dynamically emergent, which requires a process research approach). Wagner et al. (2010)'s findings indicate that the project went through periods of resistance and accommodation in the post-rollout period that were not foreseen (Wagner et al., 2010). However, in Wagner et al.'s (2010) study, it is unclear how interactions with the enterprise system differ from one community to another. It is also unclear whether the enterprise system has varying levels of interaction with, for example, project team members, enterprise system users, or communities. The current study, therefore, seeks to contribute to the sociomateriality literature by highlighting the levels at which human and technology interact. Understanding these levels helps in explaining how human capabilities and levels of interactions determine the outcomes of the sociomaterial assemblage.

2.4.3 Position of the Current Study in the Sociomateriality Debate

The current study adopts the substantiality ontology. In particular, it employs the concepts of imbrication to gain an in-depth understanding of the migration process of an on-premise IT system to the SaaS model, and how the imbrication between IT workers and technologies brings changes to their social subsystems (e.g. roles and skill sets), which in turn alters the IT workers' intentionality in supporting the system (i.e. work practices) or changing the materiality of the technologies (Leonardi, 2012). In so doing, this study examines the level at which human and technology interact.

2.4.4 Imbrications of Humans and IT

The substantiality ontology and concepts of imbrication help this study to contribute to the sociomateriality literature on the human/social and the technological dimensions of IS, to investigate them in an inclusive and coherent way (Kautz & Jensen, 2013; Leonardi & Barley, 2008; Orlikowski & Scott, 2008). There are various areas in the sociomateriality literature, to which the current study seeks to contribute, that require clarification. For example, the study aims to understand 'how the social and the material become interwoven' (Leonardi, 2011, p. 165). It is, therefore, imperative to comprehend the level or interface at which the social and material imbricate, even before talking about the ways human and material become intertwined. Moreover, the sociomateriality literature indicates that 'people who have goals and the capacity to achieve them (human agency) confront a technology that does specific things that are not completely in their control (material agency). In the enactment of their goals, then, people must contend with the material agency of the technology' (Leonardi, 2011, pp. 148-150). However, the literature is unclear on the level at which human contends with the material agency in real-life scenarios. Further, the current study seeks to understand whether the imbrication differs when human and material agencies interact with physical, digital, non-physical, and virtual features of material artefacts (Jones, 2014; Leonardi, 2011). Finally, the literature is unclear on how human and material agencies negotiate to form a new sociomaterial assemblage (Wagner et al., 2010).

2.5 Sociomateriality Implications of SaaS

As indicated earlier, the migration of an on-premise IT system to the SaaS model offers an environment in which to examine the imbrication of IT workers with these technologies. In particular, the migration process involves IT structural changes from managing the system from the physical layer to the virtual environment, which has adverse effects on how IT workers imbricate with these technologies. Therefore, based on the IS literature in the SaaS context, the current study seeks to highlight three main areas. The first is the level at which human and material agencies imbricate a concept that is unclear in the literature on sociomateriality. In other words, the current study attempts to provide insights into the level at which (according to Leonardi (2012) sociomaterial practices operate (see Figure 2-7).

Second, the study further compares such imbrications of IT workers with technologies—that is, an on-premise IT system and the SaaS model (Mbuba, Wang, & Olesen, 2015)—within the five notions that characterise sociomateriality (Orlikowski & Scott, 2008). For simplicity, Jones refers to these as ‘materiality, inseparability, relationality, performativity, and practices’ (2014, p. 897). In the context of the current study, materiality describes physical, digital, and non-physical features of material artefacts that do not change over time and space (Leonardi, 2013). Inseparability explains whether human and material agencies exist as separate or inseparable entities (Orlikowski & Scott, 2008). Relationality describes whether imbrications of human and material agencies have any ‘analytical boundaries’ (Orlikowski & Scott, 2008, p. 455). Performativity explains the ability of human and material agencies to achieve social outcomes (Jones, 2014), and practice discusses the forms of bodily and mental activities, things and their use in the form of understanding, states of emotion and motivational knowledge (Jones, 2014).

The third area investigates what entails the capability of the imbrication between human and material agencies. In other words, the current study seeks to understand if humans with different capabilities interact with technology in the same way. Accordingly, the study employs the concepts of sociomateriality—more specifically, the imbrication of human and material agencies—in understanding its implications for work practices of IT workers during changes in the materiality of technologies (Leonardi, 2012), when an on-premise IT system migrates to the SaaS model.

2.6 Chapter Summary

This chapter reviewed the IS literature, which comprises four main areas. The first is implementation: in particular, the chapter reviews the concepts of cloud computing, characteristics of the SaaS model, and its implications for humans and organisations. Second, this chapter discussed IS literature on organisational change, in particular, the concepts of IT and organisational change. That section highlighted the focus of this study on the effects of IT on IT workers in the context of cloud computing—more particularly, the interactions of IT workers with the SaaS model. The third discussion area was the background on the sociomateriality lens and how this perspective is useful in explaining the interaction between human and technology in the SaaS environment. The fourth area combined the above three concepts (i.e. implications of SaaS model, organisational change and the sociomateriality perspective) to focus the study on the sociomateriality implications of SaaS. Therefore, based on the literature, this study seeks to explain the implications of SaaS for IT workers from a sociomateriality perspective. There is a lack of in-depth studies on the reasons why SaaS adoption changes the roles and skill sets of IT workers. In addition, from a sociomateriality perspective, the migration of an on-premise IT system to the SaaS model provides a useful environment for understanding how human and technology interact in work practices. However, the sociomateriality literature is unclear on the level of interactions between human and material agencies. Thus, this study seeks to contribute to the sociomateriality literature.

Chapter 3: Methodology

3.1 Introduction

The previous chapters introduced this study; based on the literature, the main areas of concern in the study were discussed. Generally, the study aims to explain the implications of SaaS adoption for IT workers from a sociomateriality perspective. More specifically, it seeks to explain why the migration of an on-premise IT system to SaaS changes the roles and skill sets requirements for IT workers, as well as the implications of this for functions of the IT department, and how IT workers interact with these technologies. In line with these research objectives, the purpose of this chapter is to describe the research methodology used to provide empirical data to investigate them. A research methodology consists of a research strategy and a research design for collecting and analysing data (Creswell, 2014). The research strategy in this study lies within qualitative research tradition and employs an interpretive multi-case approach to collect and analyse the empirical data. The study collects data from four tertiary institutions that migrated their on-premise IT email system to the SaaS model. Concepts of structuration and sociotechnical theory (Giddens, 1984; Orlikowski, 1992, 2000) guide the data collection and analysis, and inform this study in understanding IS and organisational change. Further, a general inductive approach to the data analysis process for identifying critical events is employed (Thomas, 2006), and a PSIC model is used as a sensitising device for in-depth explanations of the events in multi-level systems (Lyytinen & Newman, 2008). Moreover, this research employs the sociomateriality lens to provide a thorough understanding of the interactions of human and material agencies (Leonardi, 2013; Orlikowski, 2009; Orlikowski & Scott, 2008).

The remainder of this chapter discusses the qualitative research tradition and then the interpretive philosophical assumption adopted in this study. The chapter concludes with a description of the research design and a discussion of the justification for using the interpretive research approach.

3.2 Qualitative Research Tradition

During an empirical investigation, the research question determines the choice of the research methodology be taken, either a qualitative or quantitative approach. The word qualitative 'implies an emphasis on processes and meanings that are not rigorously examined' in terms of quantity, amount, intensity or frequency (Denzin & Lincoln, 1994, p. 4). A qualitative researcher stresses the value of rich descriptions of a social phenomenon and seeks to answer research questions that stress how a social experience is created and given meaning (Denzin & Lincoln, 2000). Although, many quantitative approaches have been used to investigate IS implementation and organisational change—for example, surveys (Sinclaire & Vogus, 2011) and laboratory experiments (Majchrzak et al., 2000)—much research has used a qualitative approach to deal with the inherent complexity and social nature of IT and organisational change (Orlikowski, 1993; Schultze, 2001; Walsham, 2001). One of the main advantages of qualitative research is that it allows a researcher to see and understand the context of participants' beliefs, decisions and actions in an in-depth way (Myers, 2011). The goal of understanding a phenomenon from the participants' viewpoint, within their social and organisational context, is largely lost when textual data are quantified (Myers, 2011).

The reasons for adopting a qualitative research approach in this study are several. First, the objective is to gain an understanding of participants' perceptions and experiences of how the SaaS model's adoption influences changes in their roles and skill sets requirements and the implications of this for changes in functions of their IT department. The IS literature recommends the use of qualitative research when 'the individual or group is asked to describe their perceptions about a subject based on their experiences' (Hunter, 2004, p. 300). Second, this study attempts to understand the shared meaning of IT workers involved in the phenomenon. Accordingly, the qualitative approach is appropriate because it attempts to make sense of, or interpret, phenomena regarding their meanings attributed by participants (Hunter, 2004; Myers, 2011; Walsham, 1993). These participants 'are representative … They reveal a reality outside', as seen by the researcher (Silverman, 1998, p. 8). Third, this study aims to understand the implications of the phenomenon that emerges when IT interacts with people. Although ISs have physical features that allow for technical operations, they are designed and used by humans operating in a complex social context (Doolin, 1998). Thus, people differ in their understanding of IS, which is given meaning by shared understanding of a phenomenon that emerges out of social interactions (Orlikowski, 1992). Lincoln and Guba summarise the concept in this way:

> Events, persons, objects are indeed tangible entities. The meanings and wholeness derived from or ascribed to these tangible phenomena are to make sense of them, organise them, or reorganise a belief system, however, are constructed realities. (1985, p.84)

This study, therefore, seeks to understand the social interaction that emerges with the SaaS model. Lee (2001) supports this view, saying:

> Researchers must deal with the phenomena that emerge when the technology and the behavioural interact, much like different chemical elements reacting to one another when they form a compound. (p. 247)

Fourth, this study seeks to examine the processes and events through which the SaaS model influences changes in IT workers' roles and skill sets requirements in their social setting. The documentation of the empirical data provided by a qualitative approach will allow interpretation of organisational processes from the viewpoint of the participants involved (Walsham, 1993). This method can examine the processes and ‘focus on actual practice in situ, looking at how’ IT and organisational structures are routinely enacted (Silverman, 1998, p. 3). Thus, a qualitative approach is appropriate as it provides the type of data required to examine the processes, content and the social construction of the phenomenon. However, qualitative research is not necessarily interpretive; this depends on the philosophical assumptions the researcher uses to answer the research question, as discussed in the following section (Myers, 2011).

3.3 Philosophical Assumptions

A research methodology must be appropriate to address the research question and must align with an appropriate research paradigm or philosophical assumption about the nature of the world and how knowledge about the world can be obtained (Myers, 2011). Guba and Lincoln (1994) define a research paradigm as a basic belief system or worldview made up of consistent epistemological and ontological beliefs. Epistemology describes the relationship between the researcher and the researched, and what represents knowledge or evidence of the social reality (Guba & Lincoln, 1994). Ontology refers to what are the worldview and nature of the social reality being investigated. Understanding the research paradigm guiding a study is useful because it influences the choice of research methodology (Orlikowski & Baroudi, 1991). Based on the underlying research epistemology, Orlikowski and Baroudi (1991) suggest three categories of research paradigms: *positivist, critical* and *interpretive.* This study considers these three commonly accepted philosophical assumptions in IS research (Chua, 1986; Myers, 2011; Orlikowski & Baroudi, 1991). Justifications have been outlined with respect to a positivist understanding of IS and organisational change (Walsham, 1993). The current study emphases the role of social construction following the interpretive paradigm for understanding IS and organisational change (Walsham, 1993, 1995a). As will be discussed in later sections, critical research is less common in IS research (Myers, 2011). The following sections discuss philosophical assumptions in light of the interpretive research approach adopted in this study. The current study emphasises that the word ‘qualitative’ is not a synonym for ‘interpretive’. Qualitative research can be either positivist, interpretive or critical (Myers, 2011). These research epistemologies are ideal types that are philosophically distinct; in practice, these distinctions are not so clear (Lee, 1989). Table 3-1 lists philosophical assumptions discussed in this chapter.

Table 3-1

Philosophical Assumptions

Item	Positivism	Critical theory	Interpretivist (adopted in this study)
Ontology	Naïve realism—real reality but apprehendable	Historical realism—virtual reality shaped by social, political, cultural, economic, ethnic and gender values; crystallised over time	Relativism—local and specific constructed and co-constructed realities
Epistemology	Dualist/objectivist—findings true how things are and how things work	Transactional/subjectivist—knowledge is value mediated findings	Transactional/subjectivist—sees knowledge as created in interaction with researcher and respondents
Methodological	Experiments/manipulative—verification or falsification of propositions	Dialogic/dialectical—reconstruction of previously held reconstruction	Hermeneutic/dialectical—reconstruction of respondents’ shared meaning
Aim of enquiry	Explanation—prediction and control to ‘discover.'	Critique and transformation; restitution and emancipation	Understanding; reconstruction
Quality criteria	Rigour—internal and external validity, reliability and objectivity	Historical situatedness, erosion of ignorance and misapprehension, action stimulus	Trustworthiness, authenticity, credibility, transferability and conformability

Source: Denzin & Lincoln (1994, 2011)

Positivists assume that social reality is objectively given, and can be described by measurable properties, which are independent of the researcher. For example, Orlikowski and Baroudi (1991) describe measurable properties in the following way:

Organisations are understood to have a structure and reality beyond the actions of their members. The role of the researcher is to discover the objective physical and social reality by crafting precise measures that detect and gauge those dimensions of reality that interest the researcher. (p. 9)

Epistemologically, in social research, positivism research follows natural science, whereby researchers adopt a scientific and objective perspective. In other words, positivist researchers take the ontological stance that there is one knowable and observable reality (Myers, 2011). Therefore, a research methodology aligned with positivist assumptions attempts to use formal propositions to increase predictive understanding of the observable reality of phenomena (Orlikowski & Baroudi, 1991). As a result, the IS literature classifies studies as positivist if there is evidence of formal propositions about a phenomenon (Orlikowski & Baroudi, 1991).

The critical research appears to be less common in IS research (Myers, 2011), although a few IS studies in this paradigm have emerged (Myers & Young, 1997; Ngwenyama & Lee, 1997). Epistemologically, critical researchers assume that social reality is historically constituted, and is produced and reproduced by people. Researchers in this paradigm are concerned with critically evaluating social reality and the conflicts and contradictions therein, with the aim of transforming (emancipating) society from social, cultural and political domination for the better (Myers & Klein, 2011). Thus, critical studies tend to be longitudinal or ethnographic; involving studies of organisational processes and structures (Orlikowski & Baroudi, 1991). Critical research is not considered appropriate for the current study because its objective is to gain a deeper understanding of a phenomenon rather than being a social critique with an emancipation agenda (Myers & Klein, 2011; Stahl, 2008).

Arguments supporting interpretive research as a legitimate basis for understanding human activity are common in the IS literature (Doolin, 1998; Klein &

Myers, 1999; Lee, 1991; Nandhakumar & Jones, 1997; Trauth & Jessup, 2000; Walsham, 1993, 1995b). Interpretive research asserts that the positivist methodology used in the natural sciences is inadequate for understanding human actions (Walsham, 1993). The rationale for this assertion is that people enact their social reality (Lee, 1991). Human products such as organisations and society are constructs of the human mind (Walsham, 1993). Walsham adds that:

> Our knowledge of reality, including the domain of human action, is a social construction by human actors. Our theories concerning reality are ways of making sense of the world, and shared meanings are a form of intersubjectivity rather than objectivity. (2006, p. 320)

Interpretive research brings in a different method of inquiry to that of the natural sciences, by recognising human actions, processes, events and artefacts from within human life—not as the observation of an external reality (Lee, 1991; Walsham, 1993). Consequently, interpretive IS research might be characterised by an intention to understand the implications of IT for organisational activity and processes through an understanding of the context of ISs and processes whereby the IS influences and is influenced by its context (Walsham, 1993). Based on this understanding, Lee emphasises that 'The same physical artefact, the same institution, or the same human action, can have different meanings for different human subjects, as well as for the observing social scientist' (1991, p. 347).

3.4 Interpretive Research—Theoretical Foundations

Interpretive research assumes that social reality is only created through social constructions such as language, consciousness, and shared meanings (Myers, 2011; Trauth & Jessup, 2000). Ontologically, interpretive studies emphasise the importance of multiple and subjective meaning through which humans construct social realities (Lincoln et al., 2011). Social reality in IS research is understood to be produced, reproduced and reinforced by humans through their actions and interactions (Orlikowski & Baroudi, 1991). According to this belief, organisations, groups, and social systems do not exist apart from humans, and hence cannot be characterised in some objective or universal manner (Orlikowski & Baroudi, 1991; Walsham, 1995b). Interpretivists recognise that as the meaning is formed, transferred, and used—it is also negotiated, and hence interpretations of reality may change over time as circumstances change (Orlikowski & Baroudi, 1991).

Epistemologically, interpretive research assumes that valid knowledge is a social construct arising from how people perceive their world as they try to understand a phenomenon through the meanings and values that people assign to it (Oates, 2007; Orlikowski & Baroudi, 1991; Walsham, 2001). In this regard, interpretive researchers understand a social phenomenon with the assumption that there are multiple valid social realities and focus on human sense-making as the situation emerges (Kim & Kaplan, 2006).

Interpretivists believe that social processes may not be captured in hypothetical deductions, covariance, and degree of freedom. Instead, understanding a social process involves getting inside the world of social actors generating it (Orlikowski & Baroudi, 1991). Interpretivists assert that the language people use to describe social practices constitutes those practices. Accordingly, understanding social reality requires understanding how practices and meanings are formed and informed by the language and shared meaning of the phenomenon (Orlikowski & Baroudi, 1991; Walsham, 1995b). Interpretivists construct interpretations (using techniques such as hermeneutic principles and the grounded theory method [GTM]) that account for the way subjective meanings are created and sustained in a particular setting (Myers, 2011). Thus, interpretive research is premised on a subjectivity epistemology belief that the researcher creates understanding through interactions with the subject of investigation

(Lincoln et al., 2011). Interpretive research interactively links with the subject of inquiry; the values of the researcher inevitably influence the investigation process. Guba and Lincoln discuss that this position differs from that of positivist research in two ways. First, it challenges the positivist objective epistemology in the belief that the researcher and the subject of investigation are two independent entities, and that the researcher is capable of studying the subject without influencing it or being influenced by it. Second, interpretive research challenges the positivist distinction between ontology and epistemology (1994). What can be known and what constitutes reality is inseparably intertwined with the interaction between a particular researcher and subject of investigation (Guba & Lincoln, 1994).

However, an interpretive approach is not entirely homogeneous: with respect to the role of the researcher in investigating a phenomenon, *weak* and *strong* perspectives can be differentiated (Orlikowski & Baroudi, 1991). The weak viewpoint, the interpretive researcher attempts to understand the existing meaning systems shared by the social actors and interprets their actions and events when reporting. The interpretivist describes experiences in the context of purpose and intelligibility and reveals what social actors are doing and how and why they would be doing that (Orlikowski & Baroudi, 1991). In addition, the weak perspective assumes that once the process of social construction of technology has ended, technology has characteristics and capabilities, which can drive organisational change (McLoughlin, Richard, & Paul, 2000). The weak perspective of interpretive study is understood to complement positivist research by bridging a knowledge gap in positivist research, such as inherent complexity, ambiguity and instability of IS and organisational change (Orlikowski & Baroudi, 1991). According to the strong perspective of interpretive research, the researcher describes a phenomenon in the words and categories of the actors but presumes to enact the social reality of the study (Orlikowski & Baroudi, 1991). As Orlikowski and Baroudi put it:

> Retelling the actors' story is never fully possible, as the interpretive schemes of the research always intervene, and hence the researcher in part creates the reality she is studying through the constructs used to view the world. (1991, p. 15)

The strong perspective of interpretive research aims not to complement positivist investigations, but to replace them. According to this view, researchers cannot objectively select a research perspective based on the nature of the phenomenon without relying on their predispositions. Rather, researchers choose aspects of a phenomenon on which they wish to focus and construct the form of the phenomenon through the worldview they adopt to do the research. Hence, the researcher's assumptions and values are deeply embroiled in the phenomenon from the beginning of the selection of a research approach and methods (Orlikowski & Baroudi, 1991).

The current study adopts a weak interpretive perspective, holding the belief that through the process of interpretation, technology can have characteristics and capabilities (Orlikowski, 1992). In addition, this research complements, rather than substitutes for, a positivist research approach.

3.4.1 Criteria for Evaluating Interpretive Findings

Some conceptual papers on interpretive case study research suggest guidelines for conducting and evaluating interpretive case study research in IS (Klein & Myers, 1999; Trauth & Jessup, 2000; Walsham, 1995b). Klein and Myers (1999), for example, suggest a set of principles to conduct and evaluate the interpretive research of a hermeneutic nature. However, they caution that these principles do not subscribe to a model with a predetermined set of criteria that can be applied in a mechanical fashion; further, they do not agree on having no standards by which interpretive study can be judged (Klein & Myers, 1999). Following Walsham (1995b), Klein, and Myers (1999), the current study adopts some of these principles appropriate for the research. Table 3-2 shows the principles adopted with a brief definition and outlines how they are applied in the current study.

Table 3-2

Criteria for Evaluating Interpretive Findings

Principle	Definition	Application in this study
Hermeneutic	Research focuses on the interaction between the understanding of a text as a whole and the interpretation of its parts, in which anticipated explanations guide descriptions	Hermeneutic principles used in general coding and interpretation of data
Role of theory in interpretive research	Research has to state its use of theory or prior knowledge and show sensitivity to possible contradictions between theoretical preoccupations and actual findings	This study uses concepts of structuration theory and the PSIC framework as part of an iterative process of guiding data collection and analysis; a sociomateriality lens is employed for an in-depth understanding of human–material interactions
Role of the researcher	The role of the researcher and the relationship with social actors of the case organisation needs to be stated	The researcher in this study adopts the role of an outside observer during data collection
Suspicion	Research has to describe sensitivity to possible biases and systematic distortions in the narratives collected from participants	This study collects empirical evidence from various participants of the same organisation and compares narratives of each
Contextualisation	Research has to provide a critical reflection of the social and historical background of the case setting so that the intended audience can see how the current situation under investigation emerged	This study provides a case profile stipulating the organisation's history and social relationships between on-premise IT system and the roles of IT workers in each case

Source: Walsham (1995b)

Trauth and Jessup discuss four criteria for evaluating interpretive findings (2000). In the interpretive perspective, these include corroboration, authenticity, breakdown resolution, and trustworthiness. These criteria inform this study and are briefly discussed below (Trauth & Jessup, 2000). Corroboration involves the use of multiple sources to provide substantiating evidence (Creswell, 2014). Corroboration is commonly used in interpretive research to show that there is evidence other than the researcher's interpretation to support the discovery (Creswell, 2014; Myers, 2011). The objective of corroboration in this research is to find information from other sources to substantiate empirical evidence based on interview transcripts from participants. Other sources used in this study are official websites and project documents. Authenticity is an evaluation criterion that cross-examines the spectrum of interpretive research, such that the account must make sense to the reader (Patton, 2002). This is expressed as the persuasiveness of the narrative analysis (Golden-Biddle & Locke, 1993). Patton adds that authenticity is expressed in reflexive consciousness about the researcher's perspective, appreciation of the perspectives of others and fairness in constructing the values held by participants (2002). An authentic account is perceived by the reader as genuine and conveys the researcher's understanding of participants' worldviews. The quality of the narrative, including the use of quotations and rich, detailed description, is indicative of the researcher's connection to the people studied (Trauth & Jessup, 2000). IS field researchers have used this criterion to evaluate their interpretive IS research (Schultze, 2001; Walsham & Sahay, 1999). For example, in expressing reflexive consciousness, Schultze uses field note writings that result in splitting her consciousness into experiencing and observing self (2001). She uses her experience as an academic knowledge worker and self-reflexive field notes to generate substantive insights (Schultze, 2001). The current study uses authenticity in the iterative process of the interpretive discussion of interview transcripts and the context of the case studies. In doing so, the study endeavours to provide rich, detailed accounts of the organisations, the participants, relevant perceptions, self-reflexive actions and events and related issues. Also, it describes the local and broader contexts within which the research took place, to help the reader gain a better understanding of meaning in the research context (Schultze, 2001).

Breakdown resolution demands that detailed documentation of procedures be provided and considers the extent to which the empirical data yield consistent findings (Trauth & Jessup, 2000). It requires the use of methods such as principles of hermeneutic circles that can explain how the interpretation conforms to the data (Klein & Myers, 1999). Hermeneutic circles refer to the language between the understanding of the text as a whole and the interpretation of its parts, in which descriptions are guided by anticipated explanations (Myers, 2011). This interpretation is the work of thought, which consists of decoding the hidden meaning in the apparent meaning and unfolding the levels of meaning implied in the literal meaning (Myers, 2011). This is done by walking the reader through the process of developing the interpretations. As discussed in Chapter 2, this study uses hermeneutic circles to examine interview transcripts and documents in context.

The objective of trustworthiness in the interpretive case study is not to verify a correct answer, but rather to convince the reader that a believable research account is being told (Myers, 2011). This study addresses trustworthiness in two ways. First, the data analysis approach utilises coding and memoing processes providing an audit trail of the process used to reach the conclusions. Second, venting (i.e. getting feedback of the current study) is used during discussions of results and interpretations with respondents who are willing to participate (Patton, 2002).

3.4.2 Rationale for the Interpretive Approach in this Study

Consistent with the primary objective of this study that seeks to explain the implications of SaaS adoption for IT workers from a sociomateriality perspective (see details in Section 1.3), an interpretive research paradigm is appropriate for a number of reasons. First, the concept of the process brings an understanding that IS itself is not static, either in terms of its physical components and data or in the changing human perception of the IS and its output (Walsham, 1993). Human–technology interactions motivate investigations into how people enact a shared, social reality from the actors' perspectives (Orlikowski & Baroudi, 1991). Orlikowski and Baroudi (1991) add that 'In particular, the social process can be usefully studied with an interpretive perspective, which is explicitly designed to capture complex, dynamic, social phenomena that are both context and time dependent' (p. 18). Viewed that way, IT forms part of an environment in which IT workers, managers, and users interact to develop shared meanings and interpretations of an ambiguous social reality of the IS. This study draws on participants' experiences and interpretations, and hence is dependent on these interpretations (Orlikowski & Baroudi, 1991). Thus, it intends to use hermeneutic principles to help discover these shared meanings and interpretations of SaaS implications that form a basis on which action is constructed (Boland, 1979).

Second, the main aim of the interpretive research is to produce an in-depth understanding of the phenomenon in context. The context includes the complexities of social, technological, and organisational contexts incorporated into an understanding of the disruptive nature of emerging technologies such as SaaS, rather than simplifying or ignoring it (Keller & Hüsig, 2009; Lyytinen & Rose, 2003). As indicated above, the IS literature underlines the importance of contexts within which IT is implemented, because the context has an influence on the way in which IT is used (Orlikowski, 1993; Walsham, 1995b). Such a conviction informs this study, and the use of interpretive approach allows the inclusion and investigation of IT in contexts (Myers, 2011).

The third reason is that the interpretative approach is appropriate for generating a well-founded comprehension of the complex interaction process between humans and advanced technologies within their social settings (Myers, 2011; Walsham, 1995a, 2001). As indicated earlier, this study adopts the sociomateriality perspective to guide the analysis of human–technology interactions, as well as the PSIC model and principles of hermeneutics for data analysis and critical incidents interpretation. Thus, the hermeneutical nature and contextual and process analysis adopted in this study are consistent with the interpretive orientation of this research. Based on these considerations, this study adopts an interpretive stance to understand the phenomenon and answer the research questions, as well as retain consistency and appropriate philosophical assumptions. The next section discusses interpretive research methods adopted in this study.

3.4.3 Interpretive Research Methods

Interpretivists adopt research methods such as case studies, ethnography, and grounded theory for investigating social processes and examining humans in their social settings (Myers, 2011; Orlikowski & Baroudi, 1991). According to (Klein & Myers, 1999; Myers, 2011; Walsham, 2006), these research methods are:

- more subjective than objective
- concerned with the uniqueness of each particular phenomenon in context (idiographic) rather than being concerned with the discovery of general laws (nomothetic)
- aimed at the explanation of a phenomenon versus prediction and control
- taking an insider stage (endogenic) rather than an outsider (exogenic) perspective.

Table 3-3 outlines the basic characteristics of the interpretive research approach.

Table 3-3

Basic Characteristics of Interpretive Research

Characteristics of interpretive research approach
Natural setting as a source of primary data
Researcher commitment to the fieldwork
Researcher as key instrument of data collection

Multiple forms of data collection methods
Importance of research context
Data collected as words or pictures
Iterative data collection and analysis
Researcher subjectivity is part of data analysis
Critical active reflexivity or self-scrutiny by the researcher
Outcome as a process rather than a product
Inductive data analysis with attention to a particular context
Focus on participants' perspective and meaning
Social explanation of intellectual puzzles
Use of expressive language
Thick description of contexts, events, or situations in 'verbatim quotes.'
'Persuasion by reason' (verisimilitude)
Focused on theoretical generality and not generalisability

Source: Walsham (1995a, 2006)

This study adopts the interpretive multi-case study method, which is consistent with the practical and theoretical constraints of the study. Nonetheless, ethnography and grounded theory (GT) methods are briefly discussed below, along with a justification for why some of these methods were not adopted in the current research. Ethnography is a qualitative research method in which a researcher studies a specific group of people within their social and cultural context over a prolonged period (Patton, 2002). The ethnography approach aims to gain a deeper understanding of social and cultural situations by collecting primarily observational, fieldwork and interview data (Creswell, 2014; Myers, 2011). Normally, ethnography research is not guided by pre-specified research questions (Creswell, 2014). Previous IS studies used ethnographic research approaches (Hunter, 2004; Myers & Young, 1997; Prasad & Prasad, 1994). However, the current study did not consider the ethnography research method appropriate because it uses semi-structured interview questions for empirical data collection, in contrast to ethnography, which is not guided by pre-specified research questions. In addition, it was not intended that the researcher would become immersed in the participants' social lives. Rather, it aimed to gain an in-depth understanding of participants' experiences in multiple cases of on-premise IT systems moving to the SaaS model without necessarily understanding participants' social and cultural backgrounds.

GT is a qualitative research approach that seeks to develop a theory that is grounded in data systematically gathered and analysed in social research (Glaser & Strauss, 1965). This approach suggests that there should be a continuous interplay between data collection and analysis (Strauss & Corbin, 1990). Therefore, data collection, analysis, and theory generation have reciprocal relationships with each other (Urquhart, Lehmann, & Myers, 2010). More specifically, the term 'grounded theory' is used in two different ways by researchers; as a formally defined research approach, and as a data analysis technique: the GTM (Eisenhardt & Graebner, 2007). Formal GT is not designed to begin with preconceived theoretical ideas or frameworks before starting the research (Corbin & Strauss, 2008; Seidel & Urquhart, 2013; Strauss & Corbin, 1997). Previous IS studies have used GT to generate original and rich findings closely tied to the data (Bouty, 2000; Slagmulder, 1997). However, this study did not use formal GT because of the large body of IS literature available to inform the study and provide useful research questions and conceptual frameworks to guide the research design, which includes data collection and analysis. Also, this study uses existing preconceived theories—structuration (Giddens, 1984) and PSIC (Lyytinen & Newman, 2008)—to guide the data collection and analysis by providing focusing concepts for the research. Thus, using formal GT might have restricted the researcher in examining the literature and using it to guide the research design. However, this study adopts the data coding technique using GTM guidelines (Glaser, 1965; Glaser & Holton, 2004; Urquhart, 2012).

Case study research in IS uses empirical evidence from organisations to examine a phenomenon in context (Myers, 2011). Empirical evidence comes from interviews and documents (Myers, 2011). Myers adds that the case study approach aims to use empirical evidence from real people in real organisations to make an original contribution to the body of knowledge (2011). After scrutiny of these research methodologies, the case study methodology was identified as appropriate for this research.

3.5 Research Design

This section explains and justifies the research design, and includes the following topics: rationale for interpretive case study research, case study design, case selection criteria, selection of participants, data collection methods and data analysis strategy.

3.5.1 Rationale for Case Study Research

This study adopts the interpretive case study approach for several reasons. First, case research is suitable for research in the IS field because the purpose is ISs in organisations, where interest has shifted to organisational rather than technical (Benbasat, Goldstein, & Mead, 1987).

Second, by reporting on real-life IT experiences from case studies, IS researchers make both theoretical and practical contributions regarding the rapid changes occurring in the IT world as well as in organisations (Myers, 2011).

Third, case research provides for a comprehensive investigation, which helps researchers to understand the complex and ubiquitous interactions among organisations, technologies, and people. The use of multiple data collection methods such as interviews and documentation (Myers, 2011) brings richness and flexibility to the overall research process, making the case research strategy well designed for the study of a complex phenomenon such as IT.

Fourth, in-depth case investigations open the way to new ideas and new lines of reasoning that identify opportunities, challenges, and issues facing IT workers and IT managers. In this regard, the experiences of both IT workers and IT managers provide empirical evidence to understand the implications of SaaS adoption for IT workers' roles and skill sets requirements, and functions of the IT department when an organisation moves an on-premise IT system to the SaaS model. Previous IS studies (Avison & Malaurent, 2007; Bussen & Myers, 1997; Furumo & Melcher, 2006; Maznevski & Chudoba, 2000; Sarker & Lee, 2003) used a case study research methodology and hence it is a well-accepted research approach in the IS field (Klein & Myers, 1999).

These characteristics of the case study approach suit the focus and the objective of this research, and thus the current study adopts interpretive case study methodology to retain theoretical consistency and make appropriate philosophical assumptions to guide the research design. The research design is a plan for an entire qualitative research study and follows a sequence intended to improve the authenticity of IS case studies (Myers, 2011). Research design covers philosophical assumptions, research methods, data collection techniques, and analysis of qualitative data (Myers, 2011).

Figure 3-1 presents a road map, and the following outline summarises the entire research design in this study.

1. The current study introduced the research problem and objective of the study. It discussed the relevant literature and provided an overview of cloud computing, the SaaS model, and its implications and theoretical background.
2. In addition, the study discussed organisational change and IT implementation-related theories.
3. Structuration theory guides research design, formulation of interview questions and data collection. The PSIC model guides the data analysis
4. The relevant literature justifies an interpretive approach as an appropriate research paradigm to address the research questions through multi-case study.

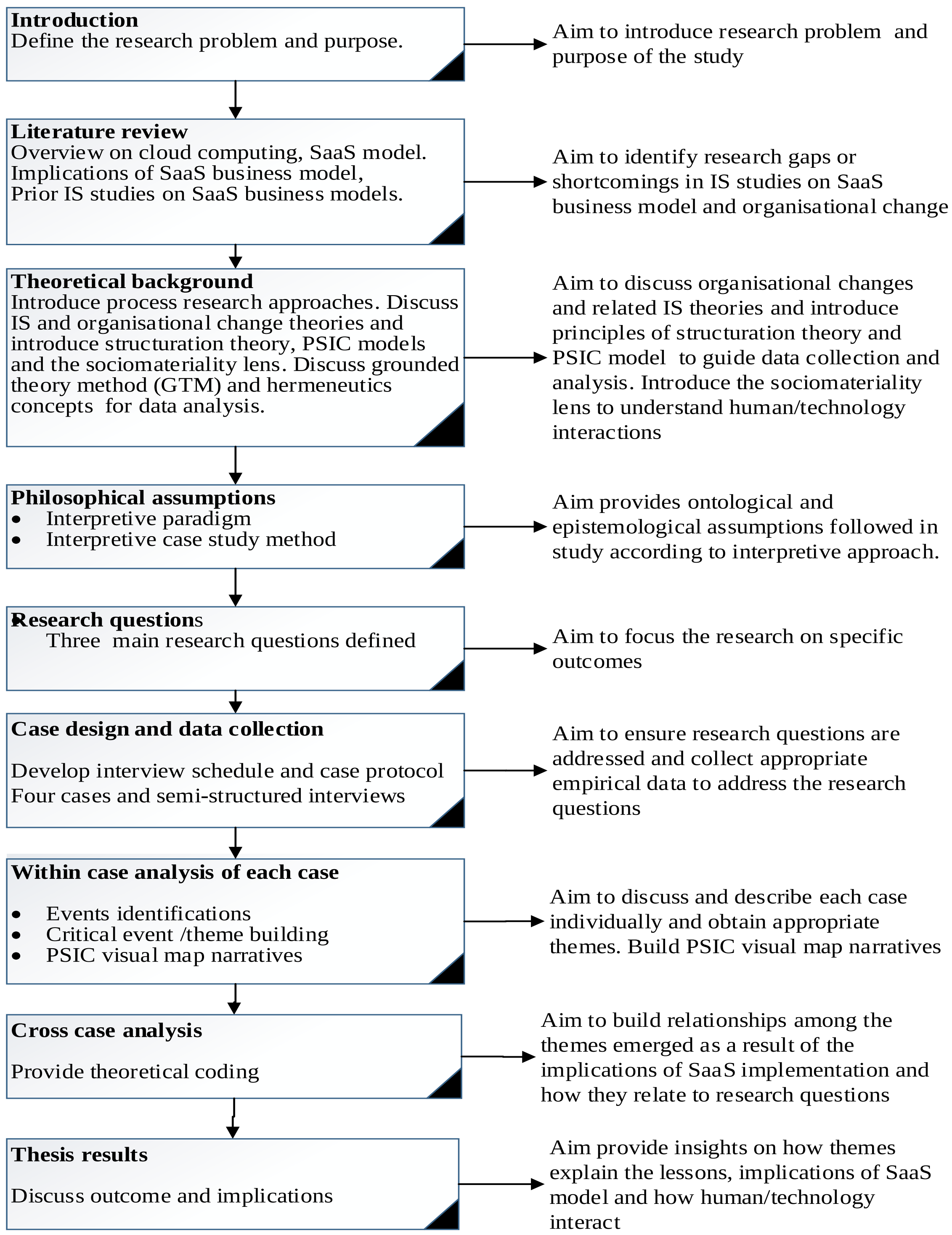


Figure 3-1. Research design roadmap.

5. This study defines a project on moving on-premise IT systems to the SaaS model as the unit of analysis based on the research questions.

6. This research selects four case studies based on theoretical and practical selection criteria.
7. The current study designs a case protocol based on research questions, theoretical frameworks and the unit of analysis. The case protocol includes an Interview Protocol and Participant Information Sheet.

3.5.2 Case Study Design

Myers defines a case study as research that uses ‘empirical evidence from one or more organisations where an attempt is made to study the subject matter in context’ (Myers, 2011, p. 76). Empirical evidence comes from multiple sources, mostly interviews and documents (Myers, 2011). An interpretive case study, therefore, relies on interpretive epistemology, that is, social reality is socially constructed (Myers, 2011). An interpretive case study attempts to understand phenomena through the meanings that participants assign to them (Walsham, 1995b).

The case study approach is appropriate when an objective of the study is to understand how and why an event occurs, especially when the researcher has no or little control over the events and the focus is on a real-life, complex social phenomenon (Myers, 2011). Via the case study methodology, this study can answer the research questions to establish the implications of SaaS adoption for IT workers and functions of IT departments from a sociomateriality perspective. The case study design seeks a natural setting of a phenomenon under study with the intention to comprehend the nature of current processes (Benbasat et al., 1987) and enables the researcher to grasp a holistic understanding of the phenomenon under investigation (Eisenhardt, 1989). The quality of the interpretive case study depends on the authenticity of the story and the overall argument (Guba & Lincoln, 2005; Myers, 2011). To establish the authenticity of interpretive case studies, IS researchers have suggested some theoretical, methodological, and reporting approaches for use in interpretive case study design

(Pettigrew, 1990; Walsham, 1995b). These include the formulation of interview questions, use of theory, a unit of analysis, criteria to establish quality in the interpretive case study approach, choice of the sector and case selection (Pettigrew, 1990; Walsham, 1995b). These issues are discussed from an interpretive perspective to meet the philosophical assumptions of the current study.

Formulation of Interview Questions

Broadly, the objective of this study is to explain the implications of SaaS adoption for IT workers and functions of IT departments from a sociomateriality perspective. More specifically, this study seeks to explain why the migration of an on-premise IT system to SaaS changes the roles and skill sets requirements for IT workers, and the implications of this for functions of the IT department, and how IT workers interact with these technologies from a sociomateriality perspective. In pursuit of this objective, the three specific research questions to be addressed are:

- RQ 1. What happens in the process of migrating an on-premise IT system to the SaaS model?
- RQ 2. Why does the migration of an on-premise IT system to the SaaS model change the roles and skill sets requirements for IT workers, and what are the implications of this for the functions of the IT department?
- RQ 3. How does the interaction between human and technology influence work practices and organisational change, when an on-premise IT system migrates to the SaaS model?

This study employs a PSIC process model to analyse critical events during the system migration process. The following sections discuss these research questions alongside the interview questions used to collect empirical evidence to address them. The first research question provides managerial implications from the four research cases analysed in Chapters five to eight. The second research question unpacks into three sub-questions that address the reasons why SaaS adoption changes IT workers' roles and skill sets requirements and the implications of this for the functions of the IT department.

RQ 2.1. Why do the roles of IT workers change when moving an on-premise IT system to the SaaS model?

In using this question, the study seeks to examine changes in IT workers' roles that result from moving an on-premise IT system to the SaaS model. If there were changes, the study expects to provide insights into how these changes occurred by analysing IT workers' experiences when implementing the SaaS model into business processes. Empirical evidence from IT workers' experiences, supported by IT managers' assessment of IT workers' performance captured from interview questions include:

- What were the positive and negative aspects of using the on-premise IT system/SaaS model?
- What challenges did you have when supporting the on-premise IT system/SaaS model and why?
- Have IT workers' roles changed due to the implementation of the SaaS model? Do you now have more/fewer responsibilities in supporting system functions?
- Can you describe any new roles and responsibilities introduced to IT workers as a result of system changes?

The Interview Protocol in Appendix D presents further interview questions.

RQ 2.2. Why the skill sets requirements of IT workers change when moving an on-premise IT system to the SaaS model?

This research question examines changes in skill sets requirements of IT workers by comparing skill sets used when supporting the on-premise IT system with those required for supporting the SaaS model. This study draws empirical evidence from IT workers' experiences using interview questions that include:

- How did IT workers support the on-premise IT system? Has that changed in the SaaS business environment? Can you explain why?
- What type of changes/issues occurred after the SaaS system was implemented? Why do you think these changes were necessary?
- How do you compare skill sets of IT workers that supported the on-premise IT system with those supporting the SaaS model? Why are new skill sets or new IT tools required in supporting the SaaS model?
- Did you receive technical training in how to support the SaaS system? Was the training helpful? Why do you think you needed further training?
- What major compliments, complaints, or issues do you wish to share?

Additional questions are presented in the Interview Protocol in Appendix D.

The objective of asking these questions is to gain a deeper understanding of IT workers' experiences and insights on how competent they are in supporting the SaaS system compared to on-premise IT system.

RQ 2.3. How does SaaS adoption trigger these changes and what are their implications for functions of the IT department?

The objective of this question is to examine the reasons for changes in the functions of the IT department because of implementing the SaaS model. Empirical evidence comes from the experiences of both IT workers and IT managers, who described issues that emerged as new functions of the IT department. Interview questions included:

- Did you have to change IT support procedures to accommodate the SaaS system? If so, please describe why?

- Did you have any informal relationship between the IT department and other business unit before the SaaS system? What happened to the relationship after SaaS was introduced?
- Can you describe any new functions of the IT department and why they had to be introduced?
- How has the SaaS system changed to accommodate the needs of other business units? Why do you think these changes were necessary?

Appendix D provides further questions in the Interview Protocol.

RQ 3. How does the interaction between human and technology influence work practices and organisational change, when an on-premise IT system migrates to the SaaS model?

This question draws on a deeper understanding of the theoretical and practical implications of the changes in IT workers' roles and skill sets requirements and the overall changes in the functions of IT departments. More specifically, as discussed in Section 2.4, this question employs sociomateriality thinking (Orlikowski, 2007) to understand how the interaction between human and technology affects work practices and whether it influences organisational change. More specifically, this study employs a sociomateriality lens to examine the level at which human and technology interact. The case study research strategy is appropriate to analyse 'how' and 'why' research questions as adopted in this study because they deal with operational links needing to be traced over time, rather than common frequencies or incidences (Myers, 2011). Accordingly, a PSIC model guides this study in analysing empirical evidence drawn from interview questions to trace the trajectory of critical events, operational links and processes as an organisation moves from an on-premise IT system to the SaaS environment (Lyytinen & Newman, 2008).

Use of Theory in Interpretive Case Studies

Walsham discusses three uses of theory in interpretive case studies (1995b). First, a theory is used as an initial guide for research design and data collection. The theory creates a sensible theoretical basis to inform the topic and the approach of collecting empirical evidence (Walsham, 1995b). Second, a theory is used as part of an iterative process of data collection and analysis. Interpretive studies aim to preserve a degree of openness to the field data, and willingness to modify initial assumptions and theories, to form an iterative process of data collection and analysis. Third, a theory may become the final product of the research (Walsham, 1995b).

As discussed in Chapter 2, this study adopts the concepts of sociotechnical and structuration theories (Giddens, 1984; Orlikowski, 1992, 1993) to guide the research design and data collection by providing focused theoretical concepts for the study. Structuration theory helps to identify possible constructs and to formulate interview questions before commencing the data collection process. In addition, the PSIC model (Lyytinen & Newman, 2008) guides the data collection and analysis as an iterative process and provides a deeper understanding of critical events occurring during SaaS implementation. Also, this study employs the sociomateriality lens for providing a fine-grained understanding of the interactions the level at which human and material agencies interact.

Unit of Analysis

The unit of analysis identifies what constitutes a 'case', and the complete collection of data for one study of the unit of analysis forms a single case (Darke, Shanks, & Broadbent, 1998; Myers, 2011). The unit of analysis for this study is the project on migrating on-premise IT systems to the SaaS environment. The implementation project in the current study is defined as an organised activity within an organisation responsible for planning and implementing the SaaS email and calendaring system. The study conducts research within organisations in which the implementation process has taken place; this involved the introduction of SaaS system applications and structures to business processes, and institutionalisation of emergency structures into business activities. The primary data collection method is semi-structured interviews supported by evidence from other sources such as official meeting minutes and organisational and project documentation. The IS discipline is regarded as an applied field so providing a chain of research evidence and topic relevance are equally important considerations in this study (Klein & Myers, 1999). This study follows Klein and Myers' (1999) set of principles for conducting interpretive field research to ensure the quality in conducting the study.

Criteria to Establish Quality using the Interpretive Case Study Approach

Walsham (1995b) discusses three strategies for establishing quality when conducting interpretive case studies. These relate to the role of the researcher, interviewing techniques and reporting methods. The role of the researcher describes how interpretive researchers approach the task of accessing participants' interpretations, filtering them through their conceptual apparatus, and reporting a series of events back to the interviewees and other audiences (Walsham, 1995b). Interpretive researchers, therefore, need to understand their role in this complex human process. Two roles are identified as an outsider observer and involved researcher (Walsham, 1995b). Neither of these roles is seen as that of an objective researcher, for two main reasons. First, the collection and analysis of data involve researcher subjectivity (Myers, 2011; Walsham, 1995b). Second, questions posed to participants determine the scope of the answers collected. Third, the presence of the researcher influences the interpretations of participants via a 'double hermeneutic' process (Giddens, 1984). The advantages of the outside observer role include having no direct participants' stake in various interpretations and outcomes. Thus, participants are relatively frank, provided the researcher establishes a rapport of trust. However, the main disadvantages include that an outsider observer may not be present on many occasions, may not get a direct sense of what happens inside the case organisation or may be barred from access to sensitive and confidential information (Walsham, 1995b).

Walsham discusses that an involved researcher becomes a member or temporary member of the case organisation (1995b). The merits of this position include that the researcher will gain an inside view and potential access to sensitive information. However, three disadvantages can be identified. First, the researcher may be perceived as having a direct personal stake in views and activities, and participants may be more guarded in their responses as a consequence. The second disadvantage is that the researcher may not be considered as a typical employee and thus not a total insider, and might not be allowed to confidential issues. Third, the researcher faces the difficulty of reporting the part they have played. Self-reporting faces twin dangers of over-modesty and self-aggrandisement; it is hard to achieve the middle ground between these extremes (Walsham, 1995b). As discussed earlier, this study adopts the role of an outside observer during data collection. Thus, interviews are the primary source of interpretation of participants' views on the actions, processes, and events involved in the phenomenon under investigation (Walsham, 1995b).

Walsham (1995b) outlines two main concerns about interview techniques for interviewers. The first is finding the balance between excessive passivity and over-direction. Excessive passivity occurs when a researcher is too passive and does not prompt with follow-up questions when the interviewee takes new directions or does not offer their ideas, which may have some negative consequences. In contrast, over-direction occurs when the interviewer directs the interview too closely and refuses to allow interviewees to express their views; hence, the data obtained lose much of the richness of interpretation that is the raw material of interpretive studies (Walsham, 1995b). The researcher of the current study observes these extremes when conducting semi-structured interviews. The second concern relates to recording media when capturing participants' interpretations (Walsham, 1995b). Two methods commonly used are audio-recording and note-taking. Audio-recording provides full descriptions of what was said, whereas note-taking is partial. However, there are disadvantages to audio-recording, including that the participant might be inhibited by the presence of the recording device, particularly in the case of confidential information; also, there are costs associated with transcribing audio recordings. The current study uses audio-recording supplemented by note-taking where appropriate.

Interpretive researchers are not reporting facts from a field study; instead, they report their interpretations of participants' interpretations (Walsham, 1995b). Thus, to establish credibility with the reader, this study reports in detail on how the results were handled during the data collection and analysis (Walsham, 1995b). Reporting of data collection includes profiles of the chosen cases; the reason for the choice and the number of participants interviewed. Data analysis includes how the field interviews and data were recorded and analysed, and how the interactive process between field data and theoretical lenses took place (Walsham, 1995b).

Choice of Sector and Case Selection

IS researchers suggest the sector for study should be chosen to provide an interesting contextual background that is likely to produce rich and significant activities about phenomena under investigation (Pettigrew, 1990). As indicated earlier, large organisations for which IT may not be their core functional systems, such as tertiary institutions, have embraced the use of the SaaS model because in these institutions, migrating to SaaS affords them the ability to provide improved real-time collaboration and research capabilities, and an opportunity to cut IT costs while providing a higher standard of computing services. The SaaS model allows institutions to use the resources of commercial cloud service providers, many of which are available either free or at reduced cost compared to similar on-premise IT systems (Wyld & Juban, 2010). With the SaaS model, students and faculty staff can take advantage of the ability to work and communicate from anywhere and on any device using SaaS applications. For example, Google and Microsoft offer the SaaS systems GAE and O365 for free or at low cost respectively, compared to on-premise IT system. Tertiary institutions adopting SaaS systems hosted by Google Apps and O365 include over 4,000 colleges and universities in over 80 countries worldwide, and numbers are still growing (Wyld & Juban, 2010). The benefits for tertiary institutions relate to the scalability and economics of the SaaS model. Scalability refers to the ability of a system to acquire dynamically or release computing resources on demand, thus bringing supercomputing to the mainstream of research centres. With respect to economic responses to challenging budgetary times, which have been forecast to persist across the education sector for the next few years, there will likely be even greater pressures on higher academic institutions to replace on-premise IT systems with free or low-cost SaaS alternatives (Wyld & Juban, 2010). Additionally, by switching to hosted email and productivity SaaS systems, the jobs and focus on IT workers can be changed. For example, Timothy Chester—CIO for Pepperdine University, which has partnered with Google—observed that his smaller IT staff could be more productive: ‘We want our staff working more with students and faculty and less on the nuts and bolts of delivering technology’ (Caplan, 2009, p. 1). Wyld and Juban assert that tertiary institutions may even become ‘server-less universities’ (p.4), by outsourcing almost all of their IT functions and all data storage and handling. This could be a viable proposition for tertiary institutions, especially when SaaS offerings expand and become more secure and reliable (2010). In the New Zealand context, the SaaS model has been embraced by most tertiary institutions, which have replaced their on-premise IT systems. The following criteria were used for case selection in the New Zealand context to gain interesting contextual background likely to produce rich and significant activities based on theoretical and practical selection criteria.

3.5.3 Case Selection Criteria

Theoretical case selection criteria and practical constraints guide case selection in the present study. Theoretical criteria ensure that concepts and constructs of the theoretical lenses guiding this study are examined, and practical considerations constrain the type and number of cases (Pettigrew, 1990).

Theoretical Case Selection Criteria

Cases may be chosen to fill theoretical categories and provide examples of polar types (extreme ends with significant changes) that are likely to contribute to the trustworthiness of the study (Patton, 2002; Pettigrew, 1990). To represent the diversity of various kinds of SaaS systems and ensure trustworthiness of the study, cases were selected based on having an on-premise email system that had migrated to a similar SaaS email system (e.g. GAE or O365) from among tertiary institutions in New Zealand. This study thus selects cases that have the following features:

- Tertiary education institution based in New Zealand that moved an on-premise IT system to the SaaS model. (Tertiary institutions have similar objectives of using IT systems for enhancing teaching and learning.)
- The on-premise IT system was related to email and calendaring with collaboration tools.
- The adopted SaaS model is a commonly known strategic SaaS service types, such as GAE or O365.
- The project had been implemented not more than three years previously, and the new system should be live and running.

- The project involved the migration of email systems that host the information of students, staff, or both user categories.
- Also, moving the on-premise IT system to the SaaS model had a clear business purpose and provided potential business benefits for the organisation.
- The institution should have at least 9000 students and 1000 staff to benefit from the use of the SaaS model.

Practical Case Selection

Selecting cases must be done to maximise what can be learnt in the period available for the study. The IS literature recommends 4–10 case studies for practical reasons including time available to spend in the field and managing the complexity of cases (Eisenhardt, 1989). According to Eisenhardt (1989), four cases provide a sufficient chain of empirical evidence to make the study trustworthy. Selecting more than 10 cases increases complexity in managing them and might lead to inadequate depth in within-case analyses. For that reason, this study chooses four cases to ensure manageability and to provide sufficient cases to support theoretical consistency, and provide enough data for the trustworthiness of the results (Pettigrew, 1990; Walsham, 1995b). For practical reasons, this study selects cases from two New Zealand cities, namely Auckland and Hamilton. Auckland is where the researcher is based, which minimised travel expenses. In addition, Auckland is a commercial hub in which many tertiary institutions are located. Hamilton is selected because of its proximity to Auckland. Other practical considerations included:

- Approval for access to the institution had been granted.
- IT workers or managers were available for interview.
- At least one IT worker was involved in supporting the on-premise IT system that preceded the SaaS model.

- The on-premise IT system had migrated to the SaaS model and had been in operation for three months but no more than three years. This period ensures that all operational challenges and configuration issues have been resolved, and participants have had sufficient time to process and recall support and operational events.

Overview of Case Identification

Based on the above theoretical and practical case selection criteria, the researcher in the current study scanned through New Zealand tertiary institutions' websites to establish which email and calendaring systems they use. For example, some institutions have published stories on their websites about moving their email and calendaring system to a SaaS-based system. Other institutional websites provide detailed user guides on how to access their new SaaS-based email system. Other information sources included staff and fellow doctoral candidates encountered by the researcher at New Zealand Information Systems Doctoral Conferences, who discussed the adoption of SaaS email systems by their institutions. Following these leads, the researcher requested friends and colleagues based in these potential institutions to act as 'gatekeepers' (Myers, 2011, p. 143). Each gatekeeper introduced the researcher to a key contact person working in the IT department within the organisation. Informal emails were sent, and these were followed by phone conversations with a key person to arrange an initial meeting with the objective of discussing the profile of the project and establishing if meets the theoretical and practical selection criteria as discussed above. After the researcher got the permission for the interviews to take place with the main participants, then interviewees obtained the Participant Information Sheet (Appendix B), according to the Auckland University of Technology Ethics Committee guidelines and procedures on the Respect for Rights of Privacy and Confidentiality. The researcher contacted eight tertiary institutions, four of which dropped out either because they did not meet the selection criteria or because the IT personnel within the institution were unavailable or unwilling to proceed with interviews. Of the four institutions selected (codenamed ALPHA, BETA, CHITA and DELTA) three migrated to GAE and one to O365. Although the institutions migrated to two different SaaS service providers, the systems are very similar—both being an important SaaS service type operating in a managed virtual layer—and both met the theoretical selection criteria. Table 3-4 provides a summary of cases, the reason for their selection and the purpose of their inclusion.

Table 3-4

Case Selection Criteria and Purpose

Case name	Selection criteria	Purpose of their inclusion in this study
ALPHA	Multiple on-premise email systems migrated to a single GAE	Examine changes in IT workers' roles and skill sets, and functions of the IT department and develop tentative theoretical issues
BETA	Multiple email systems consolidated into a single on-premise system and then moved to GAE	Confirm changes in the functions of the IT department in on-premise *vs*. SaaS systems
CHITA	On-premise email system moved to O365	Extend changes in IT workers' roles and skill sets, and functions of the IT department from the perspective of the other SaaS provider
DELTA	On-premise email system moved to GAE	Examine effect of SaaS adoption from another perspective Verify theoretical consistency and provide chain of empirical evidence

ALPHA was faced with various IT infrastructural and resources challenges involved with consolidating various on-premise IT systems running faculty calendaring, timetabling, and resource scheduling to meet the need for faster and more flexible research; and real-time collaboration tools. As part of the solution to these challenges, the institution embarked on a project to migrate its entire email and calendaring system from its on-premise IT systems (client–server architecture) to GAE. The GAE package includes email, calendaring, document processing, collaborative tools, and storage.

Following this migration, there were noticeable changes that had some theoretical significance for the objective of this research.

Faced with similar challenges, BETA migrated part of its on-premise IT email system (for students) to the GAE package, whereas the other email part (for staff) is still managed as an on-premise IT system. At this organisation, the email system is a complex mix of on-premise and SaaS email services. CHITA provided valuable input from a different perspective, and DELTA helped to verify theoretical consistency from other studies and provide a chain of empirical evidence. Details of case profiles are provided in the data analysis Chapters 5–8. These cases display ideal theoretical and practical characteristics to fulfil the main objectives of this study. First, they enable building an understanding of the migration process of an on-premise IT system to the SaaS model; and second, they allow an investigation of why the migration process alters the roles and skill sets requirements for IT workers and the implications of this for the functions of the IT department. Finally, the cases help is to explain how IT workers interact with these technologies from a sociomateriality perspective.

3.5.4 Selection of Participants

The IS literature indicates that selection of participants (also known as interviewees, informants or subjects) should be based on theoretical, not statistical criteria (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). Participants should be chosen based on their ability to contribute their insights and experiences of phenomena under study. Miles and Huberman (1994) refer to this approach as 'purposeful sampling'. In each case, this study selected at least one IT worker involved in supporting the on-premise IT system that was moved to the SaaS model. The use of this criterion was necessary to gain empirical evidence from the experiences of a person involved in both systems. Table 3-5 provides a list of the participants. IT workers were selected for the interview on the basis that:

- They participated in supporting the email system, have special roles and skill sets, and offer insights into technical aspects of the project that cannot be provided by another person supporting another system.
- Investigating changes in these roles and skill sets requirements formed the key foundation for answering the research questions.

Table 3-5

Case Participants Interviewed

Case name	Participant (code)	Position description	Interview time (min)	Mode of interview	Data capture mode
ALPHA	PA-1	IT manager	80	F2F	R & T, FN
	PA-2	Exchange/SaaS engineer	180	F2F	R & T, FN
	PA-3	Exchange/Linux engineer	90	F2F	R & T, FN
	PA-4	IT technician	60	F2F	R & T, FN
BETA	PB-1	IT manager	180	F2F	R & T; FN
	PB-2	IT manager	60	F2F	R & T, FN
	PB-3	IT technician	60	F2F	NR, FN
	PB-4	Systems engineer	45	F2F	NR, FN
	PB-5	IT technician	30	Ph	NR, FN
CHITA	PC-1	Exchange/SaaS engineer	120	F2F	R & T, FN
	PC-2	Systems engineer	60	F2F	R & T, FN
	PC-3	IT technician	60	F2F	R, FN
	PC-4	IT manager operations	60	Ph	NR
DELTA	PD-1	Exchange/SaaS engineer	180	F2F	R & T, FN
	PD-2	IT technician	60	F2F	R, FN
	PD-3	IT technician	120	T	NR
	PD-4	IT manager	30	F2F	NR, FN
Total cases = 4	17	Managers = 5 Engineers = 6 Technicians = 6	1475	F2F= 14 Ph = 3	(R&T) = 9 (R) = 4 (FN) = 14

Key: F2F, face to face; Ph, telephone; R, recorded; T, transcribed; NR, not recorded; FN, field notes

- Examining the differences in roles and skill sets requirements for supporting on-premise IT systems and SaaS model helped the researcher to scrutinise corresponding implications for the functions of the IT department.

Where applicable, IT managers were interviewed first to gain an overview of three key areas guided by the theoretical lenses. The first was the SaaS adoption environment (pre-SaaS narratives) including IT infrastructure (structure of IT), challenges faced by the organisation from both internal and external structures. The second area was the SaaS application process (narratives of SaaS applications) of migrating the on-premise IT system to the SaaS model and how SaaS structures were applied to business processes. The third area described implications following SaaS adoption (narratives of SaaS in use) of changes in roles and skill sets requirements for IT workers and any effects of this on the functions of the IT department. In the same manner, IT workers narrated their technical insights and experiences of managing on-premise IT systems, the migration process and descriptions of the changes, implications, and challenges of supporting the SaaS model compared to the old system. The following sections explain the data collection methods and data analysis strategy.

3.5.5 Data Collection Methods

The data collection procedure involved visiting case sites and collecting empirical evidence from multiple sources, which adds trustworthiness and authenticity to the findings (Pettigrew, 1990). This study collected empirical data through semi-structured interviews and documentation and then analysed the data using the PSIC framework.

Semi-Structured Interviews

The primary method of collecting empirical data was semi-structured interviews. Semi-structured interviews followed the pre-designed plan, using semi-structured interview questions to allow collection of in-depth insights from participants. The researcher interviewed IT workers and IT managers involved in managing on-premise IT systems and migration to the SaaS model. Semi-structured interviews are used when the researcher knows what needs to be asked but is unable to predict the answers (Patton, 2002). The semi-structured interview technique is useful because it ensures the researcher can obtain all the information required and at the same time give the participant freedom to respond and illustrate concepts and describe processes (Myers, 2011). Initially, potential participants were identified through their organisation's website, or friends, and then emails were sent to request the opportunity to have a one-on-one interview. The email included an attachment of the Participant Information Sheet (Appendix B). Follow-up phone calls were made to confirm appointments and schedule the interview date, time, and venue. Interview questions were formulated to cover the issues identified in the literature and chosen theory (Table 3-6).

Table 3-6

Theoretical Concepts Guiding Data Collection and Providing Focus

	SaaS implementation environment (Pre-SaaS narratives)	**SaaS application process (Narratives of SaaS applications)**	**Implications of the SaaS adoption (Narratives of SaaS in use)**
Focus of interview questions (Appendix D)	• Influence of existing technological and organisational structures • Why on-premise IT system had to move to SaaS model? • Any existing economic, technological and personnel issues? • Refer to interview questions no: 1–16 (IT workers) and no:1–6 (managers)	• How organisational and SaaS structures were institutionalised into business processes, and bring about emergent structures • How emergent structures affected IT infrastructure, IT workers 'roles and IT governance • Refer to interview questions no: 7–11 (IT workers) and no:7–10 (IT managers)	• Examines organisational and technological changes after SaaS model implantation • Any changes in roles of IT workers and how SaaS was supported compared with the on-premise IT system • Refer to interview questions no: 12–15 (IT workers) and no:11–15 (IT managers)

Chapter 2 and the concepts of structuration theory (DeSanctis & Poole, 1994; Giddens, 1984; Orlikowski, 1992; Orlikowski & Robey, 1991) and PSIC (Lyytinen & Newman, 2008) guided the formulation of interview questions. Patton (2002) and (Myers, 2011) provided useful information on how to formulate interview questions. Patton (2002) in particular provided detailed advice on how to formulate open-ended questions and how to conduct qualitative interviews. The objective of gathering responses through semi-structured interviews with open-ended questions was to capture participants' raw reality, that is, to reveal participants' depth of emotions, the way they have organised their world (ontology), their thoughts about what was happening, and their experiences and basic perceptions (Patton, 2002).

Appendix D provides details of the main interview questions, excluding follow-up questions that came up during the interviews. In collecting the narratives, the study conducts the 'interviews as a drama' (Myers & Newman, 2007) and as a model of a social encounters (Holstein & Gubrium, 1997). From the drama perspective, the researcher paid much attention to the entry and exit, the location of the interview, appearance and appropriate dress code, status and cultural aspects. Interview scripts of semi-structure questions were constructed to allow free flow of opinions and reflections of the participants' life world experiences before, during, and after the implementation of the SaaS system (Myer, 2011). The objective of the interview was to create texts by asking questions about various implementation stages of the SaaS model (Table 3-6). This method of questioning helps to obtain a story through participants' words by capturing events and processes and focusing on what happened, when and why (Myers & Newman 2007). In this way, the interview process seeks to capture the authentic lived experiences of participants in their social setting (Patton, 2002).

During the interviews, I was aware of some potential pitfalls common in qualitative interviews (Myer & Newman 2007) and made corrective measures to address them. One pitfall was the artificiality of the interviews because I was interrogating participants who were complete strangers. Also, I was asking them to share their opinions on scheduled time; this might have brought a sense of pressure on participants (Myers & Newman, 2007). However, I endeavoured to create a relaxed environment and put participants at ease when narrating their stories. The other pitfall relates to elite bias: by interviewing only certain participants of high status, as it is possible to miss deeper insights of the broader situation. The literature cautions about the bias introduced in qualitative research by interviewing the elite, articulate, well-informed, and usually high-status participants in an organisation, and under-representing data from less articulate ones (Miles, 1979). This study uses a variety of participants at different levels of the organisation to mitigate any elite bias. In particular, the focus of this study is to obtain experiences of IT workers and IT managers involved in IT systems implementation and support, before and after the SaaS model. The final pitfall, the Hawthorne effect, occurs when interviewers intrude into the social setting and potentially interfere with participants' behaviour and opinions (Miles and Huberman (1984)). The current study incorporated multiple participants and focused on common events to gain a broader perspective of the study, to mitigate the Hawthorne effect.

Three academics experienced in qualitative research on IS implementation and organisational change reviewed the interview questions. Minor changes were made to refocus the interview questions. One–on-one interviews were conducted with 17 participants from four case organisations. For each case, the number of interviewees was determined based on reaching 'theoretical sufficiency' (Glaser & Strauss, 1967, p. 61) of empirical evidence and availability of IT staff who participated in SaaS implementation process and support.

Documentation

Organisational documentation includes policies and procedures, annual reports, press releases, minutes of meetings and project documentation. The present study used documentary evidence to supplement the data provided by interviews. Four criteria were used to assess the quality of documentary evidence used in the study: authenticity (Is it genuine and of unquestionable origin?), credibility (Is it free from error and distortion?), representativeness (Is it typical of its kind and if not, is the extent of this known?) and meaning (Is it clear and comprehensible?) (Myers, 2011). Other sources included publicly available data from institutions' official websites and system documentation of both on-premise IT systems and SaaS systems, including online documentation for the GAE and O365 systems.

3.5.6 Data Analysis Strategy

Although a clear distinction between data collection and data analysis is commonly made, this distinction is problematic for interpretive research (Myers, 2011) because the meaning is actively constructed during the data collection. This has a significant effect on the choice of analysis. The purpose of the data analysis strategy was twofold. First, it sought to identify critical events that occurred during SaaS implementation, through an inductive data coding analysis strategy from the raw data (obtained from the interviews and organisational documentation). Second, following the PSIC model (see Section 3.7), the critical events were analysed to determine associated changes in the sociotechnical environment of both the work and building systems (Lyytinen & Newman, 2008). In multi-case study research, the identification and analysis of critical events involve two phases: within-case analysis, whereby each case is analysed independently of the others; and cross-cases analysis to identify commonalities and differences between cases and establish the relationship between the outcomes, and hence provide answers to the research questions.

Within-case Analysis

The goal of the within-case analysis is to describe, understand, and explain what happened in the single, bounded context represented by the case (Miles, Huberman, & Saldaña, 2014). More specifically, the purpose of individual case analysis is to gain in-depth insights of processes and outcomes observed within the local conditions. Following the PSIC model, the within-case analysis treated each case as an independent unit for identification and analysis of critical events. Chapter 4 provides an overview of cases and definition of key terms in the PSIC visual map analysis method. Chapters 5–8 discuss the within-case analysis, and the cross-case analysis is presented in Chapter 9.

Cross-case Analysis

The purpose of the cross-case analysis is twofold. First, it enhances the theoretical persuasiveness of the phenomenon and understanding of the relevance of findings, to transcend the particular and provide a chain of evidence and trustworthiness (Miles et al., 2014). The second reason for undertaking cross-case analysis is to deepen understanding and explanation of how critical events unfold, and how these conditions could be related (Miles et al., 2014). The cross-case analysis involves compiling and contrasting data from all cases by examining the results for each case and then observing the pattern of results across the cases, to provide the credibility of findings based on the empirical data (Patton, 2002). The cross-case analysis undertaken in the current study is presented in Chapter 9 to answer the research questions and build theoretical persuasiveness to explain the phenomenon under study.

The following sections discuss two steps taken in the current study for data analysis. The first involves identification of critical events through the general inductive data analysis procedure, and the second involves the PSIC process of analysing the critical events.

Identification of Critical Events

Lyytinen and Newman (2008) caution that the most challenging part of understanding the IS implementation process is to identify critical events that occur during the implementation. In previous IS studies, the identification of critical events was based on narrative data analysis (Pentland, 1999; Tan & Hunter, 2003) and principles of the hermeneutical circle (Klein & Myers, 1999) when analysing the data. This study adopts a general inductive approach (Thomas, 2006), which is a more methodical data analysis process for critical event identification. This general inductive procedure for qualitative data analysis is described by Miles et al. (2014) and Thomas (2006) and uses the GT coding principles discussed by Glaser and Strauss (Glaser, 1978; Glaser & Strauss, 1965).

Glaser and Strauss define GT as ‘the discovery of theory from data systematically obtained and analysed in social research’ (Glaser & Strauss, 1967, p. 1). That is, the theory produced is grounded in the data through a coding process (Urquhart, 2012). However, various coding processes have been developed for qualitative data analysis. These processes provide a different perspective when examining qualitative data. For example, *template analysis* (King, 2012), *analytic induction*, *schema analysis* (Ryan & Bernard, 2003) and GTM (Urquhart, 2012) analyse qualitative data differently. Template analysis is a technique of thematic analysis that balances a relatively high degree of structure in the process of analysing textual data with flexibility to adapt it to the needs of a particular study (King, 2012). However, the template analysis approach allows the researcher to define some themes in advance (King, 2012), which is not the approach envisaged for this study. Analytic induction is a formal non-quantitative method for building up causal explanations of a phenomenon by examining a series of cases (Ryan & Bernard, 2003). This approach follows a series of steps, such as defining phenomena that require explanation and proposing explanations. The next step involves examining a case to determine if the explanation fits, and is followed by another case (Ryan & Bernard, 2003). Ryan and Bernard add that this process continues until a universal explanation of all known cases of a phenomenon is attained (2003). This method is inappropriate for the current research, which does not propose explanations of the answers to the research questions. Schema analysis combines elements of linguistic and sociological traditions based on the idea that people must use cognitive simplifications to help make sense of the complex information to which they are constantly exposed (Ryan & Bernard, 2003). From a methodological view, schema analysis is similar to GT, as they both begin with a careful reading of verbatim texts and seek to discover and link themes into theoretical models (Ryan & Bernard, 2003).

The GTM produces GT (Annells, 1996). GTM builds theory from the data acquired from fieldwork interviews, observation and documents (Charmaz, 2001). The data sources are qualitative, and the use of qualitative data fits with the inductive process in which GTM is rooted (Urquhart, 2012). Here GTM is inductive refers to the analysis that continues from the ground up—from specific empirical evidence in the data to more general conclusions (Urquhart, 2012). These approaches use similar techniques of code development from texts before describing further sociotechnical implications of a phenomenon under study. The techniques associated with coding development include the sampling of data, identification of themes, core theme building, and theoretical coding or labelling of texts. However, King (2012) cautions that descriptiveness of data coding may lead to a loss of participant voices in the analysis of aggregated themes. In particular, over descriptiveness in interpretive research happens during theme building, where the researcher's intuition, background and life experience contribute to the outcome of the interpretation and description of themes. With this caution in mind, the current study adopts a general inductive approach (Thomas, 2006), utilising GTM and principles of hermeneutic circles (Klein & Myers,

1999) as a data coding strategy. In particular, the study applies the steps of the coding process discussed by Glaser (1978)—open coding and selective coding—to identify critical events from the raw data.

Open Coding

Inductive coding begins with a closer reading of the text by examining the meaning or multiple meanings inherent in the text or raw data (Thomas, 2006) and attaching initial labels to the data (Glaser, 1978). The current study applies the principle of hermeneutic circles for an in-depth understanding of the meaning inherent in the text (Myers, 2011). As discussed earlier, applying inductive coding principles along with other qualitative data analysis techniques, such as hermeneutic circles, is acceptable in an inductive coding strategy (Urquhart, 2012). Inductive coding principles ensure that researchers make their allocation of concepts to data explicit to themselves and, more importantly, that the allocations are compared to the data as a whole, by applying the principle of hermeneutic circles (Urquhart, 2012). The codes are subsequently grouped into broader codes relevant to the research objective (Figure 3-2). The researcher then identifies text segments that contain meaningful units and creates a label for a new theme to which the text segment is assigned.

Selective Coding

Selective coding is the process of grouping themes into core themes, and in which coding is limited to themes that relate to the core theme (Glaser, 1978). Urquhart discusses that the point at which selective coding occurs is when no new open codes are suggesting themselves, and specific themes are emerging (2012). Themes become saturated at this stage. Otherwise, the same themes are repeated (Urquhart, 2012). Additional text segments are added to the core themes to which they are relevant. The detailed steps of the data analysis strategy used in this study follow a PSIC visual map analysis (discussed in Section 3.7.2).

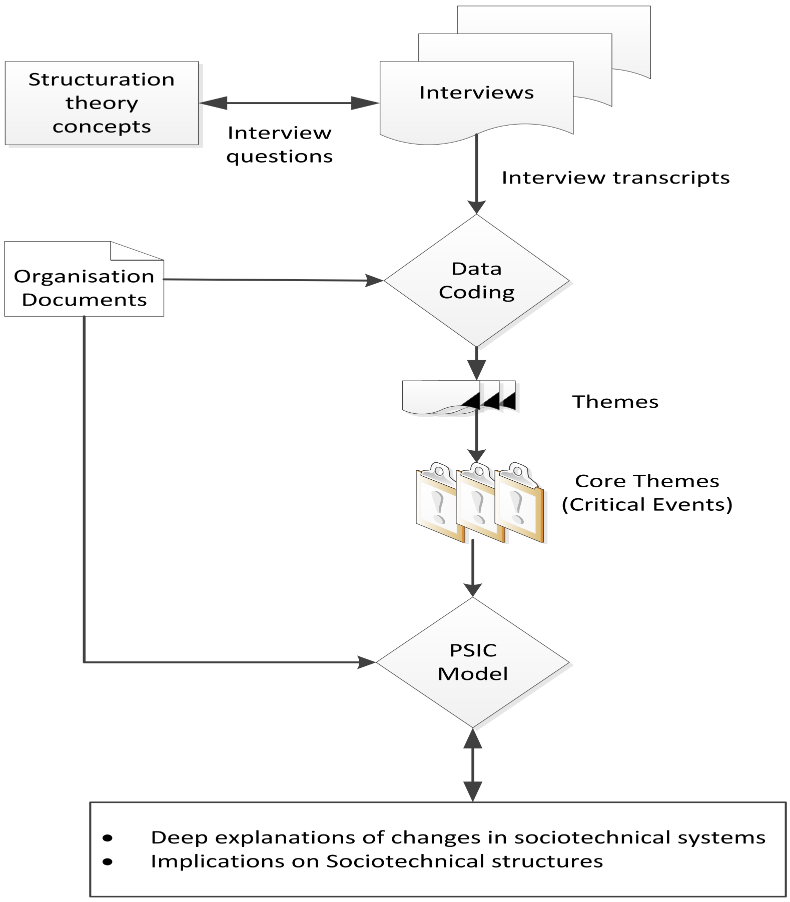


Figure 3-2. Overview of the data analysis process.

3.6 Data Coding and Interpretation

There are reasons for using a general inductive coding approach to harnessing the strengths of GTM (Urquhart, 2012). First, GTM is an appropriate technique for analysing data on emerging phenomena. Second, the GTM coding procedure is a well-known and reliable method of coding data without necessarily labelling it as pure GTM. Third, the GTM process is not fully followed; rather, GTM procedures are consciously and deliberately combined with other methods (Urquhart, 2012). For example, researchers may decide to combine GTM with other concepts from the literature, such as hermeneutic circles (Sarker, Lau, & Sahay, 2000) or action research cycles (Baskerville & Pries-Heje, 1999; Lings & Lundell, 2005). Thus, the adapted general inductive process in this study uses some principles of GTM and hermeneutic circles for coding and analysing the data items collected through semi-structured interviews. Figure 3-3 provides an overview of the coding process adapted in this study.

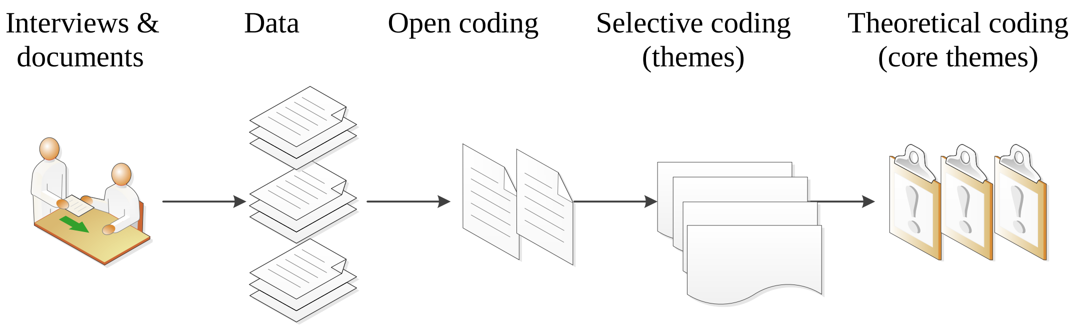


Figure 3-3. Overview of general coding process (Baskerville & Pries-Heje, 1999).

3.6.1 General Inductive Approach

The general inductive coding approach follows data coding procedures similar to the GTM procedures of *open coding*, *selective coding*, and *theoretical coding* (Glaser, 1978, 1992). Open coding involves working through the data text (usually line by line or paragraph by paragraph), attaching codes to the data items and remaining open to what the data might be describing next (Urquhart et al., 2010). Thus, the open coding process involves identifying potential themes by collecting appropriate data items. A data item is a section of conversation, text or other data—such as project documentation or an interview transcription—that share meaning with another section (Ryan & Bernard, 2003). The meaning is given a descriptive name, called an 'open code' or 'code', which is a label relevant to the objective of the research (Urquhart, 2012). Each code is defined uniquely with respect to all other codes in the study (Glaser, 1978). The open codes are then grouped into themes or categories in the stage of selective coding by key themes that shape the theoretical and practical aspects of the phenomenon under study (Urquhart, 2012). Finally, during theoretical coding, the themes are re-grouped to form core themes relevant to the study. From a GT perspective, the outcome of an inductive analysis is the development of core themes into a model or a framework that summarises raw data and conveys core themes and processes. However, the objective of this study is not theory building; rather it is providing in-depth explanations of most important themes providing answers to the research questions of this study. Themes resulting from coding have five key features (Thomas, 2006, p. 240). First, a label of the theme is a word or short phrase used to refer to the theme. The label carries inherent meaning that reflects the specific features of the theme. The second feature is theme description, which is a depiction of the meaning of the theme, including its key characteristics, scope, and limitations. Third, data associated with the theme are examples of text coded into the themes that illustrate meanings, associations, and perspectives related to the theme. Fourth, the theme may have links or relationships with other themes: when, why and under what conditions do these themes occur in the text? The last feature describes the type of model in which the theme is embedded; it is also possible that a model could not embed any theme. The general inductive approach is most similar to GT as indicated in Table 3-7.

Table 3-7

Comparison of General and Grounded Theory Qualitative Analysis

	General inductive approach	Grounded theory (Glaser, 1978)
Analytic strategies and questions	What are the core meanings evident in the text, relevant to research objectives?	To generate or discover theory using open, selective and theoretical coding
Outcome of analysis	Themes most relevant to research objectives identified	Theory that includes themes
Presentation of findings	Description of most important themes	Description of theory that includes core themes

Source: (Thomas, 2006)

The principles of hermeneutic circles assist with the identification of data items during the entire coding process (Klein & Myers, 1999).

3.6.2 Hermeneutic Circles

Interpretive data analysis methods assume that researchers cannot objectively analyse data items and assign codes of analysis to form categories or themes. Instead, interpretive approaches are concerned with the contextual circumstances that influence informants, as well as the researchers' interpretations and biases (Lacity & Janson, 1994). Interpreter bias is considered before understanding data items, and this is a distinguishing characteristic of interpretive approaches (Gadamer, 1993). Thus, interpretive methods seek to understand the phenomenon through an in-depth analysis of data items in context using analysis methods such as the principle of hermeneutic circles (Gadamer, 1977; Klein & Myers, 1999). Hermeneutics can be treated as both an underlying philosophy and a specific method of analysis (Myers, 2011). As a philosophical approach, it provides the philosophical grounding for interpretive research, and as a method of analysis, it is an approach to qualitative data analysis (Klein & Myers, 1999). This study is concerned with using hermeneutics as a method of analysing and interpreting qualitative data (Klein & Myers, 1999).

The aim of hermeneutics is twofold: first, it seeks to discover the exact translation of a text, and second, it intends to determine the instructions contained in the text (Lacity & Janson, 1994). To achieve this objective, Gadamer suggests the concept of a hermeneutic circle—that the meaning of a text is contextual and depends on the moment of interpretation and the experiences brought to it by the interpreter (1977). Gadamer adds that multiple iterations of a text are required to dispense with many preconceptions. Through the iterative process of reading and interpreting text material, a better understanding of an informant's intentions arises (Lacity & Janson, 1994). In addition to immersion into the deep interpretation of text, words, phrases or a section of conversation, these may be compared with other data items created by the same phenomenon in the study (Kögler, 1996). IS studies have used principles of hermeneutic circles in interpretive research (Boland & Day, 1989; Boland, Newman, & Pentland, 2010; Lee, 1994; Newman, 1988; Sarker & Lee, 2006). For example, Boland Jr and Day (1989) develop the experience of being an IS designer through a series of in-depth interviews with system analysts. Their study uses hermeneutic circles to disclose structures of meaning that were drawn upon during system implementation. Three dimensions portrayed the structures: ‘the experience of moving through and being located within the organisational space, the experience of interacting with others during the task of system dealing and the experience of making moral choices’ (Boland & Day, 1989, p. 87). Boland et al. (2010) describe six techniques that can serve as an entry point to the hermeneutic circle and open up the possibility for meaningful interpretations that can improve IS development. Lee provides an account of how richness occurs in communication that uses electronic mail (1994). By employing hermeneutics principles, Lee’s study finds that richness or leanness is not an inherent property of the electronic mail medium, but an emergent property of the interaction of the electronic mail medium with its organisational context (Lee, 1994). Newman discusses the hermeneutic principles of immersion and cross-comparison to understand user resistance to a university admissions system, as he analyses interview transcripts from users and systems staff (1988). Finally, Sarker and Lee illustrate the use of hermeneutic circles to understand the role of computer-based tools in business process redesign (2006).

The principles of hermeneutic circles help this study to identify data items, to attach descriptive meaning or code, and then to group codes into core themes, as I analyse responses collected through in-depth semi-structured interviews with IT workers and IT managers. The objective of identifying these themes is to determine critical events that occur when on-premise IT systems move to the SaaS model. Assisted by the PSIC model as a sensitising device, this study then conducts a detailed critical event analysis at three levels—punctuated, horizontal and vertical (Lyytinen & Newman, 2008). The outcome of this analysis provides in-depth explanations of the implications of SaaS adoption for IT workers’ roles, and skill sets requirements when an organisation moves an on-premise IT system to the SaaS model. The PSIC model is briefly discussed in the following section.

3.7 The Punctuated Sociotechnical IS Change Model

This section discusses the PSIC model, the justification for its use and how the model is used in data analysis. The study employs the PSIC model (Lyytinen and Newman, 2008) in explaining the complex IS implementation and organisational change. The PSIC model describes IS implementation and organisational change as multi-level and episodic change by drawing from theories of systems (Alter, 2002), episodic change (Lyytinen, Mathiassen, & Ropponen, 1996) and sociotechnical theories (Bostrom & Heinen, 1977). These theories narrate IS change as a process that creates and reconfigures elements and their relationship. IS change is now discussed as a multi-level and sociotechnical change in the context of this study.

IS change reconfigures a *work system* by embedding into it new IT components. Lyytinen and Newman define a work system as a ‘sociotechnical system that executes, coordinates, and manages information-related work activities’ (2008, p. 592). In this study, we regard the work system as the resources and functions of an IT department. Rigidity and high complexity characterise the work system (Alter, 2002) which means that IS change must be planned and managed through a *building system*. Here, the building system is a sociotechnical system that commands a set of resources and enacts routines to carry out change and address the issues of uncertainty, ambiguity and complexity (Lyytinen & Newman, 2008). Empirical data from the current research show that the building system was erected as a SaaS implementation project, and has been empowered to overcome resistance, obtain resources and legitimise the IS change (Lyytinen & Newman, 2008). Both work and building systems are embedded into a broader system, known as the organisational environment. This environment brings several factors that influence IS change at both systems levels. According to Lyytinen and Newman, the organisational environment has two parts: the inner or *organisational context* and the outer or *environmental context* (2008). An organisational context is the immediate organisational environment of the building system that includes the resource, authority, culture and political systems in which the IS change develops (Pettigrew, 1990). This study collects empirical evidence from New Zealand tertiary institutions as the organisational context of this research. The environmental context includes an organisation's social, economic, political, regulatory, and competitive environments that influence and are influenced by all other system levels (Lyytinen & Newman, 2008). The environmental context in this study includes regulatory bodies within the tertiary education industry. These bodies include the government's economic and political regulatory mechanism and the TEC, among others. In this research, the empirical evidence has not only been capable of establishing a SaaS implementation project trajectory but has also provided sound evidence to unpack interactions within all systems levels (Figure 3-4).

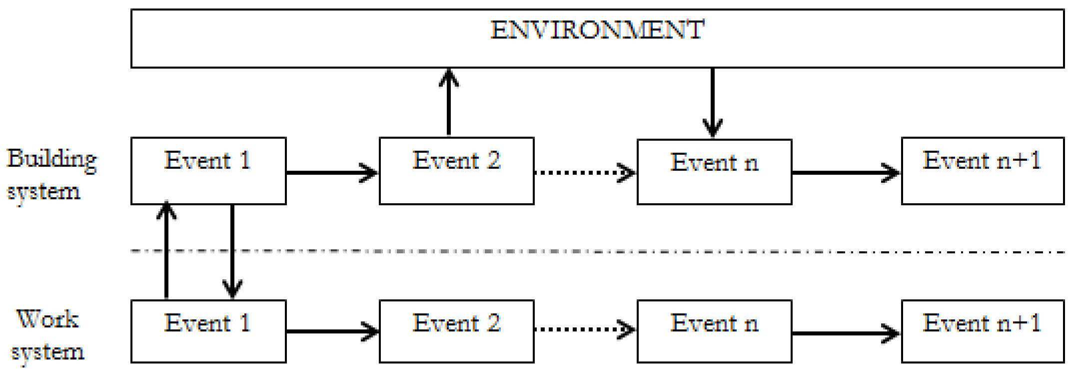


Figure 3-4. Multi-level IS change (Lyytinen & Newman, 2008).

Viewing IS change at multiple levels; the PSIC model accounts for punctuated, vertical and horizontal analyses. The vertical analysis captures interactions and interdependencies between different system levels (Lyytinen & Newman, 2008). It answers the question of how events or activities that occur on one level affect other levels. The horizontal analysis allows the tracking of horizontal and temporal interactions (Lyytinen & Newman, 2008) that capture the path dependencies of events within work and building systems. Horizontal analysis is carried out by analysing the following factors: first, what was done by the building system to generate the IS change; second, how the work system interacts with the building system and how it transforms itself over time due to these or other interactions; and third, the interactions between the work system, the building system and the environment. The PSIC model embeds Leavitt's sociotechnical diamond (Figure 3-5) as the engine to understand IS change (Keen, 1981).

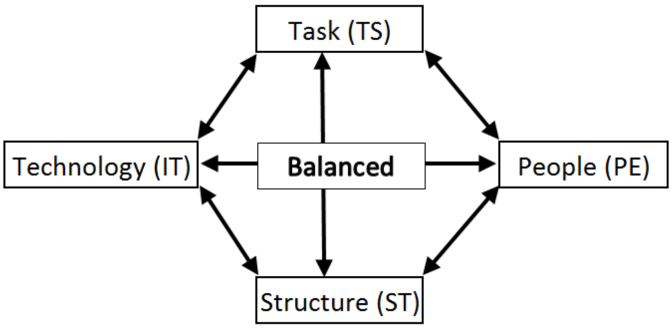


Figure 3-5. Sociotechnical framework (Keen, 1981, p. 25).

PSIC views organisational systems as multivariate sociotechnical systems of four interacting and aligned components. In this study, the components are represented as a task (TS), structure (ST), people (PE), and technology (IT). These four components make up the technological, social, organisational, and strategic cores of an organisation (Lyytinen & Newman, 2008; Scott Morton, 1995).

Sociotechnical systems during IS change are open, so they need to adapt continuously to their environment to maintain the system's stable state in which the four elements are mutually aligned in a balanced state (Lyytinen & Newman, 2008). If any one component becomes incompatible with others due to increasing variation (e.g. the replacement of an on-premise IT system by a SaaS system), this may result in a structural misalignment known as a 'gap' (Figure 3-6). Here, the gap is defined as 'a property of a system that affects the systems' behaviour and its repertoire of responses' (Lyytinen & Newman, 2008, p. 595), which may affect IT structural features, tasks (such as the roles of IT workers), people (such as IT worker and their skill sets requirements) and structure. The PSIC model embedded with Leavitt's technical diamond forms a visual map of the PSIC model (see Section 3.7.2). The visual map presents the analysis technique in three dimensions: punctuated, horizontal, and vertical (Lyytinen & Newman, 2008). Using these analyses, this study examines the properties of system gaps and incidents (Lyytinen & Newman, 2008).

3.7.1 Justification for using the PSIC Model

The PSIC model is important for several reasons. First, it examines sociotechnical change at multiple levels of the organisation's systems. Second, the analysis of performative actions and events is mapped onto types and classified according to the PSIC visual map into Leavitt's sociotechnical diamonds at multiple levels (Lyytinen & Newman, 2008). Third, the PSIC model rejects the 'closed boxing' of system's processes and focuses its investigation on critical events caused by imbalances of four components in the Leavitt's sociotechnical model. The non-restrictive nature of the PSIC model ensures that details of critical events are kept intact throughout the analysis timeline (Sabherwal & Robey, 1995). The fourth reason is that the model closely maps a clear picture of part of the real world (March & Olsen, 1975). Thus, the articulation of the PSIC model attempts to organise process data sets into a structured trajectory of process events, thereby improving our understanding of complex IS implementation and organisational change (Markus & Robey, 1988). Finally, the model depicts more closely the life experiences of subjects (Markus & Robey, 1988), and preserves details of shared meaning and events (Sabherwal & Robey, 1995).

For these reasons, this study employs the PSIC process model as a 'sensitising device' (Klein & Myers, 1999, p. 75) to explain complex IS changes and guide data analysis and data presentation (Lyytinen & Newman, 2008). In addition, the current study adopts the general inductive coding approach, utilising the GTM (Urquhart, 2012) and the principles of the hermeneutic circle (Myers, 2011) for data interpretation.

3.7.2 PSIC Visual Map Analysis

The main objective of PSIC process analysis is to map the trajectory of critical events and episodes of sociotechnical changes in multiple systems (Lyytinen & Newman, 2008). As shown in Figure 3-6, the analysis involves five steps. The first describes the overall IS change sequences of events as a narrative. The second analyses the building system and work system activities as interactions between four sociotechnical components (i.e., structure, task, technology, and people). The third uses the PSIC vocabulary to describe the overall process. The fourth analyses organisational contexts for interactions with central systems and the fifth combines Steps one to four and create overall process diagrams of the phenomena (Lyytinen & Newman, 2008). I discuss these steps in the context of migrating an on-premise IT system to the SaaS model (Figure 3-6). During the first analytical step, this study reconstructs the story (narratives) of the migration process of an on-premise IT system to the SaaS model (Pentland, 1999) and identifies antecedent conditions for critical events and episodes from participants' stories. The current study did not attempt to impose my views on the cases or in any identified differences in opinion among participants; these were maintained in the baseline description of events (Lyytinen & Newman, 2008).

The general coding analysis procedure and the principles of hermeneutic circles helped examine the texts resulting from the identification of critical events. As the number of critical incidents accumulates, data from multiple sources (interviews and documentation) are collated to build structured narratives in Steps two and three (Figure 3-6) and illustrated in Figure 3-7

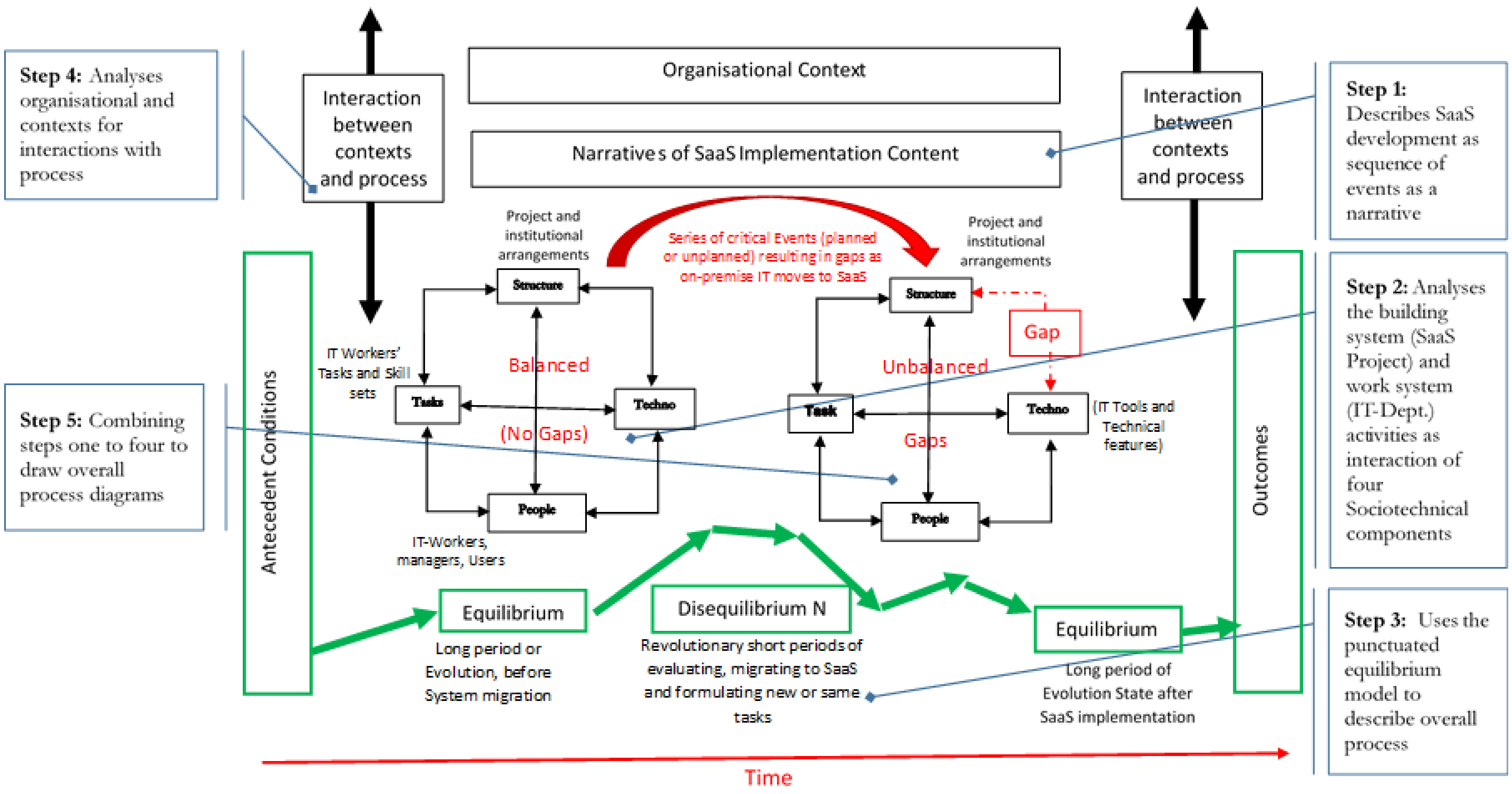


Figure 3-6. PSIC process analysis steps (Lyytinen & Newman, 2008).

At these stages, critical events and emergent structures are mapped and classified according to the PSIC model into technology, tasks, people, and structures of the sociotechnical diamond framework (Keen, 1981). Also, the study analyses new gaps (e.g. skill sets requirements and sociotechnical structures) and the interrelationships between events at multiple system levels in a hermeneutic fashion (Klein & Myers, 1999).

In particular, this study categorises events into parallel IT department level (work system) and project level (building system) events and identifies related organisational events to account for processes involved in moving an on-premise IT system to the SaaS model (as shown in Figure 3-7). Step four searches for evidence from organisational and competitive environments that influenced the migration of the on-premise IT system to the SaaS model. For example, pressure from staff and students might have created a demand for a more web-based system with some collaborative tools. The fifth analytical step builds a visual process diagram, the case study trajectory map (Figure 3-7), which highlights the trajectory of moving an on-premise IT system to the SaaS model for each case that resulted in a specific process outcome: the final stable SaaS business system running in the organisation. The building of these diagrams integrates the critical events (core themes) identified during the coding process. It also identifies gaps between components and analyses the interrelationships between the events discussed in the PSIC process analysis (Lyytinen & Newman, 2008). As a result, the study sorts events into work-level events (IT department), and project-level events in building system and organisational issues (at the institution level). The relationships among the four cases provide detailed narrative accounts of the migration process and identify the type of gaps in each. These accounts are then analysed and discussed to provide answers to the research questions posed in this study.

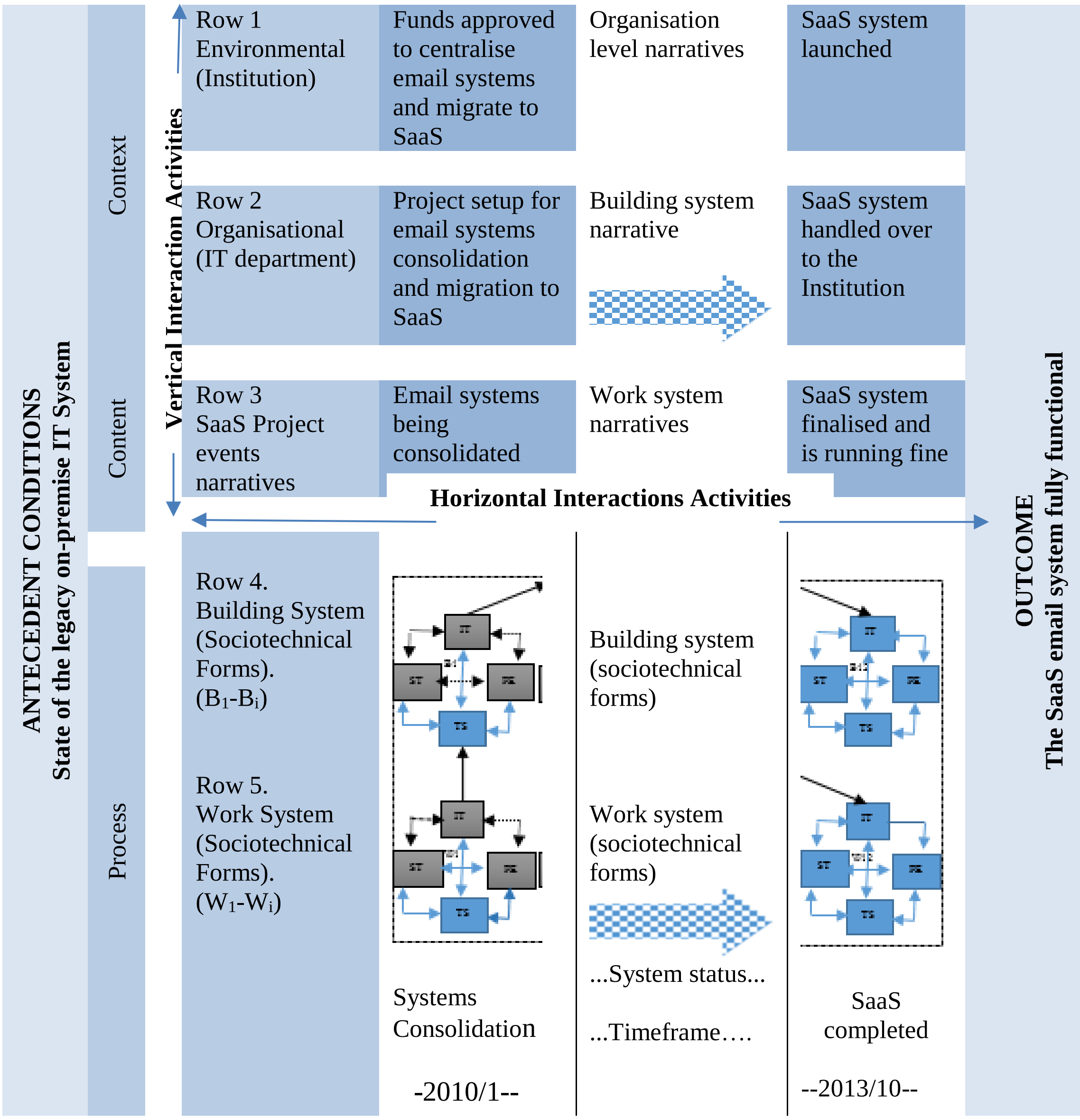


Figure 3-7. An exhibit of PSIC visual map analysis.

3.8 Chapter Summary

This chapter discussed the methodology adopted in this research. The current study adopts a multi-case study interpretive research approach. The selection of cases is based on theoretical and practical constraints. The study employs semi-structured interview questions for data collection, supplemented by documentation. The concepts of structuration theory and the PSIC model guide the research design, data collection and analysis. In addition, the principles of data coding and hermeneutic circles are used for data analysis within and across cases. The PSIC framework provides multi-level analysis of punctuation, horizontal and vertical narratives of SaaS migration that provides an account that is used to answer the research questions of this study.

Chapter 4: Overview of Case Studies

4.1 Introduction

Preceding chapters reviewed the literature and discussed the research design appropriate for this study. This research adopts a multi-case approach to collecting empirical data. The study collected data from four unique cases. This chapter presents an overview of the analysis of the empirical data based on the visual map of the PSIC model described in Figure 3-6. The visual map presents the analysis technique in each case in three dimensions: punctuated, horizontal, and vertical (Lyytinen & Newman, 2008). This study adopts analysis techniques that build an understanding of the migration process of an on-premise IT system to the SaaS model, and of the changes in the roles and skill sets requirements for IT workers, as well as the implications of this for the functions of IT departments and how IT workers interact with these technologies, by analysing critical incidents, gaps and their impact.

Figure 4-1 outlines the organisation of this chapter. Following this introductory section, the objective of each dimension of the analysis is discussed. The four cases are then introduced. Chapters 5 through 8 then examine each case separately according to the three dimensions of the visual map analysis.

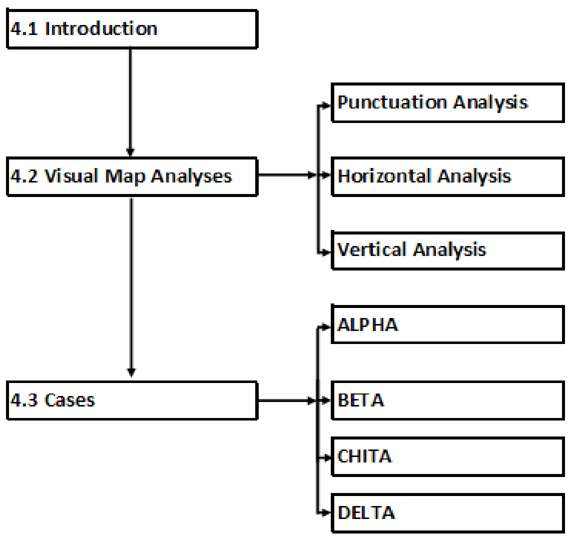


Figure 4-1. Flow chart of the main ideas in Chapter 4.

4.2 Visual Map Analyses

Table 4-1 presents the objective of each analysis. The punctuated analysis examines the gaps (G) and the responses (R) to these gaps, resulting in phases. The horizontal analysis focuses on critical incidents (I), which map into trajectories of the implementation process for the SaaS model. As shown in Figure 3-6, the horizontal dimension represents activities in environmental and organisational contexts and project activities over time (Lyytinen & Newman, 2008).

Table 4-1

Focus on Dimensions of Analyses

Dimensions of analysis	Punctuated	Horizontal	Vertical
Unit of analysis	Gaps (G) and responses (R)	Critical incidents (I)	Gaps (G)
Results of analysis	Phases	Trajectories	Themes

The vertical analysis describes gaps arising from critical incidents and resulting in themes. It also examines the context, content and gaps created by critical incidents, and capture the interactions and interdependencies between different levels of systems (Lyytinen & Newman, 2008). Table 4-2 defines the key terms used in these analyses, and the analyses are briefly discussed in the following sections.

Table 4-2

PSIC Analysis: Definitions of Key Terms

Key term	Description	Reference
Environmental context	The environment that includes the organisation's social, economic, political, regulatory and competitive environments and that influences and is influenced by all other systems during IS change	
Horizontal analysis	The process of analysing interactions at a single level, for example, development activities, work processes or organisational activities	Lyytinen & Newman, 2008, p. 613)
Organisational context	The immediate organisational environment of the building system that covers the resources, authority, culture and political systems in which the IS change unfolds	

Punctuation analysis	Sociotechnical elements and their interactions are reconfigured so that the system exhibits an entirely new range of responses and thus exhibits new emergent properties
Vertical analysis	A process of unpacking interdependencies between two consecutive system levels to explain IS change

The punctuated equilibrium model is used to analyse the responses to critical incidents (Gersick, 1991). The model describes that IS change possesses deep structure and passes through periods of *stability* or *equilibrium*, faces occasional *evolutionary* periods and embraces *multi-level explanations of change* (Lyytinen & Newman, 2008). Table 4-3 presents definitions of terms related to the punctuation analysis.

Table 4-3

Definition of Terms Related to Punctuation Analysis

Term	Definition	Reference
Critical incident	An event that results in a gap	
Event	Any change to the system state that can be observed	
Gap	A property of a system state that affects the system's behaviour and its repertoire of responses. A gap is any situation in the system that if left unattended will deteriorate the system's performance or threaten its long-term survivability	
Incremental change	Gradual and stepwise adaptation of one or several system components as a response to a gap	
Phase	A temporary period between punctuations	(Lyytinen & Newman, 2008)
Intervention	A planned measure was taken towards one or more sociotechnical elements at some system level to mitigate against an observed gap	
Sociotechnical punctuation	Reconfiguration of sociotechnical elements and their interactions so that the system exhibits an entirely new range of responses and thus exhibits new emergent properties	

Definitions of the other key terms in this study are provided in Appendix E. Figure 4-2 illustrates key constructs including the critical incident, gap, incremental change, punctuation and stability of an IS change. A critical incident (I) is an event that results in a gap (G). A gap is a property of a system that affects the equilibrium of four dimensions of the sociotechnical state of the system and its range of responses (Lyytinen & Newman, 2008). A gap invites two types of responses. The first is an incremental change in which sociotechnical components adapt incrementally as dictated by the system's deep structure with unexpected misalignments. Incremental change (R) does not result in a pronounced change, but rather in a gradual change of one or several system components as a response to a (G) gap (Gersick, 1991; Lyytinen & Newman, 2008). The second type is a punctuation response (G_i–R), in which the system rewrites its deep structure, thus changes the nature of the sociotechnical system, and precedes to a new phase (as shown in Figure 4-2).

The phase ends when another punctuation occurs, prompting the beginning of a new phase and so forth throughout the life of the sociotechnical system. Table 4-4 provides important abbreviations required in describing the type of incidents (I), gaps (G) and response to gaps (G_i-R) discussed in the chapters presenting individual case studies.

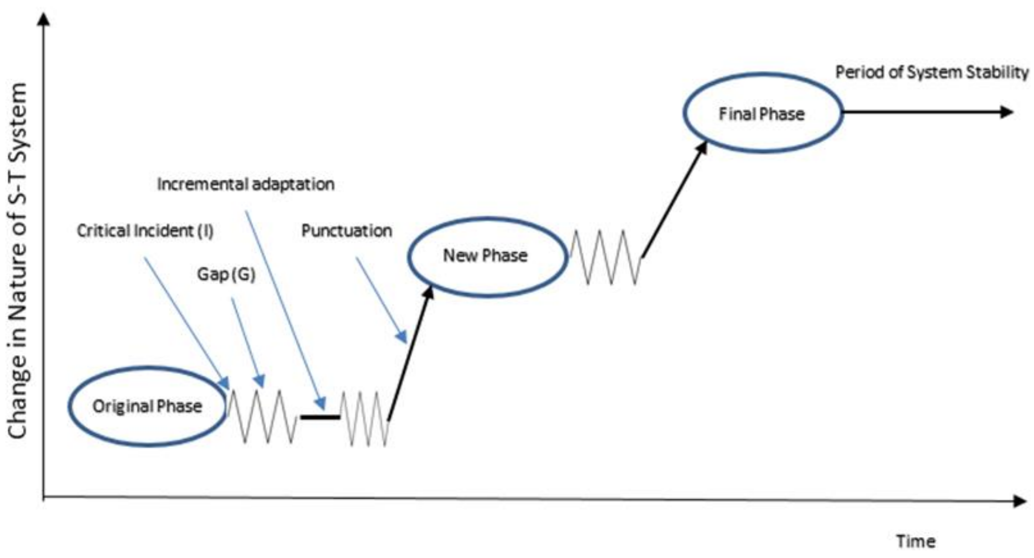


Figure 4-2. Illustration of incident, incremental and punctuation constructs.

Table 4-4

Abbreviations used for Critical Incidents, Gaps, and their Responses

Abbreviation	Description
G	Gap
I	Critical incident
R	Response
G_i	Gap (G) caused by critical incident (I)
G_i-R	Gap (G) resolved by either incremental change (R) or punctuation (R)
I_i	Critical incident (I) that caused a gap (G_i)
ST	Structure (of technology or organisation)
IT	Technology (system or application)
PE	People (staff, management or leadership)
TS	Tasks (routine, work or assignment)
$B_{1\text{-}x}$	Building system incidents (labelled 1–*x*)
$W_{1\text{-}x}$	Work system incidents (labelled 1–*x*)
Labels (1–*x*)	Incidents/Events range from 1—any number x
i	A number of an incident or gap

4.2.1 Horizontal Analysis

The horizontal analysis discusses the interactions that emerged from the analysis of the events through a visual map during the migration of on-premise IT system to the SaaS model. The horizontal analysis focuses on critical incidents (I) at the single level of the visual map, which results in trajectories for the implementation process of the SaaS model.

4.2.2 Vertical Analysis

The vertical analysis discusses the interrelationships of vertically arranged elements of events through a visual map during the migration of on-premise IT system to the SaaS model (see Figure 3-6). The vertical analysis focuses on the gaps in sociotechnical systems resulting from the interactions between building (B) and work (W) systems. It also answers the question of how the events that occur at one level affect other levels (Lyytinen & Newman, 2008).

4.3 Cases

Four case studies are presented by narrating the experiences of IT workers when moving their on-premise IT emails and calendaring system to the SaaS model in four tertiary institutions in New Zealand. The institutions migrated their on-premise email systems to a SaaS system— either GAE or hosted O365. The four cases form the primary source of empirical data for this study. As indicated earlier, the cases are codenamed ALPHA, BETA, CHITA and DELTA. Table 4-5 provides an overview of the cases contributing to the empirical data analysis. In this study, both primary and secondary sources of empirical evidence have been used. Semi-structured interviews, field notes, and photographs are among the main sources of data, and secondary sources of evidence were official documents and published information.

The following chapters analyse each case (ALPHA, BETA, CHITA, and DELTA) separately following the three dimensions of the PSIC visual map analysis techniques: punctuation, horizontal and vertical analyses (Lyytinen & Newman, 2008).

Table 4-5

Overview of Research Cases of Tertiary Institutions

	Research case			
	ALPHA	BETA	CHITA	DELTA
Organisation size	12,000 students and 1200 faculty staff	25,000 students and 1500 academic staff	10,000 students and 570 staff	20,000 students and 1500 staff
Project purpose	Consolidate departmental email and calendaring systems into a unified system	Centralise staff email systems and migrate student email into a SaaS system	Migrate on-premise email system to a SaaS solution	Migrate on-premise email system to a SaaS solution
Corporate decision	Zero-server solution	SaaS system-enhanced learning and teaching	SaaS solution	Enhanced learning, teaching and collaboration system
On-premise IT system	Microsoft Exchange 2003	Various email systems: Linux/GroupWise, Microsoft and Exchange	Email system	Linux/GroupWise
Challenges of on-premise IT system	Fragmented email/calendaring systems Limited server capacity No single calendaring system High operational and maintenance costs External apps such as Skype, Google desktop degraded system performance	Various types of email systems scattered in different departments/faculties Duplicated IT systems in faculties Lack of single calendaring & collaboration system High operational costs	Remove legacy system Migrate to email and collaborative system	High operational costs Lack of email, calendaring and collaboration system Technical support issues
SaaS model	GAE	GAE	Office 365	GAE
Number of interviews	4	5	4	4
Role of participant (code)	IT manager (PA-1) Exchange engineer (PA-2) Linux engineer (PA-3) Systems engineer (PA-4)	IT manager (PB-1) Systems engineer (PB-2) IT technician (PB-3) & (PB-5) Systems engineer (PB-4)	Exchange engineer (PC-1) Systems engineer (PC-2) IT technician (PC-3) IT manager (PC-4)	Exchange engineer (PD-1) IT technician (PD-2) IT technician (PD-4) IT manager (PD-4)

Chapter 5: ALPHA Case Analysis

5.1 ALPHA Visual Map Analyses

ALPHA has 12,000 students and 1,200 staff. The institutional email system was running on Microsoft's Exchange Server 2003 in the IT department and other email applications scattered among various faculties. The institution made a decision to consolidate these systems into a central IT system (Exchange Server) and then migrate to GAE, which is a cloud-based system (or SaaS). GAE was later integrated into business processes. Four IT workers including an IT manager involved in migration from the old email system to the cloud-based system were interviewed. Other sources of data were the organisation's website and field notes of initial meetings with the gatekeeper. Table 5-1 outlines the sources of data for ALPHA and the data source codes used. This case study examines the migration of a student email system from the Exchange Server to GAE following the visual map analysis techniques.

Table 5-1

ALPHA Data Sources

Source	Data source code	Description
Semi-structured interviews	PA-1	IT manager
	PA-2	Systems engineer (Exchange)
	PA-3	Systems engineer (Linux)
	PA-4	Systems engineer
Website	W-A	Publically available organisation information and GAE documentation
Public documents	PD-A	Publically available organisation annual reports and statistics
Photographs	PH-A	GAE dashboard
Field notes	FN-A	Initial meetings with gatekeeper
		Interviews and informal meetings
		User experiences/story details

The remainder of the chapter describes the punctuation, horizontal and vertical analyses of ALPHA. Table 5-2 provides a summary of the results of the analyses.

Table 5-2

Summary of the Results of ALPHA Visual Map Analyses

Dimensions of analysis	Punctuated	Horizontal	Vertical
Results of analysis	Three phases	Four trajectories	Four themes
	Consolidation	Roles change	Discovering
	Implementation	Skill sets change	Learning initiatives
	Integration	System change	Institutionalisation
		Routine change	System limitations

5.2 ALPHA Punctuation Analysis

At ALPHA, punctuation occurred when decentralised email systems exhibited high support and maintenance costs and were running different email applications, and there was a lack of a unified calendaring system (see Figure 5-1). As a response to this, the institution decided to consolidate these systems into a central IT email system. This consolidation was an initial preparation for migrating to a unified server-less system with minimal support costs and the ability to tap into innovations.

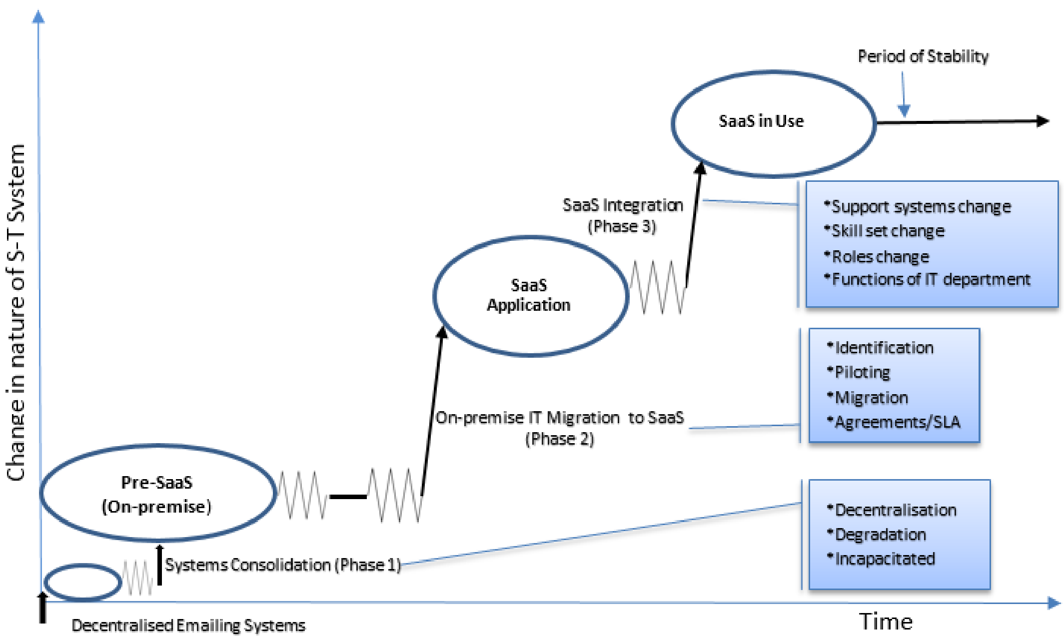


Figure 5-1. SaaS implementation trajectory for ALPHA.

The change reconfigured the sociotechnical elements of the system and became permanent, and this provides an example of a response to a critical incident. In ALPHA, an incremental change occurred when the central IT email system required a hard drive and upgrade of its memory capacity to accommodate the larger number of user mailboxes that migrated from decentralised systems. The incremental change represents a response to a critical incident by a gradual change in system technical components. The next sections discuss the punctuation of the migration of ALPHA's on-premise IT system to the SaaS model through three main phases: consolidation, migration, and integration narratives. The phases describe the critical incidents, gaps and their responses as presented in Figure 5-1.

5.2.1 Phase 1: Consolidation

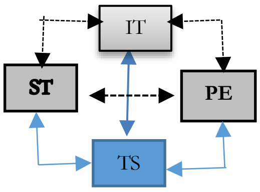
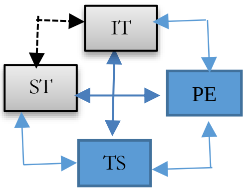
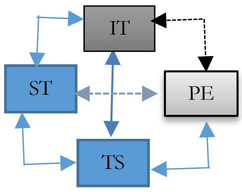
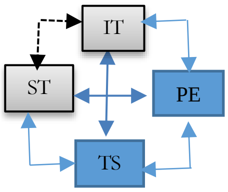
The critical events in this phase relate to the many problems caused by the existence of decentralised email systems across faculties. The problems prompted the institution to consolidate the systems to make room for a unified email and calendaring system. In this study, the consolidation of email systems describes the process of combining email servers for staff and students stationed in various departments into two central systems dedicated for staff and students. A systems engineer put it this way:

> Gmail has done it reasonably better in that it was viewed as a way of—the Vice Chancellor wanted to do a one-university policy. He did not want the university operated as independent units. He wanted it operated as a single unit. So he used the mail system as the first project to consolidate the university..., which meant that none of the other faculties was allowed to run their email servers anymore. So that got rid of all that. (PA-4)

Table 5-3 summarises the gaps initiated from the critical incidents in the consolidation phase. Four major gaps triggered the decision to consolidate the systems: *dissatisfaction, decentralisation, degradation,* and *incapacitation* of the legacy systems.

Table 5-3

Critical Incidents in ALPHA Phase 1: Consolidation

Critical incident (I)	Gap (G)	Response to gap (R)
I$_1$ 	**G$_1$:** Dissatisfaction with legacy systems: users (PE) unhappy with various legacy email systems (IT) across departments (ST) due to inability to provide unified room booking and calendaring. Disequilibrium: PE-IT, PE-ST	**G$_1$-R**: Punctuation: the corporate decision to consolidate various email systems to provide unified room booking and calendaring
I$_2$ 	**G$_2$:** Decentralised systems: institution requiring compliance with new legislation (ST) and reducing support and operational costs of legacy systems (IT). Disequilibrium: IT-ST	**G$_2$-R**: Punctuation: consolidating legacy systems into a central IT system in preparation for migration to a server-less system (SaaS)
I$_3$ 	**G$_3$**: System degradation: Staff (PE) required more hardware to handle new users' mailboxes in the central IT system (IT). Disequilibrium: PE-IT	**G$_3$-R**: Incremental adaptation: more storage and memory capacity added as a temporary measure
I$_4$ 	**G$_4$:** Incapacitation: central IT system (IT) unable to handle learning, teaching and collaboration tools, coupled with high operational costs (ST). Disequilibrium: IT-ST	**G$_4$-R**: Punctuation: the governing board agreed to a change and migrated central IT system to a server-less system hosted in the cloud

I$_1$: Dissatisfaction

From late 2009 to early 2010, the university was examining staff email and collaboration options and realised that the majority of faculties and departments were running legacy email systems and were not using a corporate central IT email system. This made it impossible for staff to share calendars or make room bookings for university-wide infrastructure. In addition, management (PE) was experiencing huge operational and maintenance costs of the legacy systems (ST) across the university. An IT manager added that:

> And then we also found that [a certain faculty] … were using the Exchange environment for email, but they were using Zimbra for calendaring, so you couldn't book a meeting in the university and see all staff calendars and you couldn't see all the meeting rooms and so on, because [this faculty] was using their meeting rooms in Zimbra and [faculty of …], so it was a corporate decision to find one email and calendaring product for staff. (PA-1)

These shortcomings led the corporate team to consolidate (G_1-R) the decentralised systems into a single central email system under the control of the central IT department.

I_2: Decentralisation

The decentralised email systems (IT) scattered in various faculties and departments (ST) were running on different applications including the Microsoft Exchange, GroupWise, and Novell email systems. Management decided to consolidate (G_2) these email systems into a centralised email system, for two main reasons. First, the institution was mandated to comply with the New Zealand's *Electronic Transactions Act 2002* demanding that organisations have a mechanism to retain business emails and archive them for a period. The second reason was to remove the costs associated with ongoing IT systems support for the legacy systems scattered around the institution. A systems engineer added:

> Now, the central IT from our perspective had an email service that was fine. It was not the greatest, but it was fine. And from our perspective, we just did not understand why others were not using it, why they were insisting on own services. When it was proposed that we amalgamate these services, everybody … saw an opportunity to review … and … add value to what was going on. (PA-4)

These reasons triggered a response (G_2-R) to consolidate the email systems into a new centralised on-premise email system running in a Microsoft Exchange Server 2003 environment. Centralisation of the email systems is considered a punctuation change, as sociotechnical elements were reconfigured, resulting in a pronounced change in the system.

I₃: Degradation

The newly centralised on-premise IT system hosted staff and student mailbox accounts in the same domain. The Exchange system encountered issues emanating from an IT source of *structures (i.e.* rules and resources organised as properties of systems), as well as internal and external sources of structures (DeSanctis & Poole, 1994).

On-premise IT Sources of Structures

As the number of students grew, the global address list became larger and the management of Exchange Server 2003 became burdensome regarding on-board accounts and individual's email issues, such as emails not being delivered or the system not working. Mailbox capacity became a major concern as the server could no longer hold more than 10,000 mailboxes—the maximum threshold recommended by Microsoft Exchange. Also, the advent of Skype and Google Desktop sent a high number of remote procedure calls (RPC) to the Exchange Server, degrading the performance of the system (G_3). RPC is an inter-process communication technique that allows client and server software to communicate (Birrell & Nelson, 1983). RPC is designed to make client and server interactions easier and safer by factoring out common tasks such as security, synchronisation and data flow handling, into a common library so that developers do not have to dedicate time and effort to developing solutions (Bagchi, 2014). An IT manager elaborated:

> And then obviously, as student numbers grew … large in Outlook and management of the Exchange Server … and people having email issues and the

mail not working and stuff. And … also finding that the advent of Skype and Google Desktop … were doing high numbers of RPC calls to the Exchange Servers, and so we are having many performance issues with the Exchange Servers. (PA-1)

More hardware and software licences were added to solve this problem (G_3-R).

I_4: Incapacitation

The central IT system was unable to meet the users' demands, as it lacked teaching, learning and collaboration tools; both internal and external factors exacerbated the situation.

Internal Sources of Structures

Staff and students complained about the degraded performance of the system and problems with email delivery. The degraded performance increased the operational and maintenance costs of the system as IT workers attempted to keep the system running. In addition, staff and students were unable to collaborate with other researchers worldwide via the teaching and learning tools on Exchange Server 2003 because the system had limited sharing capabilities. Eventually, the system reached a tipping point and was unable to hold and operate normally as an email system. As a systems engineer elaborated:

> We were at the Exchange Server migration point … because it had grown and grown ... we had some servers, and we were staring down the barrel of … Exchange Server 2012, to upgrade to it, and that required … a lot of hardware and … more licences … cost factor. (PA-2)

External Sources of Structures

Visiting faculty members from other learning institutions within and outside New Zealand shared their experiences of using collaborative tools for learning and teaching, of which some are available free of charge to students, such as GAE. This revelation created the internal demand among both faculty staff and students for a SaaS-based system for enhanced learning and teaching capabilities:

> The other thing … they wanted … to roll out voice over IP [VOIP] and … integrate that and also … to do Instant Messenger and sort of … unified communications, your email, voice over IP, Instant Messenger, and putting them all together and … that was incredibly expensive. (PA-2)

The inability of the existing system to handle collaborative tools for learning and teaching, along with its high running costs (G_4) made the governing board decide to migrate the system to a cloud-based server-less system (G_4-R).

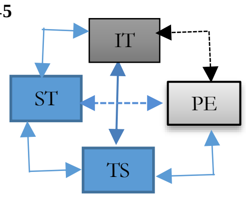
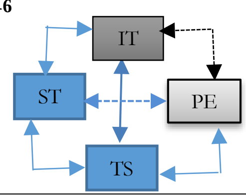
5.2.2 Phase 2: Implementation

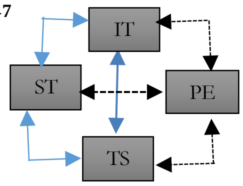
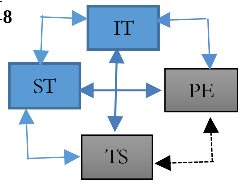
The critical incidents that characterised the implementation phase aimed at *identifying* a suitable cloud-based system through tendering, *piloting* the preferred vendor solutions, *migrating* to a cloud system and signing an SLA with the vendor.

Table 5-4 summarises the gaps initiated from the critical incidents in the implementation phase.

Table 5-4

Critical Incidents in ALPHA Phase 2: Implementation

Critical incident (I)	Gap (G)	Response (R) to gap (G)
I_5 	**G_5**: Identification: institution was challenged to identify an IT solution (IT) that meets users' requirements (PE). Disequilibrium: PE-IT	**G_5-R**: Punctuation: institution agreed to advertise a tender for a server-less system that meets the organisation's ever-growing needs
I_6 	**G_6:** Piloting: Project Team (PE) required to identify a preferred vendor system (IT) from the tender bids. Disequilibrium: PE-IT	**G_6-R**: Incremental change: three shortlisted vendors' solutions piloted for six months, and the project team recommended GAE

I_7 	**G_7:** Migration: IT workers (PE) required to move accounts of users from on-premise IT system to GAE—a SaaS solution (IT). Also, IT workers (PE) were tasked (TS) to implement GAE system configuration parameters (ST). Disequilibrium: PE-IT, PE-ST & PE-TS	**G_7-R**: Punctuation: Project Team migrated users’ mailboxes from an on-premise IT to a SaaS system
I_8 	**G_8**: Agreement: role (TS) clarity required between IT department (PE) and cloud service provider on system support and maintenance. Disequilibrium: PE-TS	**G_8-R**: Incremental change: IT department and cloud service provider signed an SLA on system support roles and responsibilities

I_5: Identification

As a response to these problems, the organisation formed a corporate team to identify a cloud-based solution to cater for the student and staff email and calendaring system. In identifying systems that are already in the market, the organisation advertised a tender for soliciting cloud-based solutions from vendors. The objective of the system was to enhance teaching and learning through various collaborative tools (G_5). A project initiation document stipulating system requirements and specifications was sent out by tender and invited vendors to present their solutions (G_5-R). Three vendor solutions were shortlisted: GAE, O365, and Oracle Beehive. An IT manager was passionate about how successful the project was, and declared:

> But we shortlisted down to those three products, and so we looked at Microsoft, Google and the Oracle product and we trialled and piloted them. (PA-1)

I_6: Piloting

ALPHA formed a project implementation team led by an IT manager (PA-1). The team was tasked to pilot (G_6) the vendor solutions on site for six months, to find out any issues, and make recommendations to the Steering Committee (G_6-R) on the preferred system. A systems engineer described:

> We tried to do a lot of testing … to uncover any issues and find the solution to cater for our needs … So we needed to be technically sure before we did—so

when we hit the migration, we did not need consultants because we knew it was going to be good and we used the pilot process to work out all the bugs and make the support calls then, which was pretty hairy. But you know, you make the mistakes in your test phase. (PA-2)

Ultimately, GAE fulfilled the organisation's requirements, and its solution met the optimal tender requirement. The Steering Committee chose GAE to be implemented accordingly. GAE was a mature SaaS, a server-less cloud-based solution operating since late 2008, and had a proven record of accomplishment of other successful similar migrations. Therefore, the project team migrated student email accounts to GAE, as the cloud-based server-less solution—the SaaS model.

I_7: Migration

IT workers were involved in the migration (G_7) of on-premise email systems to the GAE environment. During the migration of user mailboxes to GAE, a systems engineer elaborated that:

> A big bang approach was not a good idea because it was a shift in people's experiences and expectations and what their user interface was going to be like. Instead, we decided to make the handholding approach. We identified mailboxes to be shifted, sort them by units and departments. Then we moved mailboxes the night before the second level support staff come in the next morning to help users with migrated mailboxes. (PA-2)

Google support staff were not involved. However, the IT workers (PE) were tasked (TS) with moving all user accounts across from the on-premise IT system (Exchange Server 2003) to GAE (G_7-R). The IT workers used GAE system tools for migrating a set of mailboxes from the on-premise IT system to the SaaS model. An IT manager and a systems engineer added that:

> The effort to move stuff across was—needed to take a PST [personal storage table] copy of their existing email out of Exchange Server and then to use that. Google had a tool for loading PST files up into their Google environment, so we had a process. We were doing about 20 staff per night, so it was sort of like an overnight process. (PA-1)

> For staff, I think it was about three months for the entire 2000 old mailboxes to be transferred. (PA-4)

Moreover, the university had no funds to engage external contractors in the project. One systems engineer argued that:

> *So we did all this in-house with our IT implementation team. This worked well for us, because if you do it in-house, you keep all the knowledge and skills. I mean … you end up having full control over how the system works. (PA-2)*

Thus, by the end of 2013, both staff and students were operating on GAE. This incident showed the commitment of IT workers (PE) in migrating (TS) user accounts from an on-premise IT system to GAE (IT), as well as integrating the structural features of the new system (GAE) into the organisation's business operations.

***I_8*: Agreement**

The institution (PE) signed an agreement with Google—the United States (US) based company on legal issues and outlined the responsibilities of both parties regarding system support and maintenance (TS). Legal matters were related to the *Patriot Act 2001* (US), email data storage outside the US and archiving solutions. The Patriot Act is an anti-terrorism law passed by the US Congress following the September 2001 New York Trade Centre attacks (Abadi, 2009). Technically, the law gives the US government access to any data stored within the US. With respect to the Patriot Act, Google assured the institution that its emails would be stored outside the US, although there would be no monetary comeback on Google if security breach went wrong because the institution was not paying for the use of the software and storage. However, Google signed an SLA for an archiving solution (known as 'Postin'), because this feature integrated into GAE at a fee, as illustrated by a systems engineer:

> We had to get our heads around … Patriot Act and what its net effect would be to our organisation … Google … guarantee not to warehouse our email inside the borders of the United States … But we have taken them at their word, and they signed a legal contract … One of the downsides of this whole situation is that because we are not paying for the service, there is no comeback on Google if something goes wrong, financially … So that was an issue because we were trying to get them to agree to some form of monetary compensation should certain events occur … Now that changed of course with the archiving solution (Postin). For the archiving solution, yes, we were able to negotiate with them for some surety that it was going to work and how it would work and its performance. (PA-3)

In addition, the IT department (PE) and Google outlined their roles and responsibilities (TS) for the GAE system support and maintenance. The workload for IT workers is less on supporting GAE than it was with the Microsoft Exchange Server environment, as illustrated by an IT manager:

> Google has its problems from time to time that we work through, but no the day-to-day workload is nowhere near as high as what it was with the Exchange Server. (PA-1)

5.2.3 Phase 3: Integration

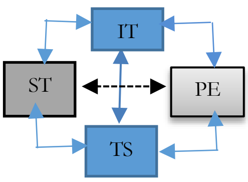
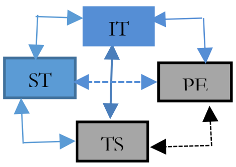
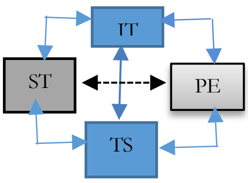
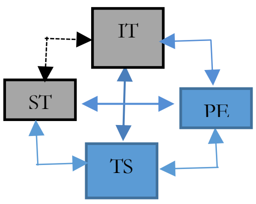
The critical incidents that characterised the integration phase relate to changes on how SaaS was supported and maintained. These include changes in skill sets requirements, and in both the roles of IT workers and functions of the IT department. A systems engineer added that:

So we were able to leverage this situation where all we had been dealing with was disparate systems of email and all of a sudden, we had this combined collaborative tool rolled out to every person in the organisation. Students as well as staff. So we gained by having the collaboration. We gained by having the additional online tools. We gained by not having to maintain physical hardware. We gained by not having to do a lot of administration with this (PA-4).

Table 5-5 summarises the gaps initiated from the critical incidents in the integration phase, which are discussed in following sections.

Table 5-5

Critical Incidents in ALPHA Phase 3: Integration

Critical incident (I)	Gap (G)	Response (R) to Gap (G)
I_9 	**G_9:** Changes in SaaS system support: IT workers (PE) challenged on way SaaS need to be supported and maintained (ST). Disequilibrium: PE-ST	**G_9-R**: Punctuation: changed routines and methods of SaaS to allow new ways of supporting SaaS
I_{10} 	**G_{10}:** Role change: Roles changed for IT workers (PE) as the vendor takes on the main support role (TS) for the SaaS system. Disequilibrium: PE-TS	**G_{10}-R**: Incremental change: IT workers relocated to other strategic roles
I_{11} 	**G_{11}**: Skill sets change. IT workers (PE) required different skills for supporting and maintaining the SaaS environment (ST). Disequilibrium: PE-ST	**G_{11}-R**: Punctuation: IT workers retrained as SaaS demanded new skills to handle new abstraction layer of the SaaS virtual environment
I_{12} 	**G_{12}:** Functions of IT department: mismatch of IT department (ST) roles in supporting the SaaS model (IT). Disequilibrium: IT-ST	**G_{12}-R**: Punctuation: IT department assumed a new brokering role in managing systems in the SaaS environment

I_9: Changes in the SaaS System Support Model

There were changes to IT systems support in the SaaS environment. Instead of users contacting the IT Helpdesk for support, they contacted the systems engineers directly. A systems engineer added that:

> I was the go-to Google guy because I had been the technical lead on the project … In terms of support, I get those constant phone calls about … What about this and that … from users and helpdesk staff. In a way, helpdesk technicians lacked confidence in dealing with SaaS stuff … and the workload went a bit crazy. (PA-2)

Thus, the first tier support (helpdesk) was unable to deal with SaaS-related faults. Instead, they escalated these faults to the second level support of systems engineers. Changes in the systems environment increased the workload, especially for one systems engineer, which forced him to resign:

> *I mean I do wonder if the helpdesk was a bit different. I might not have resigned because of the pressure I had … I do not know. So there was quite a lot of pressure and stress for second tier support staff by then.* (PA-2)

Therefore, in the SaaS model of ALPHA, the helpdesk support was bypassed. Instead, users contacted second level support staff directly. These changes had been made permanent (G_9-R) by the time this study conducted interviews. As a way of incorporating IT technicians in supporting the SaaS system, systems engineers designed API scripts for creating and integrating users' accounts from staff and students' registries into GAE by following simple clicks on the screen. A systems engineer elaborated on this point:

> So for example, creating resource mailboxes—previously that was an administrative-intensive task down here—now it is done by the helpdesk, and it is done by basically the push of a couple of buttons on a web page. So you tick a

box, tick that box, type that name in, press go, and it is done. Whereas, previously it was a job that was raised, came down here, we had to create the account in AD [active directory], create the mailbox, set the permissions on the mailbox against the account, create the group that the users need to go in for that group, and then assign that group to the mailbox … 45 minutes, whereas now it is a couple of clicks and it is done. (PA-4)

I_{10}: Changes in Support Roles

One systems engineer (PA-3) stopped supporting the SaaS system to concentrate on other things. Most of the other SaaS support roles were moved to the cloud service provider:

> but things like spam, mail storage and viruses is now handled by the Google support team. In a way, it is outsourced … to a particularly effective company and technical specialists in a way. Google seems different somehow; they seem more effective, and this is useful from our perspective because we can say to others well you know, the mail got blocked on Google by Google because Google decided so as spam. But quite nice, it became their problem in a way. (PA-3)

I_{11}: Changes in Skill Requirements

Users were unaccustomed to the new system and hence needed constant support. However, the IT helpdesk lacked the technical skills to support the SaaS system. On the other hand, the second tier support consisting of IT workers (mostly systems engineers) lacked people skills to support users directly. One systems engineer elaborated:

> *The helpdesk staff needed some skill up … The thing I am not so good at … is doing frontline support, is something I never really saw coming … and that is something we should have done better.* (PA-2)

Although initial training had been undertaken by IT technicians, they still found it challenging to work on the virtual layer of the SaaS system. Working on this layer requires coding skills in troubleshooting and creating various scripts for fixing systems faults. A systems engineer added that:

> So here's the other side of this as well is to be able to have this level of almost hands off. You need some pretty strong scripting skills, so you need subsystem administrators who are programmers. (PA-2)

I_{12}: Changes in IT Governance

The functions and roles of the IT department were reduced to supporting the new SaaS system. The reasons for this include operational issues related to managing mailboxes and shifting them to the cloud service provider and the advent of ideal management tools, which allow systems engineers to automate and synchronise many system operations. A systems engineer described:

> Yeah, over time we have built up a bunch of management tools that plug into the GAE system, so when users are created, there is a script that kicks off, and so they get created and integrate with Google Apps. So most of what we do is automated because there are not enough of us to do it manually. (PA-2)

Google dashboard has simplified the management of the GAE systems. The dashboard shows the user when their status is created, Google Apps is loaded, or when the user is suspended or resigned and describes any problems the system might be facing. A systems engineer explained:

> The neat thing is that because there is SLA, we do not need to keep a very close eye on it. The status dashboard shows how much mailbox size when the user logs on and off, and how often people log on. (PA-2)

Hence, the SaaS model administration has been shifted to the cloud service provider:

> So Google monitors all pieces of mail and looks for unusual amounts of traffic or delay … and stuff like that. We get notified when major changes that can have an impact we know about. We get alerted when people log in from places that they maybe should not. (PA-2)

Over time, the routine work of IT workers has been reduced in the SaaS environment compared with the on-premise IT system environment:

> Oh, absolutely, for sure, we do not have to replace servers, we do not have it upgrade software, we do not have to go and find viruses all over the system anymore. We do not have to track down lost mail. Yeah, it is less work. (PA-2)

The use of the Google Apps management tool requires strong scripting skills by IT workers. To help with this, Google provides an interface via which IT workers can create customised codes to automate some functionalities to suit their organisational needs:

> It is like having a web interface to suspend users, how users add automatically, how mailing list get done, how user aliases get done ... So I wrote a program to synchronise the user name, the details of a person, so we got a thing called 'phonebook', and so it has their room number, their telephone, postal address, their title, departmental affliction and I wrote some Java to synchronise that to Google, so that when people look in the phone book it will work. (PA-2)

5.2.4 Summary of the ALPHA Punctuation Analysis

The three phases of consolidation, implementation, and integration illustrate critical incidents or gaps occurring when migrating from an on-premise IT system to the SaaS model. They describe how the responses to the critical incidents brought deep sociotechnical changes in the systems as illustrated by 12 critical incidents (I_1–I_{12}).

5.3 ALPHA Horizontal Analysis

The trajectories of change in systems from on-premise IT system to the SaaS model that emerged in this analysis include the Brokering role of the IT department, Changes in skill sets and Changes in system features of the building system, and Changes in organisational routines of the work system. Table 5-6 summarises the horizontal analysis of these trajectories.

Table 5-6

Summary of ALPHA Horizontal Analysis

	Systems architecture	Client/server	Cloud computing	Interviewee quote
	System type	On-premise IT (Microsoft Exchange 2003)	SaaS model (GAE)	
Context	Organisational (IT department) narratives	Brokering role →		‘So we were looking for an alternative … to get the student email off of Exchange and … Google was one of the early cloud options’ (PA-1). Related incidents: **I_4, I_6, I_7, I_{10}, I_{12}**
	Build system (activities)	Skill set change →		‘Something that we should have done better is … skilled up the help desk … How can we skill you guys up?’ (PA-2). Related incidents: **I_{11},**
	Build system (sociotechnical form)	System features change →		‘We noticed with the Exchange Server is that it is very hands-on … When we moved to Gmail into the cloud, it freed up one person. Technically, Gmail offers a different system configurations and support model’ (PA-4). Related incidents: **I_5, I_6, I_7,**
Process	Work system (sociotechnical form)	Organisational routines →		‘(Helpdesk staff) confidence in dealing with stuff may have been not as much … I had enough of the help desk calling me constantly and resigned … the majority of the problems were just people unaccustomed to the new system’ (PA-2). Related incidents: **I_8, I_9**

5.3.1 Brokering Role

Horizontal narratives from ALPHA show that the role of the IT department metamorphosed into a cloud brokering role when moving its on-premise IT system to the SaaS model. A *cloud broker* is an entity that manages the use, performance, and delivery of cloud services, and negotiates relationships between cloud providers and cloud consumers (Pawlowski & Robey, 2004) (see Appendix E for definitions of key terms). This section describes how the IT department transformed into a brokering role.

Table 5-7 summarises the analysis of key incidents that explain the brokering role trajectory.

Table 5-7

ALPHA Brokering Trajectory

Critical incident	Key brokering roles depicted by ALPHA IT department	Interviewee quote
I_6, I_{10}, I_{12}	Service Intermediation: enhanced some specific capability and provided value-added services to cloud users	'we are more just making it work and supporting it. Supporting the environment' (PA-1)
I_6	Service aggregation: integrated multiple services and provided data integration	'by the time we got to migration … we figured out how to integrate with our single sign-on system' (PA-2)
I_4	Service arbitrage: chose solutions from multiple services or agencies and aggregated them	'So we looked at a number of solutions … on their zero-server solution' (PA-1)
I_7	Security monitoring: ensured the safety and integrity of data through an SLA	'we put this in front of the university's risk assessors and asked them to assess the risk and what they thought of that' (PA-3)
I_7	Privacy checks: checked and monitored compliance of data through SLA management	'we had to get our heads around quite a lot of legality around things like the Patriot Act and what its net effect would be to our organisation, should the American government deem it necessary to close their borders' (PA-3)

Due to the transformation of IT workers' roles to the second and third support level roles, in the same vein, the IT department has taken on the responsibility of supporting both the on-premise and the SaaS model. This mixed IT infrastructure demands a different organisational supporting structure. The department assumes responsibilities that include managing the SLA with the cloud service provider, security issues, an exit strategy, a form of disaster recovery, and the archiving system to comply with the legal requirement for retaining emails for a period. The IT department, therefore, is being transformed into a cloud broker.

5.3.2 Changes in Skill Sets

When all user accounts migrated to the SaaS model, IT workers faced a new abstraction layer that requires new skills in creating and maintaining user accounts and supporting the system. As a result, IT workers went through formal system support training. Table 5-8 summarises the key incidents that illustrate the changes in skill sets trajectory.

Table 5-8

ALPHA Changes in Skill Sets Trajectory

Critical incident	Description	Interviewee quote
I_6	*Piloting* helped to master the new system	'The good part about the pilot is that we figured out what the problems were, where the pain points were' (PA-2)
I_7	*Operations and user support* in the SaaS environment challenged the skills of both systems engineers and IT technicians	'To do the migration thing, there's a change. I think you need technical component sys admins who can write scripts, at least, write the programmes' (PA-2)
I_{11}	*Integrating* user registry accounts with Google active directory synchronisation (GADS) required scripting skills	'You need … strong scripting skills, so you … need systems administrators who are programmers. We have written … an easy 10,000 lines of code' (PA-2)
I_9	*Programming or API skills* were needed for IT workers to be able to support the SaaS model	'I wrote some Java to sync that to Google so that when people look in the phone book, it will work' (PA-2)

An IT manager and a systems engineer added that:

We run what we call skills metrics, so we have all the skills, all the different systems that we need to support and the skills required to be able to support those systems. And then we marry up IT workers to have the right mix of skills. (PA-1)

I think you need technically competent system administrators who can write scripts, at least, write programmes … But if you do not have the in-house experience on how to fix … when it breaks … Even with the training that they would do, I just don't know if it would work that well. You have to have user buy-in, and you have to have administrative systems buy-in … You need to have people who have domain knowledge of it. (PA-2)

5.3.3 Changes in Features of Systems

IT workers experienced some differences when interacting with the SaaS model compared with the on-premise IT system. These differences are due to the variations in the technical features of the abstraction layer or materiality of the system administration. Table 5-9 summarises how changes in features of the system administration were experienced differently by IT workers—IT technicians, systems engineers and IT managers.

Table 5-9

ALPHA Changes in Features of System Trajectory

Critical incident	Description	Interviewee quote
I_6, I_9	IT technician finds it difficult to deal with the SaaS system due to changes in the abstraction layer	'No, we do not support SaaS system, ask the system engineer in charge of SaaS support' (During interview with PA-2)
I_7	Systems engineer was able to cope with the new system's working environment, by using scripting skills	'To be able to have this level of almost hands-off-ness, you need some pretty strong scripting skills, so you need systems administrators who are programmers' (PA-2)
I_5, I_9	IT managers show concern about how SaaS ought to be supported by IT workers due to changes in the administration environment of the new system	'I think they have also got the opportunity to say to staff … Hey we can do so much more in the new environment' (PA-1)

5.3.4 Changes in Routines

The routines involved in IT system support changed dramatically when the SaaS model was commissioned and the on-premise IT system retired. Table 5-10 summarises key incidents that illustrate the changes in routine for IT system support. These incidents relate to change in actions by IT technicians, resignation of some systems engineers due to the pressures involved in SaaS user support, reassignment to other roles and automation of operations in the SaaS model. The discussion of the change in routines trajectory is rendered in two ways: changes in actions by IT workers and changes in the structure of routines, as portrayed in the SaaS environment.

Table 5-10

ALPHA Routines Trajectory

Critical incident	Description	Interviewee quote
I_9	Actions: some IT technicians made deliberate changes in the way of supporting users in the SaaS model; instead, they channelled all queries directly to systems engineers as frontline supporters	'I think there's—the thing I am good at, which is technical stuff, we did well. The thing I am not so good at, which is doing support, frontline support, is something I never really saw coming … that is something that we should have done better, is skilled up the help desk' (PA-2)
I_9	Resign: systems engineer (PA-2) resigned after being under pressure by users and IT helpdesk queries	'But in terms of my workload you get this sort of … constant phone calls about—What about this? … I had enough of the help desk calling me constantly and resigned. So my workload, yeah, went a bit crazy' (PA-2)
I_8	Reassigned a new role: systems engineer (PA-4) was reassigned a SaaS support role; the IT department added a security specialist role	'But on the other hand, I know (PA-4)'s … Exchange Server workload … just dropped off. So he was able to concentrate on other things' (PA-2)
I_{11}	Automate: systems engineers have reduced the time to create a user mailbox from 45 minutes in the Exchange system, to a few clicks in the SaaS environment	'Whereas previously it was a job that was raised, came down here … to create the account in AD ... So it took 45 minutes, whereas now it is a couple of clicks and it is done' (PA-4)

Changes in Actions

The responsibilities of IT workers metamorphosed into second and third support levels, and they even joined the vendor corporate online support forums for maintaining the SaaS system. An IT manager and a systems engineer described it this way:

> We have been doing stuff that is more productive. So rather, than being operational, doing support, we can get them (IT workers) now more on strategic stuff and do more project work. (PA-1)
>
> Yeah, there is Google forum that people write in. They are very … smart people. They are geniuses, but they have got to be. I do not know … when you talk to someone, who knows what is talking about like. They are technically competent. (PA-2)

Changes in Structure of Routines

IT workers experienced changes in the setup and structure of systems of the SaaS model compared with the previous on-premise IT system. An IT manager and a systems engineer illustrated these changes:

> Google has its problems from time to time that we work through, but the day-to-day workload is nowhere near as high as what it was on the Exchange Server [on-premise IT system]. (PA-1)
>
> We do not have to trace mail anymore. The overall, probably before GAE, it was 20% of my time … would have been mail support. (PA-2)

Reassigned Roles

Changes in systems structures required a different kind of role for support staff. Existing IT workers who were solely supporting the on-premise IT system were unable to support the SaaS model. Instead, they were reassigned other strategic roles, such as project work. An IT manager elaborated further:

> In the team, we run what we call a 'skills metrics'. So we have all the skills, all the different systems that we need to support and the skills you need to be able to support those systems, and then we marry up people to have the right mix of skills to be able to cover what we need to do … So it is a sort of win–win, based on the staff movements and where staff skills reside. (PA-1)

Automation of Operations

Migrating Exchange Server 2003 to GAE reduced the administrative work of IT workers, as most of the work in SaaS is automated. A systems engineer explained:

> Whereas previously it was a job that was raised, came down here … to create the account in AD, create the mailbox, set the permissions on the mailbox against the account, create the group that the users need to go in for that group, and then assign that group to the mailbox. So it took 45 minutes, whereas now it is a couple of clicks and it is done. So administration-wise, our administration overhead for mail has gone down, considerably. (PA-4)

5.3.5 Summary of ALPHA Horizontal Analysis

The ALPHA horizontal trajectories formed four texts that illustrate the relationships among critical incidents. The incidents illustrate how one critical incident may have an influence on another incident that could be realised later. The analysis describes the Brokering role, Changes in skill sets, Changes in features of systems, and Changes in organisational routines relating to the 12 critical incidents identified during the punctuation analysis. Figure F-1 in the appendices describes the ALPHA trajectory visual map of the migration process from the on-premise IT system to the SaaS model

5.4 ALPHA Vertical Analysis

The vertical analysis focuses on the gaps in the sociotechnical systems from both project activities (B_1–B_{12}) of the building system and SaaS implementation activities (W_1–W_{12}) of the work system resulting from a critical incident, then compares and contrasts critical incidents with similar gaps. These incidents are contrasted in Table 5-11 and summarised in Table 5 12.

Table 5-11

ALPHA Contrasting of Gaps and Incidents

	Structure	Information technology	People	Tasks
Tasks			I_7, I_8, I_{10}	X
People	I_7, I_9, I_{11}	I_1, I_3, I_5, I_6, I_7	X	
Information technology	I_2, I_4, I_{12}	X		
Structure	X			

As shown in Table 5-11, each gap in these subsystems was analysed on the four-sociotechnical dimensions to form an interaction matrix. Matrix gaps represent the incidents resulting from this study. For example, gaps depicting disequilibrium between people (PE) and tasks (TS) are listed in the cell in the first row of the fourth column as I_7, I_8, and I_{10}. These incidents denoted as 'PE-TS' are analysed to represent a theme entitled 'Discovering' (see Table 5-12). Similarly, for other cells. The following sections discuss these themes. An example of the detailed analysis leading to the formulation of themes is provided in Appendix F.

Table 5-12

Summary of ALPHA Vertical Analysis

	Structure (ST)	People (PE)
Tasks (TS)		Discovering
People (PE)	Learning initiatives	
Information technology (IT)	Institutionalisation	Systems limitations

5.4.1 Discovering (PE-TS)

The gap between people and tasks was seen in two ways: first, when IT workers (PE) pursued ways of configuring (TS) the new SaaS system; second, when the institution (PE) undertook investigations (TS) into security issues around the cloud solution. Table 5-13 describes the gaps and incidents that resulted in the discovery endeavour and how they became apparent to the researcher.

Table 5-13

ALPHA Gaps between People and Tasks

Critical incident	Expression of a cap	Gap (G)
I_7	Configurations needed for a new system abstraction layer	IT workers (PE) pursued ways to determine (TS) configurations of the new SaaS system
I_8	Staff expressed concerns about security and legal issues before signing an SLA	The institution (PE) followed due diligence (TS) on security and legal issues before signing an SLA and putting user data into the SaaS system
I_{10}	Role clarity and changes emanate from the SaaS environment	Changes in roles forced IT workers (PE) to learn new ways of providing system support (TS)

IT workers were entering an unknown territory to perform system management tasks that had never been done before. They were exploring the new abstraction layer of various SaaS systems, especially during the piloting phase. IT workers aimed to discover any problems with the systems being trialled. One systems engineer elaborated:

> So there were some options, and we piloted them … That would have been about a year I think. So you know, the first … five months are getting everything set up and licences and you know test domains and all that sort of stuff. … actually took quite a while in validating that everything—I mean because the pilots that we did were … fully technically detailed. We needed to, at the end of the pilot process, to be able to say hand on heart—this will work, and we know

> what the bugs are, there won't be any showstoppers. Which is a very important point, why it took a year … we decide to go to be a no surprises approach. And this meant a lot of testing. (PA-2)

Similarly, before staff and students' data were migrated to the SaaS system, the institution investigated security and legal issues that could have endangered user information in the cloud system. A systems engineer and an IT manager put it this way:

> And we were very concerned about the Patriot Act and the implications thereof. … Now, one of the few things we did get out of Google was that they would guarantee not to warehouse our email inside the borders of the United States. The document—Google Docs … they could not—probably technically it was too difficult for Google Docs to make that separation. But for the email, they undertook to do that. We took them at their word …We put this in front of the university's risk assessors and asked them to assess the risk and what they thought of that. And they all came back saying … This is all acceptable. (PA-3)
>
> So it was a pan-university decision, and we went through the whole due diligence exercise around the security of Google and where their data centre is located in the world and those sorts of things. So we did quite a bit of work around that. (PA-1)

5.4.2 Learning Initiatives (PE-ST)

Gaps between people (PE) and structure (ST) of the system manifested when IT workers had to learn how to manage and support the new SaaS system environment. Table 5-14 summarises the gaps embedded from the learning initiatives and how these gaps were manifested to the researcher.

Table 5-14

ALPHA Gaps between People and Structure

Critical incident	Expression of gap	Gap (G)
I_7	SaaS system unexplored territory	IT workers (PE) were challenged by the SaaS structure (ST) during the migration process
I_9	IT technicians were unable to maintain the same IT support procedures for the SaaS system	IT technician (PE) modified the IT support routines to circumvent supporting the SaaS system (ST)
I_{11}	Systems engineers' current is inadequate to support SaaS	Systems engineers (PE) had skill gap in managing SaaS environment (ST)

IT workers took some initiatives to learn the new system's structures and to set up and test it to ensure the preferred system would work when it went live. As one systems engineer puts it:

> So you know, the first … five months are getting everything set up and licences and you know test domains and all that sort of stuff … If there were any showstoppers, I needed to find them early. Again, this was part of the pilot process. By the time we got to migration …we figured out how to integrate with our single sign-on system, how to do the migration, how to do, etc. … we did a sort of technical hand on heart—yes we're sure we can make this happen. (PA-2)

IT technicians, on the contrary, required training in how to support the SaaS system. Otherwise, they would not have deserted the support role and re-routed all the users' queries to systems engineers. One systems engineer elaborated on it this way:

> But yeah, random phone calls from staff and quite a lot of phone calls from the helpdesk, who—I do not know, I would not say they are anti it …The vast majority of the problems were just people unaccustomed to the new system … The thing I am not so good at, which is doing support, frontline support, is

something I never really saw coming I think, and that is something that we should have done better, is skilled up the help desk [technicians]. (PA-2)

5.4.3 Institutionalisation (IT-ST)

Gaps between technology (IT) and structure (ST) can be characterised by the institutionalisation of systems (IT) into business processes (ST). Table 5-15 describes gaps manifested from the application of SaaS into business processes and how these gaps expressed to the researcher.

Table 5-15

ALPHA Gaps between Technology and Structure

Critical incident	Expression of gap	Gap (G)
I_2	Frustration about high running costs of legacy systems	Legacy systems (IT) scattered across departments displayed high operational and support costs (ST)
I_4	Dilapidated central IT email system	On-premise email system (IT) unable to handle teaching and learning tools (ST)
I_{12}	Managers conceded the need to monitor cloud providers	IT department (ST) lacked security experts and SLA management strategies in the new SaaS system (IT)

Institutionalisation in case ALPHA was seen at three levels. The first was the decommissioning of legacy systems and their amalgamation into a central IT email system. Existing systems became a burden to the organisation, due to the high operation and support costs. As a result, the institution decommissioned the existing systems and amalgamated them into a central IT email system running Exchange Server 2003, in preparation for moving mailboxes to a cloud solution. One systems engineer alluded to his experiences of this:

> Now, the central IT from our perspective had an email service that was fine … And … we just did not understand why others were not using it, why they were insisting on … to have their services. And when it was proposed that we amalgamate these services... (PA-3)

The second level of institutionalisation was seen with the deterioration of the central IT email system. The central IT email system grew and began to deteriorate, and the system was heading towards failure; hence, it was due for an upgrade both in its hardware and software licences:

> So … I do not quite remember why transformation. All I remember at the start of it was, we were at the Exchange Server migration point, and we were staring down the barrel. Because it had grown … we had a number of servers, and we were staring down the barrel of, I think it was Exchange 2012, to upgrade to it, and that required quite a lot of hardware, and it may have required more licences, it might have been a cost factor then. (PA-2)

The last level relates to the integration of the SaaS model into business processes. When the on-premise central IT system migrated to the SaaS model, GAE, the organisation benefited not only from GAE being a free commercially available solution, but because the operations, support, and human costs were reduced. In addition, GAE is integrated well into business processes like communication, teaching, learning and collaboration tool. Two systems engineers explained:

> When we moved to Gmail … into the cloud … it freed up one person. In other words, we used to have three Linux individuals and four Windows persons looking after the systems. Now we just have three of each. So we lost one position … And it meant that things were getting less maintained, less well done. So, therefore, when Exchange Server went away, it freed up our human resource. (PA-4)

> Google brought with it … all of the associated applications … So we were able to leverage this situation where all we had been dealing with was disparate systems of email and all of a sudden, we had this combined collaborative tool rolled out to every person in the organisation; students as well as staff. (PA-3)

5.4.4 System Limitations (PE-IT)

Gaps between people (PE) and technology (IT) manifested as the inability of legacy systems (IT) to provide university-wide email and collaborative tools, and that the SaaS abstraction layer brought some challenges to the IT workers. Table 5-16 describes gaps manifested in the system limitations and how these gaps were expressed to the researcher.

Table 5-16

ALPHA Gaps between People and Technology

Critical incident	Expression of a gap	Gap (G)
I_1	Lack of unified email and calendaring system at the university	Management (PE) frustrated at legacy systems (IT) across departments, unable to provide a university-wide email and calendaring system
I_7	Challenged by the new abstraction layer of the SaaS system structure	IT workers (PE) had limited skills in how to configure the SaaS system (IT)
I_9	IT technicians were unable to support the SaaS system	IT technicians (PE) circumvented calls from users on SaaS system (IT) support
I_{11}	SaaS systems required new IT worker skills	IT workers (PE) challenged on how to support and maintain the SaaS system (IT)

Therefore, the systems limitations portrayed in the ALPHA case study describe three levels. The first is the inability of legacy systems across departments to provide university-wide email, room bookings, and calendaring services. An IT manager explained:

> The majority of the university was using our Exchange environment for staff, except for … who were running their send mail server … And then we also found that to others were … using the Exchange Server … for email and Zimbra for calendaring. So you could not book a meeting … and see all staff calendars, and … meeting rooms, etc. … so it was a corporate decision to find one email and calendaring product for staff. (PA-1)

Second, the inability of the central IT email system to provide teaching, learning, and collaborative tools prompted the institution to look for alternative solutions for email and collaboration processes. An IT manager added:

> so then the Exchange environment could be more customised and everything, more tailored for staff and staff communication. But then, when was it … early 2010, we started looking at staff email and collaboration. (PA-1)

Finally, challenges provided by the SaaS abstraction layer to IT workers can be regarded as system limitations. Despite the benefits that SaaS provides to the organisation, the SaaS system requires scripting skills to support and integrate it with other systems:

> So here's the other side of this as well is to be able to have this level of almost hands-off (ness), you need some pretty strong scripting skills, so you need systems administrators who are programmers. We have written … 10,000 lines of code. There are tools out there to do this, it is an artefact of how we do this, we have a bunch of legacy systems around (integrate to), but for us this probably … 10,000 lines of code, probably, by the time you are done. (PA-2)

5.4.5 Summary of ALPHA Vertical Analysis

In summary, four themes identified during the vertical analysis (Discovering, Learning initiatives, Institutionalisation and System limitations) illustrate how the events that occur at one level affect other levels. For example, system limitations in the building system (B) induced discovering initiatives by IT workers in the work system (W).

Table 5-17

Summary of ALPHA Visual Map Analyses

#	Incident	Gap	Gaps (sociotechnical form)	Gap resolution	Punctuated analysis (phase)	Horizontal analysis (trajectory)	Vertical analysis (theme)
1	Dissatisfaction with legacy systems	Users (PE) unhappy with various legacy email systems (IT) across departments (ST) due to inability to provide unified room booking and calendaring	PE-IT PE-ST	Corporate decision to consolidate various email systems to provide unified room booking and calendaring	Consolidation		System limitations; Learning initiatives
2	Decentralised systems	Institution required to comply with new legislation (ST) and reduce support and operational costs of legacy systems (IT)	IT-ST	Consolidation of legacy systems into a central IT system in preparation for migration to a server-less system (SaaS)			Institutionalisation
3	System degradation	Staff (PE) required more hardware to handle other users' mailboxes in the central IT system (IT)	PE-IT	More storage and memory capacity added as a temporary measure			Systems limitations
4	Incapacitation	Central IT system (IT) unable to handle learning, teaching and collaboration tools, coupled with high operational costs (ST)	IT-ST	Governing board agreed to a change and migrated central IT system to a server-less system hosted in the cloud		Brokering role	Institutionalisation
5	Identification	Institution was challenged to identify an IT solution (IT) that meets users' requirements (PE)	PE-IT	Institution agreed to advertise a tender for a server-less system that meets the organisation's ever-growing needs	Implementation	System features change	Systems limitations
6	Piloting	Project Team (PE) required identifying a preferred vendor system (IT) from the tender bids	PE-IT	Three shortlisted vendor solutions were piloted for six months, and GAE was recommended		System features change; Skill sets change; Brokering role	System limitations

7	Migration	IT workers (PE) required to move accounts of users from the on-premise IT system to GAE— a SaaS solution (IT); IT workers (PE) tasked (TS) to implement GAE system configuration parameters (ST)	PE-IT PE-ST PE-TS	Project Team migrated users' mailboxes from the on-premise IT system to the SaaS model		Brokering role; System features change; Skill sets change	Discovering; Learning initiatives; Systems limitations
8	Agreement	Role (TS) clarity required between IT department (PE) and cloud service provider on system support and maintenance	PE-TS	IT department and cloud service provider signed an SLA on system support roles and responsibilities		Organisation routines change	Discovering
9	Changes in SaaS system support	IT workers (PE) challenged on the way SaaS needs to be supported and maintained (ST)	PE-ST	Changed routines and methods of SaaS to allow new ways of supporting SaaS		Organisation routines change; System features change; Skill sets change	Learning initiatives
10	Role change	Roles changed for IT workers (PE) as the vendor took on the main support role (TS) for the SaaS system	PE-TS	IT workers were relocated to other strategic roles	Integration	Brokering role	Discovering
11	Skill sets change	IT workers (PE) required different skill sets to support and maintain the SaaS environment (ST)	PE-ST	IT workers were retrained as SaaS demanded new skill sets to handle the new abstraction layer of the SaaS virtual environment		Skill sets change; Organisation routines change	Learning initiatives
12	Functions of IT department	Mismatch of IT department (ST) roles in supporting the SaaS model (IT)	IT-ST	IT department assumed a new brokering role of managing systems in the SaaS environment		Brokering role	Institutionalisation

5.5 Overall Summary of ALPHA Visual Map Analyses

Each of the punctuation, horizontal, and vertical analysis provided a unique insight into understanding the implications of moving an on-premise IT system to the SaaS model at ALPHA. Table 5-17 provides a summary of the punctuation, horizontal and vertical analysis outcomes.

Chapter 6: BETA Case Analysis

6.1 BETA Visual Map Analyses

The institution has around 25,000 students and 1500 staff. The institutional on-premise email systems based on the Linux and Microsoft Exchange email services and were scattered across faculty service divisions, departments and the central IT department. The institution thus faced the challenge of centralising its email systems before migrating to the SaaS model. BETA moved only student mailboxes to the SaaS model. Table 6-1 outlines the sources of data and respective data source codes used for BETA.

Table 6-1

BETA Data Sources

Source	Data source code	Description
Semi-structured interviews	PB-1	IT manager
	PB-2	Systems engineer
	PB-3	IT technician
	PB-4	Systems engineer
	PB-5	IT technician
Website	W-B	Publically available organisation information and GAE and hosted O365 documentation
Public documents	PD-B	Publically available organisation annual reports and statistics
Photographs	PH-B	None
	FN-B	Initial meetings with gatekeeper
		Interviews and informal meetings
		User experiences/story details

Following the visual map analysis, the following sections discuss the punctuation, horizontal and vertical analyses for BETA. Table 6-2 summarises the results of the visual map analyses for BETA.

Table 6-2

Summary of the Results of BETA Visual Map Analyses

Dimensions of analysis	Punctuated	Horizontal	Vertical
Results of analysis	Three phases	Three trajectories	Two themes
	Centralisation Implementation Integration	Brokering roles Technicians/engineers split Complex systems	Governance Infrastructure Harmony

6.2 BETA Punctuation Analysis

The punctuation observed when moving the on-premise IT systems to the SaaS model at BETA traversed through three main phases: a centralisation process to bring various on-premise IT systems into a central IT system, implementation and integration of SaaS into business processes (Figure 6-1).

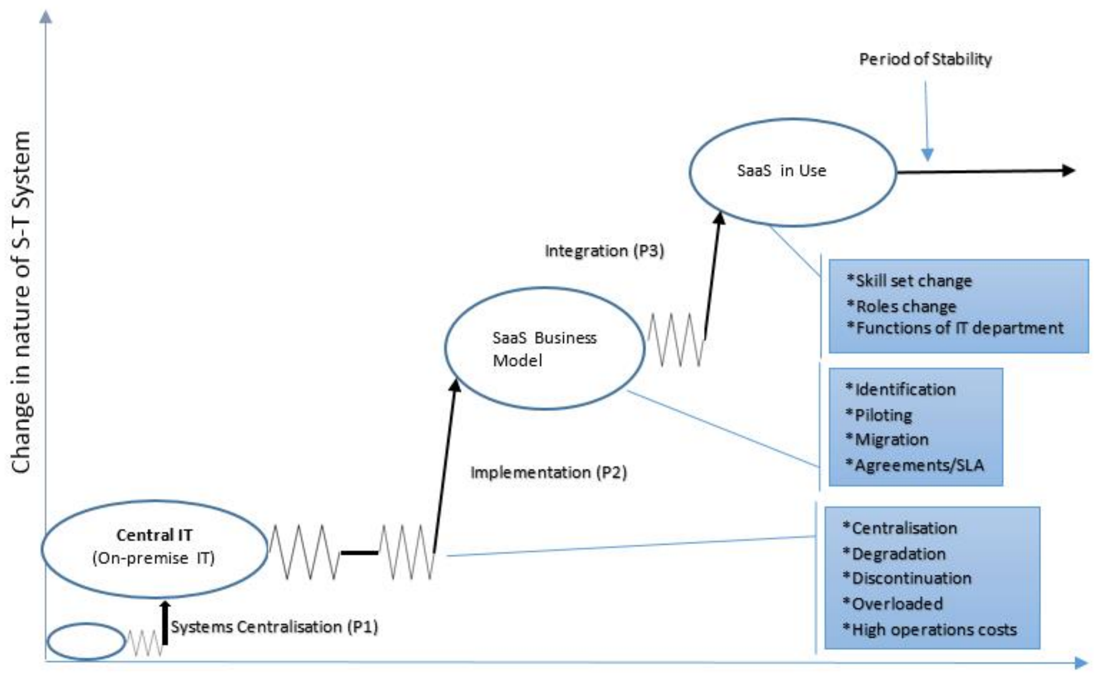


Figure 6-1. SaaS implementation trajectory of BETA.

6.2.1 Phase 1: Centralisation

Before moving the on premise email systems to the cloud-based system, the IT department centralised email services into an email service running on Microsoft Exchange servers housed in the central IT department. The centralisation of the email systems involved, taking email servers operating from different platforms (e.g. Outlook, GroupWise) into a single central email system run by the IT department. The executive decision to centralise the email systems and other systems such as storage, server hosting, lightweight directory access protocol (LDAP) services and identity management systems into the central system had an effect on IT department and faculty staff who were maintaining and servicing these systems. This also affected distributed IT workers in faculty service divisions, because they were no longer supporting faculty servers, as these were relocated to the central IT department. One IT manager explained the situation this way:

> So a lot of the faculties and service divisions were running their email servers, for example. So the effect on the organisation of centralising the email servers, as a centralised email service, that organisationally—so to give you some contrast—was a bigger impact on the IT organisation, than moving student email to the cloud. (PB-1)

The decision to centralise the systems aimed at addressing four major gaps: high operations costs, duplications of IT services, ineffectiveness, and uncertainty of IT service delivery. Table 6-3 summarises the gaps initiated from the critical incidents in the centralisation phase.

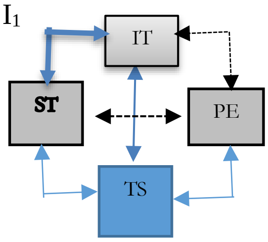
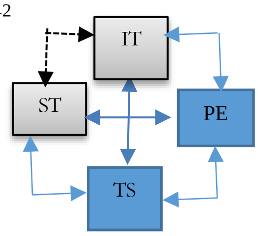
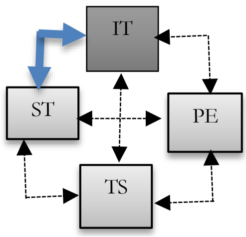
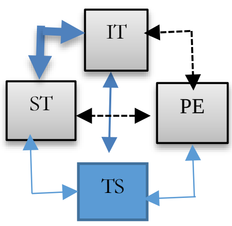
I_1: High Operational Costs

The institution had a collection of legacy systems across faculties, serving mainly IT needs within faculties. The operating costs of these systems were high because they were old, un-scalable, and difficult to integrate with newer systems. The executive decided to centralise various IT products and services under the IT department as a measure of cutting operations costs. An IT manager passionately elaborated on it this way:

That happened with a very senior executive mandate. So this was not something that was optional. It was quite clear that over something like 23 different core IT-related services, the big ticket items—which were the first ones tackled—which included storage, server hosting, email, identity and LDAP—all of those things were going to be centralised starting now.(PB-2)

Table 6-3

Critical Incidents in BETA Phase 1: Centralisation

Critical incident (I)	Gap (G)	Response to Gap (R)
I_1 	**G_1**: High operational costs: executives (PE) frustrated by high operational costs of IT delivery (IT) across faculties (ST). Disequilibrium: PE-IT, PE-ST	**G_1-R**: Punctuation: executive approved centralisation of IT services for cost saving and services delivery improvement across faculties
I_2 	**G_2**: Duplication of IT services: duplication of IT products and services (IT) across faculty division services (ST). Disequilibrium: IT-ST	**G_2-R**: Punctuation: centralised all duplicate IT products and services
I_3 	**G_3:** Ineffectiveness: running legacy IT systems (IT) and duplicating services across faculty service divisions and central IT (ST); lacked clarity of staff roles (PE) and duties in service delivery (TS). Disequilibrium: PE-IT, PE-ST, PE-TS	**G_3-R**: Incremental adaptation: management saw centralisation as an opportunity in change management of staff roles and duties in managing IT services
I_4 	**G_4**: Uncertainty: faculty staff (PE) lacked confidence in central IT service (IT) delivery across the institution (ST). Disequilibrium: PE-IT, PE-ST	**G_4-R**: Incremental adaptation: IT department increased efficiency in central IT services, eliminated ambiguity in IT service delivery and enhanced confidence building with faculty staff

That was the nature of the mandate … And the management of the effects of change on people went a certain way, but in many cases… Some of these systems had been created 20 years ago by people who had loved them for all that time, and whose users loved them too. And there becomes some self-defining aspect of that in the box-huggers—it is mine, I made it, you cannot take it away from me (PB-1).

I_2: Duplication of IT Services

Eliminating duplication of IT products and service delivery between faculty service divisions and central IT was aimed at service model changes. This was designed to streamline IT services, keep up with practices in IT service delivery, and drop out products and services that were no longer needed. This affected the IT workers supporting faculty service divisions, and those in central IT, because they were to serve all staff. An IT manager added that:

> So when that all came into the centre, there was an impact on the distributed IT workforce, because they no longer were looking after those things. There was also an impact … For the people looking after the central staff email service. Because it grew considerably because suddenly it had to take in all staff. So that was one area. The staff that was using those services in the faculties and the service divisions—in some cases, they received superior functionality or superior local support, and also the ability to have vanity [prestige] email addresses in subdomains … So that variety was largely diminished by the migration to a central email service. (PB-2)

I_3: Ineffectiveness

The management saw the centralisation mandate as a change management opportunity to bring changes in staff roles and the management of IT services, to increase efficiency and effectiveness of IT service delivery. An IT manager explained it this way:

> So there's a service model change where people in the faculties who were spending considerable amounts of time provisioning, feeding and watering,

> caring for, patching, dealing with user issues, their departmental email services—and they were either Linux-based or separate instance of Exchange—usually at faculty level, often at departmental level … People in the faculties also found that they were looking forward to having some of the time that they had been spending dedicated to looking after … these email systems freed up for other purposes, such as supporting of researchers, doing more hands-on stuff, doing more innovation at the faculty [level]. (PB-1)

I_4: Uncertainty (Politics and Power Struggles)

For the IT department, taking over IT products and services from the faculties, eliminated the ambiguities in IT service delivery. It also enhanced confidence building with faculty service divisions. However, the centralisation of IT services introduced power struggles and politics to some extent. An IT manager emphasised this on how the new technological arrangement needed to fulfil the organisational goals:

> So that did require quite a lot of deliberate change management, and quite a lot of confidence building to bring one faculty at a time into the centre and demonstrate that it worked well, and demonstrate they could live without their vanity [prestige] features, and demonstrate that it would be adequate and good. So some of it were confidence building, some of it were—we are sorry, you cannot be different anymore. So certainly, there was many politics around that … So there was a bit of … some emotion and some politics around that. (PB-2)

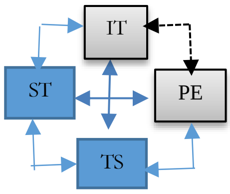
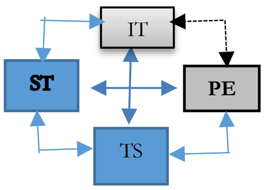
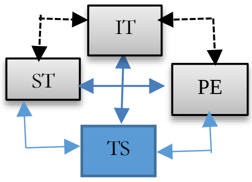
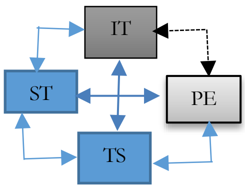
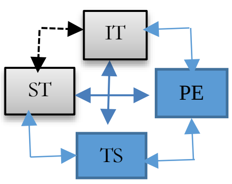
6.2.2 Phase 2: Implementation

Critical incidents observed during the implementation phase of BETA were based on addressing drivers that prompted BETA to migrate to the SaaS model, and on decisions around selecting a cloud service vendor. The drivers to migrate were the need to resolve issues of mailbox size expandability, a desire to establish email for life, an easier email interface, and complying with an official communication policy as per the

New Zealand's *Electronic Transactions Act 2002*. Selection criteria for the cloud service vendor centred on system maturity, usability, and vendor reputation in the cloud market. Table 6-4 summarises the gaps initiated from critical incidents in the implementation phase.

Table 6-4

Critical Incidents in BETA Phase 2: Implementation

Critical incident (I)	Gap (G)	Response to Gap (R)
I_5 	**G_5:** Vendor selection strategies: selecting one provider from fee-free cloud email services (IT) from two big cloud service providers was a decision the executive team (PE) had to make. Disequilibrium: PE-IT	**G_5-R**: Incremental adaptation: executive team considered system maturity, usability and vendor reputation as decision points when selecting Google as the preferred cloud service provider
I_6 	**G_6**: Expandability: number of users (PE) mailboxes exceeded the capability of an on-premise IT system (IT). Disequilibrium: PE-IT	**G_6-R:** Punctuation: migrating an on-premise IT system to a scalable SaaS system resolved capacity issues
I_7 	**G_7:** Email for life: the institution (ST) was losing email contacts (IT) for returning and alumni students (PE). Disequilibrium: PE-IT, ST-IT	**G_7-R**: Punctuation: implemented a fee-free Gmail used by students, by incorporating their existing private accounts as an email account for life
I_8 	**G_8**: Email interface: the email interface (IT) of an existing on-premise email system led to a poor user experience (PE). Disequilibrium: PE-IT	**G_8-R**: Incremental adaptation: during migration to the SaaS model, IT department used it as an opportunity to rebrand and enhance user email interface experience
I_9 	**G_9**: Communication policy: institution lacked an official email communication infrastructure (IT) to fulfil legal requirements (ST). Disequilibrium: IT-ST	**G_9-R:** Incremental adaptation: student email system incorporated contractual legal acknowledgement for abiding by an official communication policy

I_5: Vendor Selection Strategies

In 2010, two cloud service providers, Google and Microsoft, offering fee-free email services for staff and students, approached BETA. The institution did not advertise a tender; instead, it selected the GAE SaaS model for three main reasons. First, the maturity level of Google products at that time was superior to that of Microsoft systems. Second, organisations perceive as a neutral web player compared with a heavily corporate Microsoft. Finally, a high percentage of students were already using Gmail accounts, so GAE was a familiar environment for them. An IT manager explained it this way:

> We did not tender for this. We had simply been approached by two of the big players. They were the only sensible options because they were fee-free and they were already established, global players. At that time … both the feature set, the reliability, the footprint of Google was far superior to Microsoft. Both in terms of basic email and also in terms of those apps in the early days that were vastly superior regarding co-authoring … We also looked carefully at our student base. Most students relative to Microsoft already had a Gmail account. So they were familiar with the environment. They knew what to expect … Google also was perceived—and I think remains perceived and probably is—under their do no evil banner and their heavy presence as a relatively neutral web player, rather than the heavily corporate Microsoft—those factors came into consideration for us. (PB-1)

I_6: Expandability

BETA has an existing 200,000 mailboxes, and this increases by 20,000 new mailboxes annually. During system migration, BETA enabled SaaS scalability to allow system expandability for unlimited growth of mailboxes. An on-premise email system could not handle such an amount:

> And we have something like 200,000 Gmail accounts in our 'BETA' domain now; because there was a whole bunch, we created at the beginning, and we create another, let us say 20,000 a year. (PB-1)

I_7: Email for Life

The institution wanted to stay in touch with alumni and staff who left the organisation. For this reason, the institution decided to incorporate students' Gmail accounts to ensure they were contactable for life. In addition, there was a need for an easier way to re-activate user accounts for returning students. An IT manager explained this as a factor that compelled the organisation to move to the SaaS email system:

> For us, the factor I am speaking to there is lifelong relationships and being able to provide our students and our staff with email for life. So that was one driver for us to move off a locally managed student email service. Because we could see that we would grow and grow. (PB-1)

I_8: Email Interface

The look and feel of the old email system provided a poor user experience. The IT department decided to rebrand its new email under the institutional banner to enhance the email user interface. An IT manager explained it this way:

> It was open source [email system], and so students would log into that and see this weird screen they would never see again in their lives. So the user experience was another factor for us to consider. So students went from something that was bizarre-looking and not as usable as they were accustomed to in the email user world. So students were very happy about it. We branded it with our logo and said—this is your new Gmail, go. (PB-1)

I_9: Communication Policy

The institution introduced an official communication policy as per New Zealand's *Electronic Transactions Act 2002 that* requires every official communication sent by the institution to a student to be sent to their official institutional email address. An IT manager added that:

> And a driver that made both of those considerations more important for us was the introduction of an official communication policy for students, which specified that every official communication that was sent by the university to a student must be sent to their official 'BETA' email address. So that was also a driver to do a better job. The idea there being that students have, effectively, a behavioural contract to sign saying they will check their email regularly. And they do. We see most weeks there are about 35,000 active users in the Gmail domain for 'BETA'. (PB-1)

6.2.3 Phase 3: Integration

This phase entailed integrating the SaaS system into the main business processes. BETA integrated GAE with *student registry, collaboration tools,* and other *enterprise applications*. Table 6-5 summarises the gaps initiated from critical incidents in the integration phase, which are discussed in the following sections.

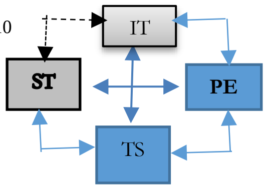
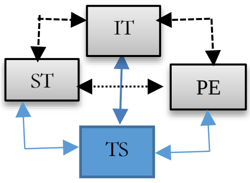
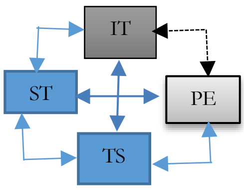
I_{10}: Student Registry

GADS incorporated the student registration system. GADS allows IT workers to automatically add, modify, and delete users, groups, and contacts to synchronise the data between the Google Apps domain and the institutional users' directory. An IT manager described that:

> The … enrolment group and identity information are now being sent off to Google out of the back of our active directory, and that provisions automatically not only for students, but also for staff, and contractors, and certain types of visitors. And (creates an) account in the 'BETA' Google domain. So that simply happens, and we do not have to think at all beyond the provisioning, about the email and the calendar service. (PB-1)

Table *6-5*

Critical Incidents in BETA Phase 3: Integration

Critical incident (I)	Gap (G)	Response to Gap (R)
I_{10} 	G10: Student registry: existing student registration system (ST) not incorporated into the legacy system (IT). Disequilibrium: ST-IT	G10-R: Punctuation: after migrating the on-premise IT system to the SaaS model, student registry incorporated into GADS
I_{11} 	G11: Collaboration: teaching staff (PE) lacked collaboration tools (IT) in teaching and learning business processes (ST). Disequilibrium: PE-IT, ST-IT, PE-ST	G11-R: Incremental adaptation: institution integrated various collaboration tools into teaching and learning processes
I_{12} 	G12: Enterprise apps: users (PE) lacked appropriate Google enterprise apps (IT). Disequilibrium: PE-IT	G12-R: Incremental adaptation: BETA enabling required 12 apps out of 63 available Google services

I*$_{11}$*: Collaboration

BETA integrated GAE into its learning and teaching collaboration tools, which included the following applications: Mail, Calendar, Contacts, Sites, and Google Groups for Business, Google Plus, Picasa, Google Hangouts, Blogger, and YouTube. An IT manager added that:

> So we have got a lot of accounts, there is a lot of email activity. There is a surprising and pleasing level of use of the other applications and the raw storage through the Google Drive. Also, we were requested by teaching staff who have seen international presentations about using Google Plus in their teaching and using Blogger in their teaching, to enable a range of additional services in the Google domain. So we had a project late last year to do that. And now we have got a wider range of Google services branded underneath 'BETA'. And they are being used in learning and teaching, and there are researchers using them as well for various things. (PB-1)

I_{12}: Enterprise Applications

Using Google applications and APIs, BETA integrated other applications into their business processes, including Google Office Suite (Docs, Slides, and Sheets), AdWords, Tasks, Drives, Maps, Translate, and Forms. An IT manager added that:

> Some people perhaps want to play with AdWords and things like that. I think at last count, there were 63 additional services available, and we have enabled about 12 that we knew there was a demand for. Again, that demand came from learning and teaching, where they wanted to be doing the stuff, and a little bit from student communications, who saw themselves slightly hamstrung with email as the only communication medium … and that some of these new things might give them some new tools to communicate well with their students. (PB-1)

6.2.4 Summary of BETA Punctuation Analysis

The three phases traversed by BETA were centralisation, implementation, and integration; these illustrate critical incidents occurring when migrating from an on-premise IT system to the SaaS model. They describe how responses to the critical incidents result in sociotechnical changes in the systems. Twelve critical incidents were identified.

6.3 BETA Horizontal Analysis

The horizontal interactions that emerged from the analysis of the visual map of the events at BETA are three trajectories—Brokering role, Technician/Engineer split and Mixed IT systems—which are summarised in Table 6-6 and discussed below.

Table 6-6

Summary of BETA Horizontal Analysis

	Systems architecture	Client/server	Cloud computing	Interviewee quote
Context	Systems type	On-premise IT (Microsoft Exchange 2008)	SaaS model (GAE)	
	Organisational (IT department) narratives	Brokering role		'Looked at all of the different things to do with IT that were being done across faculty service divisions and central IT, and tried to identify duplication' (PB-1). Related incidents: $\mathbf{I_7, I_9, I_{11}, I_{12}}$
	Build system (activities)	Technician/engineer split		'An engineer … understands how computing works, so they are trained to adapt and to be able to cope with anything, whereas a technician is trained to use an interface and a tool' (PB-2). Related incidents: $\mathbf{I_{10}, I_{11}, I_{12}}$
Process	Work system (activities)	Mixed IT systems		'Do provide some administration and assistance with the Google domain … similar things in some cases, for the student email, when we ran that locally. Across all of our servers now—and at last count, there was something such as 2000 different virtual servers that we know about from a central perspective' (PA-4). Related incidents: $\mathbf{I_5, I_6, I_7, I_{11}}$

6.3.1 Brokering Role

The trajectory of changes in roles and responsibilities of the BETA IT department drifted towards a brokering role, for two main reasons. First, centralisation of IT services from faculty service divisions to central IT made the IT department the sole custodian of the institutional IT products and services. Second, the IT department is responsible for integrating, managing, and monitoring cloud service provisioning with other third party providers. Therefore, the BETA IT department acts as an internal and external IT broker among faculties and for the organisation as a whole. An IT manager added:

> So that fell against the backdrop of an IT roles and responsibilities programme of work, which looked at all of the different things to do with IT that were being done across faculty service divisions and central IT, and trying to identify duplication. So a lot of the faculties and service divisions were running their email servers, for example. So there are some things that we have done since—such as starting to look at Lync as the unified communication platform for the institution—and we have got a large Yammer network up and running here as well now. (PB-1)

6.3.2 Technician/Engineer Split

After the migration of the on-premise IT system to the SaaS model, BETA IT workers required new skill sets and roles to manage the new system. However, IT workers exhibited different capabilities in acquiring new skills and taking on new roles, based on whether they were IT technicians or systems engineers. An IT manager described this difference:

> There is a difference between a technician and an engineer. An engineer … understands how computing works, so they are trained to adapt and to be able to cope with anything, whereas a technician is trained to use an interface and a tool. These guys are going—well, we know how that tool is built. So when you talk to the people who are the most under threat by this change, the technicians are most under threat. The engineers tend to be valued because the engineers have got an ability that goes beyond the tool. (PB-2)

IT workers normally support existing systems, and if systems change these workers need new skill sets and to adapt to new roles in supporting new technologies such as SaaS, otherwise they could become irrelevant to the organisation. An IT manager described it this way:

> So the providers work out the value of the individual's skills, and whether they can come up to stack or not. When you go to a SaaS situation, you have gone completely away from that set of skill sets to a different set of skills. And that is not always possible, in which case it means that unless there's enough work remaining for that skill set, then that role or the number of those roles will diminish. (PB-2)

New skills and roles in managing cloud computing include systems integration (by using programming tools such as APIs and web services), managing the SLA, and showing leadership in brokering roles. An IT manager added that:

> The future of jobs in IT is going to be based on integration, vendor management, and leadership. These are the skills that you need, and if you cannot do those things you will be a legacy guy. (PB-1)

6.3.3 Mixed IT Systems

Migrating the on-premise IT system to SaaS and other cloud models transformed the IT infrastructure at BETA into a complex mixed IT system with both on-premise physical and virtualised systems, and SaaS systems. An IT manager elaborated in this way:

> We still have a core of people (IT workers) … who do provide some administration and assistance with the Google domain. They were doing some similar things in some cases, for the student email when we ran that locally. Across all of our servers now—and at last count there was something like 2,000 different virtual servers that we know about from a central perspective—there are more from a faculty and research perspective—through a combination of using the Microsoft tools for the Microsoft servers, and using Linux tools such

as Puppet for the Linux servers—we're doing much automatic management of those servers. We have got a large enterprise monitoring and management facility in place, to know what is healthy and what is sad. (PB-1)

6.3.4 Summary of BETA Horizontal Analysis

Three BETA horizontal trajectories—Brokering role, Technician/Engineer split, and complex Mixed IT systems—illustrate the relationships among critical incidents. The trajectories relate to 12 critical incidents identified during the punctuation analysis. Figure F-2 in the appendices describes the BETA trajectory visual map of the migration process from the on-premise IT system to the SaaS model.

6.4 BETA Vertical Analysis

This analysis focused on the gaps in the sociotechnical systems, from the activities of both the building (B_1–B_{12}) and work systems (W_1–W_{12}) resulting from a critical incident. Comparing and contrasting the critical incidents with similar gaps led to the matrix in Table 6-7, and the simplified summary version in Table 6-8. Each gap in these subsystems was analysed on the four-sociotechnical dimensions to form an interaction matrix. For example, gaps depicting disequilibrium between people (PE) and structure (ST) are listed in the cell of the second row of the first column as I_1, I_3, I_4, and I_{11}.

Table 6-7

BETA Contrasting of Gaps and Incidents

	Structure	Information technology	People	Task
Tasks		I_2	I_3,	X
People	I_1, I_3, I_4, I_{11}	I_1, I_3, I_4, I_6, I_5, I_6, I_7, I_{11}, I_{12},	X	
Information technology	I_7, I_9, I_{10}, I_{11}	X		
Structure	X			

The subtitle of these incidents describing the disequilibrium between people (PE) and structure (ST), that is exorbitant, ineffectiveness, uncertainty and collaboration tools are identified under ‘PE-ST’ relationship, and are analysed to represent a theme ‘Governance’ as indicated in Table 6-8 (see Table F in the appendices for more detail). Also, subtitles of incidents describing the disequilibrium between technology (IT) and structure (ST)—include, email for life, communications policy, student registry and collaboration tools, are identified under IT-ST relationship and are analysed to represent a theme ‘Infrastructure’. Similarly, the study analysed the subtitles in the cell PE-IT–having subtitles: high operation cost, ineffectiveness, uncertainty, vendor selection strategy, expandability, email for life, collaboration, and enterprise applications, to represent a theme ‘Harmony’, and the following sections discuss these themes.

Table 6-8

Summary of BETA Vertical Analysis

	Structure (ST)	Information technology (IT)
People (PE)	Governance	Harmony
Information technology (IT)	Infrastructure	

6.4.1 Governance (PE-ST)

The gap between people and structure is evident in the executive team (PE) noticing the high operational costs, ineffectiveness and uncertainty of legacy systems across faculties, and the need for a system with enhanced collaborative tools (ST). Table 6-9 summarises the gaps and incidents that resulted in governance initiatives, as a response to cost cutting, confidence building, and integration of collaboration tools in the new system.

The executive team decided to reduce the maintenance and operational costs of legacy systems by centralising them under the IT department (or central IT). An IT manager elaborated this way:

> Well, perhaps unusually for a university, that happened to a very senior executive mandate. So this was not something that was optional. It was quite clear that over something like 23 different core IT-related services, the big-ticket items—which were the first ones tackled—which included storage, server hosting, email, identity and LDAP—all of those things were going to be centralised starting now. That was the nature of the mandate. (PB-1)

Table 6-9

Gaps between People and Structure in BETA

Critical incident	Expression of a gap	Gap (G)
I_1	Ageing legacy systems running at high operational and support costs, needing control to reduce or prevent this	Executives (PE) noted large operational costs across faculties (ST)
I_3	Staff from central IT and faculty division services duplicated provision of IT products and services; hence centralisation of IT provisions was required	Duplication of IT provisions across faculty service divisions, and central IT (ST) suggested lack of clarity of staff roles (PE)
I_4	After IT products and services had been centralised, staff from faculties had low confidence in provision of IT services by central IT staff, making confidence building necessary	Faculty division services staff (PE) lacked confidence in central IT infrastructure (ST) service delivery
I_{11}	Academic staff demanded a system that incorporates teaching and learning tools as experienced by external colleagues; new system required to meet the demand	Teaching staff (PE) required incorporation of teaching and learning, and collaboration tools into business processes (ST)

Also, management of staff members' emotions and the politics around the centralisation exercise was required. This was particularly true for faculty staff who created or managed legacy systems for years and for faculty users who had received premium service and lost confidence in IT service delivery from the central IT department. Thus, the IT department made deliberate change management efforts to build confidence with users across the organisation. One IT manager described this as follows:

> And there becomes some self-defining aspect of that in the box-huggers—it is mine, I made it, you cannot take it away from me. So that did require quite a lot of deliberate change management, and quite a lot of confidence building to bring one faculty at a time into the centre and demonstrate that it worked well, and demonstrate they could live without their vanity features, and demonstrate that it would be adequate and good. So some of it were confidence building, some of it were—we are sorry, you cannot be different anymore. So certainly there was many politics around that. (PB-1)

Similarly, the IT department governed integration of IT applications with the SaaS model as required by academic staff. An IT manager explained:

> We started off just with the core applications, which were effectively Mail, Calendar, Contacts, Sites and Google Groups for Business … We have since expanded that by … a dozen applications including Google Plus and … Picasa and YouTube. We have enabled Google Hangout (and) Blogger. Again, that demand came from principally learning and teaching, where they wanted to be doing the stuff, and a little bit from student communications, who saw themselves slightly hamstrung with an email-only world—email plus content management system—and … some new tools to communicate well with their students. (PB-1)

6.4.2 Infrastructure (IT-ST)

Three issues arose from the gap between IT and ST: email for life for students, enforcing policies, and collaboration. Table 6-10 summarises the gaps and incidents that became apparent to the researcher. On the first issue, the institution was losing contact details for returning alumni and hence was unable to create a lifelong relationship with students due to the inadequacies of the current email system. In response, the institution opted for a SaaS system—an elastic platform expandable and capable of providing student email for life. An IT manager elaborated on this:

> For us, the faster I am speaking to there is lifelong relationships and being able to provide our students and our staff with email for life. So that was one driver for us to move off a locally managed student email service. Because we could see that we would grow and grow. (PB-1)

Table 6-10

Gaps between Information Technology and Structure in BETA

Critical incident	Expression of a gap	Gap (G)
I_7	Inability of the institution to retain alumni and student contact details	Failure of the email system (IT) to maintain a lifelong relationship (ST) with students
I_9	Legacy systems lacked the capacity to hold all students' email communications	Current email system (IT) unable to enforce legislation relating to communication via official email address because of system's capability constraints (ST)
I_{10}	The SaaS model has to incorporate the student registration system	Student registration system (ST) needed to be incorporated into an email system (IT)
I_{11}	Academic staff lacked collaboration tools needed for teaching and learning processes	Collaboration tools (IT) were not available in teaching and learning processes (ST)

The second issue is related to a range of legacy systems that created inconsistency in how to enforce the student email policy of having an official email communication to students via an institutional email system. This policy forms part of the compliance with New Zealand's *Electronic Transactions Act 2002*. This was one of the drivers to migrate to a SaaS email system, which provides both the mechanism and the infrastructure capability. An IT manager added:

> Moreover, a driver that made both of those considerations more important for us was the introduction of an official communication policy for students, which specified that every official communication that was sent by the university to a student must be sent to their official University of Auckland email address. So that was also a driver to do a better job. The idea there being that student has, effectively, a behavioural contract to sign saying they will check their email regularly (PB-1).

The last issue relates to incorporating the student registry into GADS and collaboration tools, thus unifying the student registration process with the email system, as well as enhancing teaching and learning processes. An IT manager explained:

> And now we have got a wider range of Google services branded underneath 'BETA'. And they are being used in learning and teaching, and researchers are using them as well for various things. So those were some of the factors … Again, that demand came from principally learning and teaching, where they wanted to be doing the stuff, and a little bit from student communications, who saw themselves slightly hamstrung with an email-only world—email plus content management system—and that some of these new things might give them some new tools to communicate well with their students. (PB-1)

6.4.3 Harmony (PE-IT)

The gap between people (PE) and IT relate to frustrations due to the inefficiency of legacy systems and service delivery, as well as system capabilities and integration issues. Table 6-11 summarises the gaps and incidents that needed to be harmonised with people, and how these were manifested to the researcher. As indicated in Table F, the term harmonise in this study describes how IT workers brought into control various issues and challenges faced by the IT systems into an agreeable working standard, and eventually, people and technology worked in harmony.

The executive team had become frustrated by high operating costs and duplication of IT legacy systems in faculties and central IT. In addition, users were confused about IT support staff responsibilities and ownership of various IT service delivery processes. As a response to these gaps, the executive ordered systems centralisation and harmonisation of IT service delivery under the central IT. An IT manager explained:

> Unusually for 'BETA', that happened to a very senior executive mandate. So this was not something that was optional. It was quite clear that over something like 23 different cores IT-related services … all of those things were going to be centralised starting now. That was the nature of the mandate. (PB-1)

Table 6-11

BETA Gaps between People and Information Technology

Critical incident	Expression of a gap	Gap (G)
I_1	Executive team frustrated by the high operating costs of IT delivery	Executives (PE) noted high operational costs of legacy IT systems (IT)
I_3	Lack of clarity on staff roles for IT delivery, resulting in inefficient services	Duplication of IT services (IT) across faculty service divisions and central IT lacked clarity in staff roles (PE)
I_4	Central IT staff must build confidence and prove they are capable of delivering IT services to the entire organisation	Faculty staff (PE) lacked confidence in IT service delivery provided by central IT systems (IT)
I_5	Executive team challenged to select a cloud provider	Executive team (PE) challenged to choose a SaaS system (IT) to fit the organisation
I_6	On-premise IT system expandable to cater for required mailbox sizes	Number of users (PE) mailboxes exceeded the ability of the on-premise IT system (IT) to handle
I_7	BETA was losing an opportunity to retain contact with both alumni and returning students	Institution (ST) unable to retain email contact (IT) with alumni (PE)
I_{11}	Academic staff frustrated by lack of online collaborative tools with students	Teaching staff (PE) lack collaboration tools (IT) for teaching and learning business processes (ST)
I_{12}	Users demanded more Google applications for doing various business tasks	Users (PE) demanded Google Enterprise Apps (IT) be incorporated into the new system

Centralisation stirred up some emotions and politics among faculty staff who had created the legacy stream:

> Some of these systems had been set up 20 years ago by people who had loved them for all that time, and whose users loved them too. And there becomes some self-defining aspect of that in the box-huggers—it is mine, I made it, you cannot take it away from me. (PB-1)

Some disgruntled users lost confidence in IT delivery from central IT. As a result, the IT department required deliberate change management initiatives to harmonise IT service delivery across the organisation and build confidence. An IT manager elaborated:

> So that did require quite a lot of deliberate change management, and quite a lot of confidence building to bring one faculty at a time into the centre and demonstrate that it worked well, and demonstrate they could live without their vanity features, and demonstrate that it would be adequate and good. So some of it were confidence building, some of it were—we are sorry, you cannot be different anymore. So certainly, there was many politics around that. (PB-1)

Also, some users required more mailbox space, collaborations tools, and applications, and the desire to provide email for life was provided accordingly. The IT manager added:

> We started … with the core applications, which is … Mail, Calendar, Contacts, Sites, and Google Groups for Business … We have since expanded that by … another dozen applications including Google Plus … Google Hangouts … Blogger. Some particular people have asked for things like Google Chrome Sync … AdWords and things like that. I think … there were 63 additional services available, and we have enabled about 12 that we knew there was a demand for. Again, that demand came from principally learning and teaching,

where they wanted to be doing the stuff, and a little bit from student communications. (PB-1)

6.4.4 Summary of BETA Vertical Analysis

In summary, these vertical themes—Governance (PE-ST), Infrastructure (IT-ST) and Harmony (PE-IT)—provide insights into how issues between people and structure are governed; how the integration of IT into organisational structures formed system infrastructure; and how IT features required by people were harmonised.

6.5 Overall Summary of BETA Visual Map Analyses

Each of the punctuation, horizontal, and vertical analysis for BETA provided unique insights into the implications of moving an on-premise IT system to the SaaS model. Table 6-12 provides a summary of the punctuation, horizontal and vertical analysis of BETA.

Table 6-12

Summary of BETA Visual Map Analyses

#	Incident	Gap	Gaps (sociotechnical) form	Gap resolution	Punctuated analysis (phase)	Horizontal analysis (trajectory)	Vertical analysis (theme)
1	High operational cost	Executives (PE) frustrated with high operational costs of IT delivery (IT) across faculties (ST)	PE-IT PE-ST	The executive approved IT services to be centralised for cost saving and service delivery improvement across faculties	Centralisation		Governance; Harmony
2	Duplication of IT services	Duplication of IT products and services (IT) across faculty division services (ST)	IT-ST	All duplicate IT products and services were centralised			
3	Ineffectiveness	Running legacy IT systems (IT), and duplication of services across faculty service divisions and central IT (ST) created lack of clarity over staff roles (PE) and duties in service delivery (TS)	PE-IT PE-ST PE-TS	Management saw centralisation as an opportunity for change management of staff roles and duties in managing IT services			Governance; Harmony
4	Uncertainty	Faculty staff (PE) lacked confidence in central IT service (IT) delivery across the institution (ST)	PE-IT PE-ST	IT department increased efficiency in central IT services, eliminated ambiguity in IT service delivery and enhanced confidence building with faculty staff			Governance; Harmony

5	Vendor selection strategies	Selecting one provider of fee-free cloud email services (IT) from two big cloud service providers was a decision executive team (PE) had to make	PE-IT	Executive team examined system maturity, usability and vendor reputation as decision points when selecting Google as a preferred cloud service provider	Implementation	Mixed systems	Harmony
6	Expandability	Some user (PE) mailboxes exceeded the capability of an on-premise IT system (IT)	PE-IT	Migrating the on-premise IT system to a scalable SaaS system resolved capacity issues		Mixed systems	Harmony
7	Email for life	The institution (ST) was losing email contact (IT) with returning and alumni students (PE)	PE-ST PE-IT	Implemented fee-free Gmail for use by students, by incorporating their existing private accounts as an email account for life		Mixed systems; Brokering role	Infrastructure; Harmony
8	Email interface	Email interface (IT) of an existing on-premise email system portrayed bad user experience (PE)	PE-IT	IT department used migration to the SaaS model as an opportunity to rebrand and enhance user email interface experience			
9	Communication policy	Institution lacked an official email communication infrastructure (IT) to fulfil legal requirements (ST)	IT-ST	Student email system incorporated contractual and legal acknowledgement of abiding with a formal communication policy		Brokering role	Infrastructure
10	Student registry	Existing student registration system (ST) not incorporated into the legacy system IT)	IT-ST	After migrating the on-premise IT system to the SaaS model, student registry incorporated into GADS	Integration	Technician/engineer	Infrastructure

11	Collaborations	Teaching staff (PE) lacked collaboration tools (IT) for teaching and learning business processes (ST)	PE-ST PE-IT	Institution integrated various collaboration tools into teaching and learning processes	Brokering role; Mixed systems; Technician/engineer	Governance; Infrastructure; Harmony
12	Enterprise apps	Users (PE) lacked appropriate Google enterprise apps (IT)	PE-IT	BETA enabled 12 required apps out of the 63 available from Google services	Technician/engineer; Brokering role	Harmony

Chapter 7: CHITA Case Analysis

7.1 CHITA Visual Map Analyses

CHITA has 20,000 students and 1570 staff. The institution's email system was running on a Sun Java email server—a customised legacy on-premise IT system. The Java email system has the capability to host over one million user mailboxes, unlike Microsoft Exchange, which is limited to 10,000 mailboxes. However, the Java email system encountered two main problems: capacity constraints—offering low user mailbox quotas of 20 MB for students and 50 MB for staff; and the inability to connect to the Microsoft Outlook client—as was sometimes required in class demonstrations.

Given these problems, in 2010 the management team made the decision to move the mailboxes of the Java system to two different systems (hybrid deployment). Around 20,000 student mailboxes transferred to a Microsoft Live@edu system— this system is hosted external to New Zealand, which had implications for the decision to move staff emails to this system. Thus, the 1570 staff accounts transferred to an on-premise Microsoft Exchange 2010, hosted by the University. Live@edu is an early version of the O365 system and offers training institutions, a free hosted, co-branded communication, and collaboration services for students, faculty members, and alumni. With 10 GB of email storage, it is a no-cost Outlook Live email service built on Exchange Server 2010.The migration solved two problems: the student mailbox quota increased to 10 GB with Live@edu and Exchange Server 2010 was able to connect to Outlook for class demonstrations. However, in late 2012, the institution was required to migrate student accounts from the Live@edu system to O365 (a SaaS) and integrate it into business processes, as Microsoft was planning to decommission the Live @edu system after being replaced by the hosted O365. Table 7-1 outlines the sources of data for CHITA and the data source codes used. This case study facilitates examination via visual map analysis techniques of the migration of a student email system from Java to O365.

Table 7-1

CHITA Data Sources

Source	Data source code	Detailed description
Semi-structured interviews	PC-1	Email systems engineer
	PC-2	Systems engineer
	PC-3	IT technician
	PC-4	IT manager
Website	W-C	Publically available organisational information and GAE and O365 documents
Public documents	PD-C	Publically available organisation annual reports and statistics
Photographs	PH-C	Few pictures where taken
Field notes	FN-C	Initial meetings with gatekeeper
		Interview and stand-up meetings
		User experiences/story details

Four IT workers involved in the migration from the old email system to the cloud-based system were interviewed. Table 7-2 summarises the results of the punctuation, horizontal and vertical analyses for CHITA.

Table 7-2

Summary of the Results of CHITA Visual Map Analyses

Dimensions of analysis	Punctuated	Horizontal	Vertical
Results of analysis	Three phases	Three trajectories	Two themes
	Hybrid deployment	Support services levels	Dominance
	Migration to SaaS	Cost issues	Technological coercion
	Integration	New skill sets	

7.2 CHITA Punctuation Analysis

Punctuation occurred when the on-premise IT system (Sun Java server) was unable to integrate with the Outlook client and offered limited mailbox quotas to staff and students. In response, the executive team ordered the system to be migrated to a hybrid infrastructure; that is, student accounts moved to the cloud-based Live@edu system, and staff were hosted on Microsoft Exchange 2010—the on-premise IT system. CHITA subsequently migrated the Microsoft Live@edu system to O365 under the SaaS model and integrated it into business processes. The following sections discuss these punctuation phases: hybrid deployment, migration to SaaS, and integration into teaching and learning processes as illustrated in Figure 7-1.

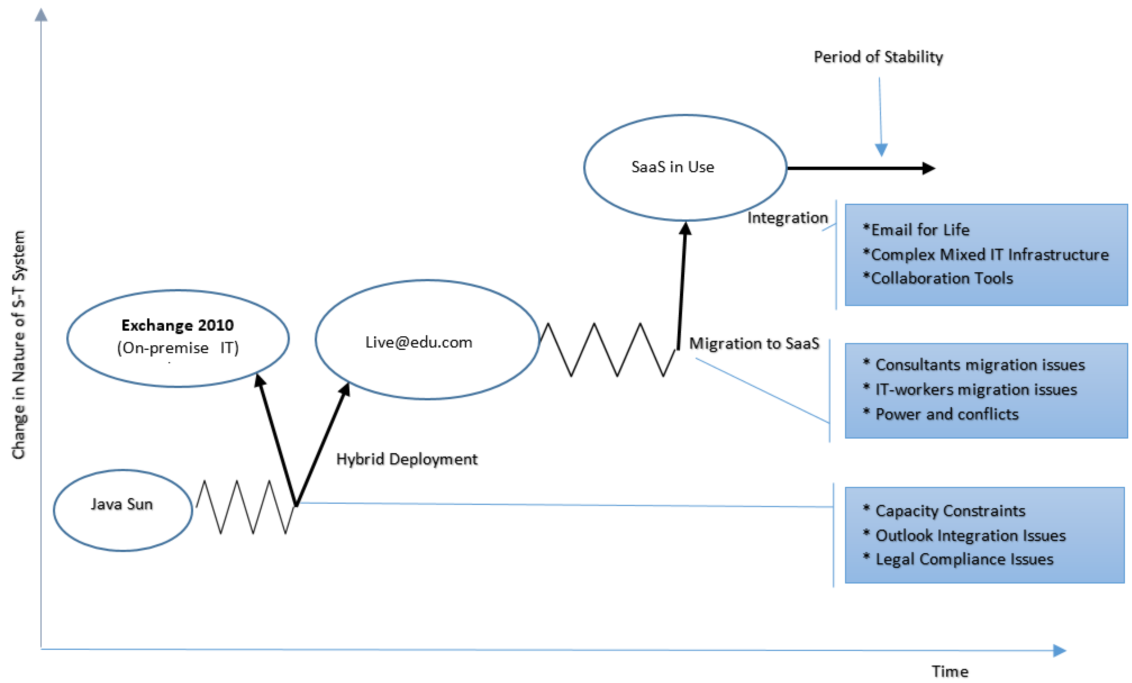


Figure 7-1. SaaS implementation trajectory of CHITA.

7.2.1 Phase 1: Hybrid Deployment

The critical incidents in this phase include the mailbox capacity constraints of the Java system; the inability of the Java server to connect to the Microsoft Outlook client; and privacy and legal concerns. In response, the IT management team ordered the Java system to be migrated to a hybrid infrastructure involving Microsoft Live@edu for students and on-premise Exchange Server 2010 for staff.

Table 7-3 summarises the gaps initiated by critical incidents in the hybrid deployment phase. These incidents are discussed in the following sections.

I_1: Capacity Constraints

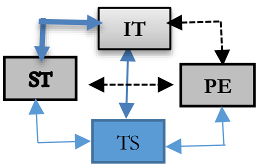
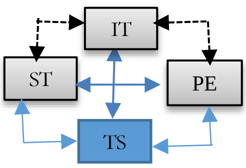
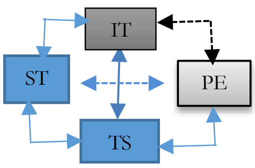
The Java email server for CHITA had the capability to connect to over one million email accounts but with limited mailbox quotas, which was unsatisfactory for both staff and students. An IT manager explained:

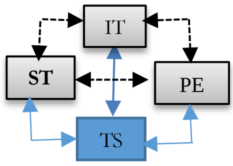
> *So we were [using Sun Java email server] for a long time, but the only problem … was the students. We had … 20-MB quotas for students only, and 50 MB for staff.* (PC-1)

Hence, management decided to migrate the email system to other systems to increase the mailbox quotas.

Table 7-3

Critical Incidents in CHITA Phase 1: Hybrid Deployment

Critical incident (I)	Gap (G)	Response to gap (R)
I_1 	**G_1**: Capacity constraints: users (PE) unhappy with mailbox quota (ST) allocated on the Sun Java system (IT). Disequilibrium: PE-IT, PE-ST	**G_1-R**: Punctuation: IT management decided to migrate to a hybrid system with larger mailbox quotas
I_2 	**G_2:** Outlook client issues: staff (PE) unhappy with the inability of the Java email system (IT) to connect to the Outlook client (ST) for class demonstrations. Disequilibrium: IT-ST, PE-IT	**G_2-R**: Punctuation: institution decided staff mailboxes should be migrated to Exchange 2010 system, capable of connecting to the Outlook client
I_3 	**G_3:** Privacy issues: staff (PE) worried about moving their mailboxes from an on-premise email system to a cloud-based hosted solution (IT). Disequilibrium: PE-IT	**G_3-R**: Punctuation: staff Java mailboxes moved to an on-premise Microsoft Exchange Server 2010 instead

I_4 	**G_4:** Legislative compliance: staff (PE) unhappy with the Sun Java system (IT) but there was legal compliance issues (ST) when migrating to a new system. Disequilibrium: PE-IT, PE-ST	**G_4-R:** Punctuation: the institution agreed to keep staff off the cloud-based system to achieve public act compliance

I_2: Outlook Client Issues

Faculty staff and students wanted to connect the Microsoft Outlook client to the Sun Java email system for class demonstrations. Thus, the inability of the Java email system to connect to the Outlook client caused frustration for both students and faculty staff. An IT manager explained:

> So there was a desire from management to go to the Exchange Server because we had a problem … to connect Outlook to Sun Java—back to Sun Java—but it did not work very well. So people wanted Outlook as a native experience—staff and management—so they pushed us to go to Exchange Server. (PC-1)

As a response to this problem, IT management decided to migrate the 1,500 staff email accounts to Exchange Server 2010 and the 20,000 student accounts to Live@edu (now O365). PC-1 added:

> But we could not (move students also to Exchange Server 2010), because of a number of students. So we basically moved them to Live@edu—back then it was Live@edu. And now it is called Office 365. So we basically migrated all [student] accounts to there [O365]. And then we migrated one year ago all staff to Exchange Server 2010, which 1.5 thousand users. So that was a driver for moving to the cloud-based system. (PC-1)

I_3: Privacy Issues

CHITA did not move staff email accounts to Live@edu, because of concerns raised by staff about having mailboxes in the hosted environment, with respect to New Zealand's *Privacy Act 1993*. A systems engineer added:

> The Privacy Act establishes a set of privacy principles to ensure the protection of personal privacy in respect of personnel in any New Zealand organisation. This Act is very important, and we are not exempted from this. (PC-2)

Therefore, only student mailboxes were migrated to the Live@edu infrastructure, and hosted outside New Zealand borders: the staff remained in the on-premise IT system. An IT manager alluded to this:

> The only issue I see is privacy and legal compliance issues … Can we keep this communication between tutors—because it is records—it is official communication between students and tutor? It can be—basically because it goes out of New Zealand, this information —is it legal—how it is handled? I do not know. I know that these are the reasons why we legally can't put staff (mailboxes) on the cloud outside of New Zealand. (PC-1)

I_4: Public Records Act Compliance

The New Zealand *Public Records Act 2005* guides the selection and archiving of public records for five years. Such records include emails and various forms of documents. CHITA, like other institutions, is obliged to fulfil the legal requirement of archiving all staff communications in the organisation—that provides evidence of transactions and activities. A systems engineer confirmed this:

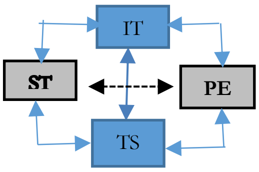
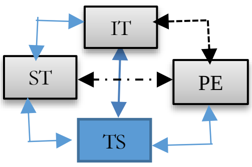
> For staff, we do archive, and we have to fulfil for legal compliance. We do for the staff of course, but for students, no we do not. (PC-1)

7.2.2 Phase 2: Migration of the Student System to a SaaS System

CHITA decided to migrate its student accounts from Live@edu to O365, which is a SaaS system hosted in Singapore. This phase of the study analyses the engagement of consultants and IT workers in the migration process. Microsoft contracted consultants to CHITA at no charge to help migrate the student mailboxes. However, the consultants pulled out of the project before it was completed because CHITA's management delayed the process for around one year (2010–2011), by not cooperating well with the external consultants. Consequently, early 2011, IT workers (i.e. CHITA's IT staff) used Microsoft's migration guidelines to move student mailboxes from Live@edu to O365, and completed in late 2011. Table 7-4 summarises incidents occurring during the migration process.

Table 7-4

Critical Incidents in CHITA Phase 2: Migration

Critical incident (I)	Gap (G)	Response to gap (R)
I_5 	**G_5:** Migration by consultants: Consultants (PE) frustrated by the failure of management support (ST) to migrate mailboxes from Live@edu to Office 365. Disequilibrium: PE-ST	**G_5-R:** Punctuation: CHITA IT management decided to engage its IT workers to do the migration
I_6 	**G_6:** Migration by IT workers: CHITA's IT workers (PE) struggled to configure the Office 365 (IT) system structure (ST). Disequilibrium: PE-IT, PE-ST	**G_6-R**: Incremental adaptation: IT workers resorted to using configuration guides to accomplish the work, as they learn how the system works

I_5: Migration by Consultants

A consultant engaged by Microsoft to help CHITA migrate Live@edu to the SaaS model, O365, was unable to finish the work because of sociotechnical issues within the organisation. PC-1 explained how this brought frustrations to the IT workers, and had to migrate the student mailboxes themselves:

> So it was a business case for this thing. And this consultancy firm, work with universities—had a free programme funded by Microsoft to help to move accounts. However, unfortunately, because we were very slow and the project was sabotaged for almost one year by the management… (PC-1)

I_6: Migration by IT Workers

As a result, the CHITA's IT workers consulted various Microsoft online guidelines and documentation to move student mailbox accounts from Live@edu to O365. An IT manager explained:

> When the offer ended, so we had to move it by ourselves, without help … So that is what happened. So we used the instructions on how doing this and moved it ourselves. (PC-1)

7.2.3 Phase 3: Integration

Critical incidents that characterised the integration phase relate to issues of email for life, the complexity of the mixed IT infrastructure and the inability of O365 collaboration tools to enhance teaching and learning. Table 7-5 summarises the gaps initiated in the integration phase and discussed in the following sections.

I_7: Email for Life

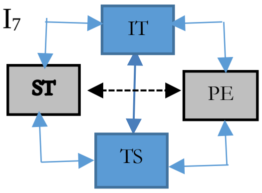
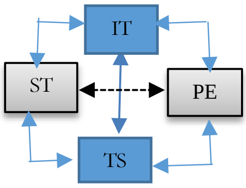
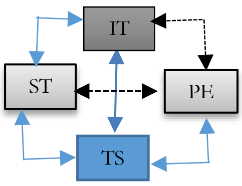
With the earlier system, Live@edu, CHITA maintained student accounts on one system. When students left, IT workers simply deleted the account or blocked it from connecting to the institution active directory and then it continued with an alumni student for life. However, the introduction of O365 raised some issues:

> With Office 365, it is a different story. You cannot … completely disconnected … so you create accounts and then you cannot even reset the password there [Office 365] easily. So if you change the password here—so you need to maintain the second system over there. Or … they need to authenticate locally through Enhanced Distributed File System servers, which authenticates them here against the local directory, and then redirect them to there—so that is how it works. Moreover, then this creates also a problem because people are leaving—we cannot disable their account properly. We need to keep their accounts open, but we still need to mark them as disabled, so they cannot log on here actually.

So that is, from my point of view, created many problems. Personally, I am not happy. It is not brilliant or transparent, and it is a little bit clumsy as I see … so they forced us to keep all students' accounts. (PC-2)

Table 7-5

Critical Incidents in CHITA Phase 3: Integration

Critical incident (I)	Gap (G)	Response to gap (R)
I_7 	**G_7:** Email for life: IT workers (PE) unhappy with Office 365 structure (ST) settings for email for life for alumni. Disequilibrium: PE-ST	**G_7-R:** Incremental adaptation: institution forced to retain disabled alumni accounts on a local directory
I_8 	**G_8:** Complex mixed IT infrastructure: IT workers (PE) challenged by the complexity of the infrastructure of SaaS and on-premise email systems (ST). Disequilibrium: PE-ST	**G_8-R**: Incremental adaptation management sent some IT workers for upskilling to handle the complex IT infrastructure
I_9 	**G_9:** Inadequacy of collaboration tools: Staff (PE) unimpressed by the inability of Office 365 (IT) to provide teaching and to learn collaborative (ST) enhancement. Disequilibrium: PE-IT, PE-ST	**G_9-R:** Punctuation: management encouraged staff to use Blackboard instead as a teaching and learning collaboration platform

I_8: Complex Mixed IT Infrastructure

When it was running a legacy on-premise IT system, CHITA had one email server (Java system). In the present mixed IT infrastructure, the institution runs two separate email systems. The first is the on-premise IT system for staff, which is Exchange Server 2010 via six servers (for storage and messaging). The second is O365, a SaaS system for students, supported by two on-premise servers for authentication and synchronisation. The eight on-premise servers and the SaaS model produce a complex IT infrastructure with added challenges for IT workers, as explained by a systems engineer:

> The current setup (Exchange 2010 and O365) has become more complicated. Live@edu was fine … Now we have two servers only supporting this authentication and synchronisation for students, and for staff, we have six because we have Exchange Server 2010 hosted on six servers; that is four mailbox servers, two unified messaging servers. (PC-2)

I_9: Collaboration Tools

CHITA had trouble setting up the O365 collaborative tools, as explained by a systems engineer:

> That is the biggest thing. Yes, we had lots of discussions—should we use it or not? We had discussions with Microsoft as well. How they see it. Then we have seen how Google uses it. We were much more impressed with Google actually than the Microsoft. The way how they do this Hangout system and other things. Regarding the simplicity and features of communicating, like sharing, Microsoft has it, but we found it a little bit difficult, actually to use it. (PC-2)

Rather, staff are encouraged to use Blackboard as a principal communication tool for teaching and learning:

The Blackboard is the primary student communication tool. For instance, learning materials—primarily they teach—like notes from lecturers—they put up to a shared drive … So we had —how to use Live@edu, but we found Office 365 … unclear. There is no clear, straightforward understanding how to—because people expect from us some guidance, we should say... (PC-2)

7.2.4 Summary of CHITA Punctuation Analysis

The three phases—hybrid deployment, migration, and integration—illustrate critical gaps occurring when moving the on-premise IT system to the SaaS model. The phases show how responses to critical incidents introduced profound sociotechnical changes into the systems.

7.3 CHITA Horizontal Analysis

The trajectories of changes from the on-premise IT system to the SaaS model that emerged in this horizontal analysis include: changes in the Support service level of IT workers within the IT department, Cost issues in building systems activities and New skill sets requirements. Table 7-6 summarises the horizontal analysis.

Table 7-6

Summary of CHITA Horizontal Analysis

	Systems architecture	Client/server	Cloud computing	Interviewee quote
	Systems type	On-premise IT (MS Exchange. 2010)	SaaS model (Office 365)	
Context	Organisational (IT department) narratives	Support service level		'I would say the work moved maybe from second level support more to third level support' (PC-2). Related incidents: **I_6, I_8**
Context	Build system (activities)	Cost issues		'Cost is a factor, of course, but because we did not pay extra for Sun Java—that is why the cost was not an actual driver. Actually, by moving stuff, we spent more money than we were' (PC-2). Related incidents: **I_1, I_7**
Process	Work system (activities)	New skill set		'And it requires definitely expertise in ADSL [asymmetric digital subscriber line], EDFS … PowerShell interfacing and do … Exchange Server management' (PC-2). Related incidents: **I_8**

7.3.1 Changes in Support Service Level

CHITA experienced changes in the way the staff supported SaaS model compared to the on-premise IT system. A systems engineer explained it this way:

> I would say the work moved maybe from second level support more to third level support because if it is broken now, it is a serious problem. It is not something that happened with hardware or something; it means something serious going on, which can be identified with a second level. So it puts more load on the third level, I think. (PC-2)

Table 7-7 summarises the key incidents that illustrate the changes in the support service level. As a result, IT workers became upskilled to handle the third level support needed by the new SaaS model (O365).

Table 7-7

CHITA Changes in Support Service Level Trajectory

Critical incident	Description	Interviewee quote
I_6	Movement of second level support to the third level	'I would say the work moved maybe from the second level support more to third level support, because if it is broken now, it is a serious problem' (PC-2)
I_8	Second level unable to support, as issues with the SaaS model are third level system problems	'And level two can't support it—too complicated—because as I said, not because they are not like—can't understand this—but because all the issues arise, they are level three straight away' (PC-2)
I_8	In the SaaS model, third level support staff have greater workloads	'So at level three IT will get more work because of the nature of how SaaS is being supported' (PC-2)

7.3.2 Cost Issues

At CHITA, moving the on-premise IT system to the SaaS model was not driven by cost; rather, the cost increased. Therefore, the benefits brought by the new system came at a cost. Costs issues relate to educational campus agreement institutions pay Microsoft in exchange of free Office .365 to current students. A systems engineer explained this as summarised in Table 7-8, which outlines the incidents that illustrate the trajectory related to cost issues.

Table 7-8

CHITA Cost Issues Trajectory

Critical incident	Description	Interviewee quote
I_1	Moving to cloud systems might cost more	'Yes, it was free. Cost is a factor, of course, but because we did not pay much for—we did not pay extra for Sun Java—that is why the cost was not an actual driver. Actually, by moving stuff, we spent more money than we were' (PC-2)
I_1	Licence for educational campus agreement gives free Office 365 to current students	'We are paying for licences. We have an educational campus agreement with them. So with this, we can have free Office 365 for students. So basically, we pay for it, yes. Not directly, but we pay' (PC-2)
I_7	Live@edu was fee-free	'It used to be free … Live@edu was free because if you are an institution—regardless if you have any agreement with Microsoft—you just register, you prove that you are an institution, then you get permission and then just use it. Not with Office 365. Now you need to have this licence agreement to have free Office 365' (PC-2)

7.3.3 New Skill Sets

Supporting O365 required new skills for managing the system remotely compared with the on-premise email system:

> Yeah, you require special skills [to support Office 365]. And it requires … expertise in ADSL, EDFS … So everything, which needs to be done to those accounts, done through Exchange Server interfaces because it is Exchange Server in the cloud. So you connect remotely through PowerShell interfacing and do Exchange Server management. (PC-2)

Table 7-9 summarises the key incidents that illustrate the trajectory related to new skill sets requirements.

Table 7-9

CHITA New Skills Trajectory

Critical incident	Description	Interviewee quote
I_8	The skills level at level two unable to handle level three system issues	'Level two can't support it—too complicated … because all the issues arise, they are level three straight away. So something was seriously going on, usually. So the requests go straight to level three in these cases' (PC-2)
I_8	IT becomes more intelligent	'But I would say IT definitely will be made more intelligent. So like level three IT will get more work' (PC-2)

7.3.4 Summary CHITA Horizontal Analysis

The CHITA horizontal analysis formed three trajectories—Support service level changes, cost issues and new skill sets requirements—, which relate to four critical incidents (I_1, I_6, I_7 and I_8) identified during the punctuation analysis. Figure F-3 in the appendices describes the CHITA trajectory visual map of the migration process from the on-premise IT system to the SaaS model.

7.4 CHITA Vertical Analysis

This analysis focuses on the gaps resulting from critical incidents in the sociotechnical systems of the activities from both the building system (B_1–B_{10}) and work system (W_1–W_{10}) as illustrated in Table 7-10. Comparing and contrasting the critical incidents with similar gaps results in summary shown in Table 7-11.

Table 7-10

CHITA Contrasting of Gaps and Incidents

	Structure	Information technology	People	Task
Tasks				X
People	I_1, I_2, I_4, I_5, I_6, I_7, I_8, I_9	I_1, I_3, I_4, I_6, I_9	X	
Information technology	I_2	X		
Structure	X			

As shown in Table 7-10, each gap was analysed on the four-sociotechnical dimensions to form an interaction matrix. In this case, gaps showing disequilibrium between people (PE) and structure (ST) are listed in the cell of the second row of the first column: I_1, I_2, I_4, I_5, I_6, I_7, I_8, and I_9. These incidents describe the tension between PE and ST about constraint, compliance, complexity, and incapability. The cell is summarised to describe the 'Dominance' of the organisational or technological structure on people. Similarly, the cell representing PE-IT concerns the tension between people and IT about restrictions, compliance, formality, order, and control. In the same manner, this cell is summarised to describe the 'Technological coercion' of IT on people. Finally, the cell IT-ST contains a single incident (I_2, Outlook client issues), which was found to be insignificant in this analysis. Table 7-11 summarises the CHITA vertical analysis themes, which are discussed in the following sections.

Table 7-11

Summary of CHITA Vertical Analysis

	Structure (ST)	Information technology (IT)
People (PE)	Dominance	Technological coercion
Information technology (IT)	X	X

7.4.1 Dominance (PE-ST)

The gap between people and structure (both technological and organisational) was seen in various ways, such as when users (PE) complained about the allocation of insufficient mailbox quotas (ST), consultants (PE) faced organisational power and conflict (ST) issues and IT workers (PE) faced the complexity of the hybrid infrastructure (ST). Table 7-12 summarises the gaps and incidents and shows how staff applied appropriate initiatives to circumvent the dominance of the structure on people.

Table 7-12

CHITA Gaps between People and Structure

Critical incident	Expression of a gap	Gap (G)
I_1	Sun Java system allocation of mailboxes quotas constrained users in their routine work	Users (PE) unhappy with mailbox quota (ST) allocations on the Sun Java system
I_2	Outlook client was incompatible with the Java email system. Staff were frustrated with this as it hindered class demonstrations on Outlook	Staff (PE) unhappy with the failure of the Outlook client to connect to the Sun Java email system (ST)
I_4	The structure of the Public Records Act forced the institution to keep staff off the cloud-based system to comply with the legislation	Staff (PE) need to comply with public records legislation (ST) when migrating to a new system
I_5	Failure of management support controlled the performance of IT consultants, sabotaging the project	IT consultants (PE) frustrated by the inability of management support (ST) in migrating the system
I_6	During system migration from Live@edu to Office 365, IT workers, before been trained were confronted and challenged by the new system structure, thus forced to use online guidelines during system migration to circumvent the situation	IT workers (PE) struggled to configure the Office 365 system structure (ST), as they were not yet trained on how to support it
I_7	The structure of Office 365 was inconvenient for deleting departing student accounts in a local directory, which forced the institution to retain all alumni accounts and in a disabled state	IT workers (PE) unhappy with Office 365 structure (ST) in maintaining email for life for alumni, as it lacked security structure to separate students and alumni accounts
I_8	The complexity of the mixed IT infrastructure forced the management to send IT workers for upskilling in handling the new infrastructure	IT workers (PE) challenged by the complexity of the mixed IT infrastructure (ST) of SaaS and on-premise email systems
I_9	The inability of Office 365 to provide collaborative enhancements compelled the institution to retain the use of Blackboard as a teaching and learning collaboration platform	Staff (PE) unimpressed by the inability of Office 365 to provide teaching and learning collaborative (ST) enhancement

To address the dominance of structure over people, the institution took decisive measures by migrating user mail accounts to the hybrid system to solve the issue of insufficient mailbox quotas; complied with legislative requirements by retaining staff on an on-premise email system; and supported the upskilling of IT workers to enable them to handle the new complex mixed IT infrastructure.

7.4.2 Technological Coercion (PE-IT)

The gap between people (PE) and IT at CHITA relates to restrictions on mailbox system usage and compliance with system formalities. Table 7-13 describes the gaps and incidents that formed a layer of technological coercion upon the people, and how they were addressed.

Table 7-13

CHITA Gaps between People and Information Technology

Critical incident	Expression of a gap	Gap (G)
I_1	Sun Java restricted user performance due to system capacity constraints	Users (PE) unhappy with the mailbox capacity constraints of the Sun Java system (IT)
I_3	For privacy reasons, staff were uncomfortable with having their email on a cloud-based hosted system, so instead were migrated to on-premise Microsoft Exchange Server 2010	For privacy reasons, staff (PE) worried about having their mailboxes moved from an on-premise email to a cloud-based system (IT)
I_4	Staff were unhappy with the limitations of Java system capacity but had to comply with legislation	Staff (PE) unhappy with the limited system capacity of the Sun Java system (IT)
I_6	IT workers faced various challenges in configuring the Office 365 system. They resorted to using online guides to accomplish the tasks	IT workers (PE) struggled to configure Office 365 (IT)
I_9	Migration to Office 365 promised enhancement of teaching and learning collaboration tools; instead, the tools were inadequate, forcing the institution to retain the use of the Blackboard	Staff (PE) unimpressed by the inability of Office 365 (IT) to provide enhanced teaching and learning collaboration tools

To address the ‘technological coercion’ (Smids, 2012, p. 126) on people, the institution migrated users to a hybrid system solution, both to address the limitations of the IT and comply with legislation.

7.4.3 Summary CHITA Vertical Analysis

In summary, these vertical themes—Dominance (PE-ST) of the structure and Technological coercion (PE-IT)—are attributes of the effect of technology on people, and provide insights into how these constraining features were addressed. Despite these, CHITA can use and benefit from the technology.

7.5 Overall Summary of CHITA Visual Map Analyses

Overall, the punctuation, horizontal, and vertical analysis for CHITA provided unique insights into understanding the implications of moving the on-premise IT system to the SaaS model. Table 7-14 provides an overall summary of the punctuation analysis, horizontal analysis and vertical analysis.

Table 7-14

Summary of CHITA Visual Map Analyses

#	Incident	Gap	Gaps (sociotechnical form)	Gap resolution	Punctuated analysis (phase)	Horizontal analysis (trajectory)	Vertical analysis (theme)
1	Capacity constraints	Users (PE) unhappy with mailbox quota allocated on the Sun Java system (IT)	PE-IT PE-ST	IT management decided to migrate to a hybrid system to obtain greater mailbox quotas	Hybrid Deployment	Cost issues	Dominance; Technological coercion
2	Outlook client issues	Staff (PE) unhappy with the inability of the Java email system to connect to the Outlook client (ST) for class demonstrations	IT-ST	The institution decided staff mailboxes be migrated to Exchange 2010, capable of connecting to the Outlook client			
3	Privacy issues	Staff (PE) worried about moving their mailboxes from an on-premise email system to a cloud-based hosted solution (IT)	PE-IT	Staff Java mailboxes moved to an on-premise Microsoft Exchange Server 2010 instead			Technological coercion
4	Public Records Act compliance	Although staff (PE) were unhappy with the Sun Java system (IT), there were legal compliance issues (ST) with migrating to a new system	PE-IT PE-ST	The institution agreed to keep staff off the cloud-based system to achieve legal compliance			Dominance Technological coercion
5	Migration by consultants	Consultants (PE) frustrated by the failure of management support (ST) to migrate mailboxes from Live@edu to Office 365	PE-ST	IT management decided to engage IT workers to do the migration	Migration		Dominance
6	Migration by IT workers	IT workers (PE) struggled to configure Office 365 (IT) systems structure (ST)	PE-IT PE-ST	IT workers resorted to using configuration guides to accomplish the work		Support service level	Dominance; Technological coercion

7	Email for life	IT workers (PE) unhappy with Office 365 structure (ST) settings for email for life of alumni	PE-ST	The institution was forced to retain or disable alumni accounts on a local directory		Cost issues	Dominance
8	Complex mixed IT infrastructure	IT workers (PE) challenged by the complexity of the mixture of infrastructure for the SaaS and on-premise email systems (ST)	PE-ST	Management sent some IT workers for upskilling to handle the complex IT infrastructure	Integration	New skill sets; Support service level	Dominance
9	Inadequacy of collaboration tools	Staff (PE) not impressed by the failure of Office 365 (IT) to provide teaching and learning collaborative (ST) enhancement	PE-IT PE-ST	Management encouraged staff to use Blackboard instead as a teaching and learning collaboration platform			Dominance; Technological coercion

Chapter 8: DELTA Case Analysis

8.1 DELTA Visual Map Analyses

DELTA has 20,000 students and 1500 staff. Until 2010, the institution email system was operating on an in-house built legacy Linux system. The institution needed to upgrade and add more features and functionalities to the email system. The demand to upgrade came for two reasons. First, the institution wanted to eliminate the basic email system, which was inferior and could reflect badly on the brand and image of the organisation. Second, at that time, GAE and Microsoft Live@edu were promoting free-hosted email systems to the education sector. Other institutions were migrating to these systems. Thus, DELTA did not want to be seen lagging behind adopting a new system. In choosing between GAE and Live@edu, DELTA did not put up a tender; rather, around 25 students randomly selected to review the two systems. The students received incentives for their participation. The IT workers installed the products on the students' computers and were trialled for three months. Eighty percent of the students recommended GAE, and DELTA made a decision based on this. In analysing this case, this study interviewed four IT workers involved in supporting and migrating from the legacy email system to GAE. Table 8-1 outlines the sources of data for DELTA and data source codes used in this study.

Table 8-1

DELTA Data Sources

Source	Data source code	Detailed description
Semi-structured interviews	PD-1	Exchange engineer/IT manager
	PD-2	IT technician-1
	PD-3	IT technician-2
	PD-4	IT manager
Website	W-D	Publically available organisational information and GAE and Live@edu documents

Public documents	PD-D	Publically available organisation annual reports and statistics
Photographs	PH-D	Few pictures were taken
Field notes	FN-D	Initial meetings with gatekeeper Interview and stand-up meetings User experiences/story details

The following sections discuss three visual map analyses conducted in this case: punctuation, horizontal and vertical. Table 8-2 summarises the results of these visual map analyses for DELTA.

Table 8-2

Summary of the Results of DELTA Visual Map Analyses

Dimensions of analysis	Punctuated	Horizontal	Vertical
Results of analysis	Three phases	Three trajectories	Two themes
	Preparation Migration to SaaS Integration	Department brokering roles User brokering New skill sets	Control Facilitation Regulation

8.2 DELTA Punctuation Analysis

Figure 8-1 shows the SaaS implementation trajectory for DELTA during the preparation, migration, and integration punctuation phases.

The sections that follow discuss the preparation, migration, and integration phases of GAE at DELTA.

8.2.1 Phase 1: Preparation

Critical incidents exhibited by the DELTA legacy system in this phase relate to inferior functionalities offered to users and the need for the institution to promote its image and brand. Table 8-3 summarises the gaps initiated from critical incidents in the preparation phase, and discussed in the following sections.

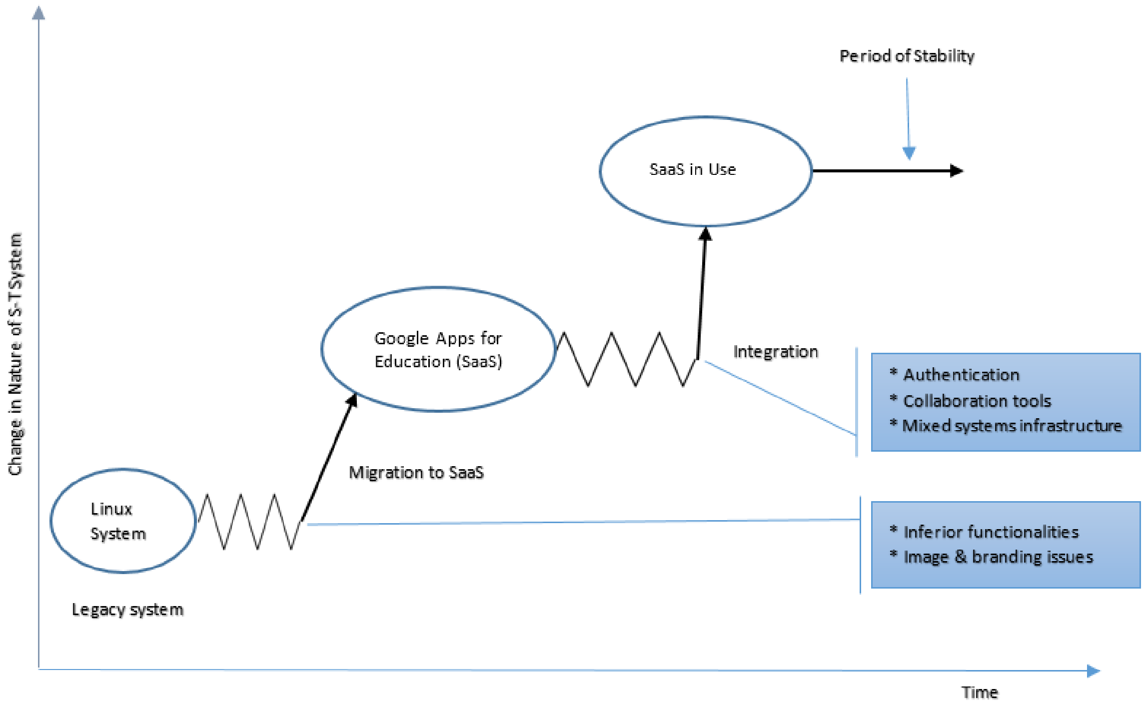
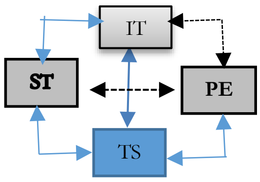
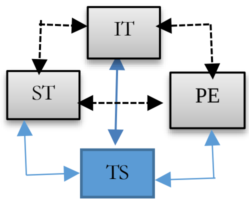
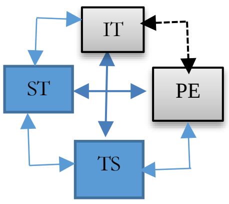


Figure 8-1. SaaS implementation trajectory of DELTA.

Table 8-3

Critical Incidents in DELTA Phase 1: Preparation

Critical incident (I)		Gap (G)	Response to gap (R)
I_1		**G_1:** Inferior functionalities: users (PE) unhappy with the inferior functionalities (ST) offered by the legacy email system (IT). Disequilibrium: PE-IT, PE-ST	**G_1-R**: Punctuation: management decided to migrate students to GAE and staff to an on-premise email system to improve system functionalities
I_2		**G_2:** Image and branding: management (PE) perceives the institutional image and brand (ST) at risk due to the inferior email system (IT) Disequilibrium: PE-IT, PE-ST, IT-ST	**G_2-R**: Punctuation: the institution decided to migrate students to a well-regarded hosted system
I_3		**G_3:** System selection: management team (PE) faced a dilemma in choosing a suitable hosted email system (IT) for students. Disequilibrium: PE-IT	**G_3-R:** Punctuation: the institution engaged students selected at random to pilot the hosted email solutions of GAE and Live@edu

I_1: Inferior Functionalities

Both staff and students complained about inferior functionalities offered by the DELTA legacy email system, which had basic email functionalities with limited mailbox storage and included neither calendaring nor collaborative tools. An IT manager added:

> We did not want to be seen as offering a product that was pretty much inferior or basic and no frills, and they tend to reflect what is happening in the organisation, the products that we deliver to our students. (PD-4)

I_2: Image and Branding

The limited functionalities of the legacy system did not only affect its users; the image and brand of the institution were not well valued compared with other institutions. An IT manager explained it this way:

> So if we deliver basic, very no-frills types of products, and there is another organisation that can deliver much more. Then the other organisation tends to be held in a higher standing, not necessarily just over that, but across the board, so they have a better potential to have a slightly better reputation because of what they offer. (PD-4)

I_3: System Selection

DELTA encountered an issue with selecting a suitable email system for students. Instead of following the conventional way of IT workers piloting the system, the institution engaged several students to pilot two candidate-hosted systems in the market (GAE and Live@edu) as an IT manager explained:

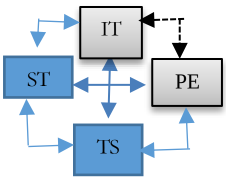
> So we decided that we would not make the decision because it is a product … for the student, so we went out and consulted with some students and … just picked randomly about 25 students … So we ended up setting some test environments, both on the Google and Microsoft products, and we had them …

test for a few months and so the students had generic accounts they could log into and have a look and see the products. And we used them to evaluate what they thought was the preferred product for them … and overwhelmingly the information that we got back—I think 80% said they liked the Google product better, so we made the decision based on that. Because from a technology point of view both the products worked similarly, but it was important for us to have that feedback from the students to say yes they liked this one over the other one. So that is how we chose Google Apps. (PD-4)

8.2.2 Phase 2 Migration

Table 8-4

Critical Incidents in DELTA Phase 2: Migration

Critical incident (I)	Gap (G)	Response to gap (R)
I_4 	**G_4:** Moving mailboxes. IT workers (PE) lacked the expertise to migrate student mailboxes from the legacy system to GAE (IT). Disequilibrium: PE-IT	**G_4-R:** Punctuation: management team engaged consultants to migrate student's mailboxes to GAE

I_4: Moving Mailboxes

DELTA did not have IT workers skilled in migrating an on-premise email system to GAE, so the institution engaged a company to assist them. An IT manager described this process:

> We made that decision based on feedback that we would go with some Google Apps, so we employed a company to assist us to do that. So the company … Support academic institutions and schools to … migrate across, so we used their expertise to migrate us across to all our student accounts, to Google Apps … We had four of our staff here who are involved in that project along with the consultants. (PD-4)

8.2.3 Phase 3 Integration

Incidents in this phase relate to the integration of system authentication and collaborative tools into business processes. Table 8-5 summarises these incidents in the integration phase, which are discussed in the following sections.

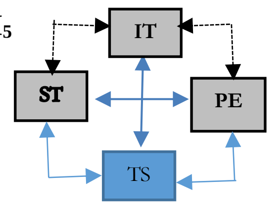
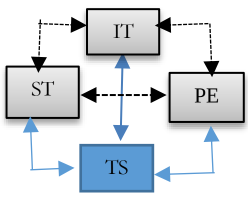
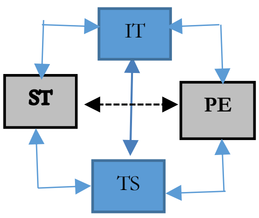
I_5: Systems Authentication

Synchronisation of student accounts in GAE with the student registration system was part of integrating SaaS into business operations. An IT manager explained:

> We have a connector that was created by some other company and that connector takes information out of our directory about the student, namely their user ID and password, and that synchronises it out into the cloud, so that is all done automatically. (PD-4)

Table 8-5

Critical Incidents in DELTA Phase 3: Integration

Critical incident (I)	Gap (G)	Response to Gap (R)
I_5 	**G_5:** System authentication: IT workers (PE) unable to set up synchronisation of student accounts on GAE (IT) with the student registry (ST). Disequilibrium: PE-IT, IT-ST	**G_5-R**: Incremental adaptation: DELTA engaged an external company to install a connector that synchronises students' accounts on GAE with the student registry
I_6 	**G_6:** Collaboration tools: Staff (PE) frustrated because their on-premise IT system (ST) (GroupWise) unable to collaborate with students on GAE (IT). Disequilibrium: PE-IT, PE-ST, IT-ST	**G_6-R**: Incremental adaptation punctuation: management decided to create ~100 accounts for staff on the GAE system for ease of collaboration with students
I_7 	**G_7:** Mixed system infrastructure: IT workers (PE) lacked the expertise to support the mixed IT infrastructure (ST). Disequilibrium: PE-ST	**G_7-R:** Incremental adaptation punctuation: IT management sent IT workers for further training

I_6: Collaborative tools

DELTA aimed to enhance the teaching and learning experience within the new system. To overcome the problem of staff and the student being on different systems, management decided to create some staff accounts on GAE to enhance collaboration with students:

> I think the students that have taken up the offer of the Google Apps account at DELTA are the ones that probably benefit from the collaboration tools, probably because they have got a lecturer who understands how to use it … So we would have to create manually accounts for academics (on GAE). Moreover, also, there was … some of the academics, who saw the advantages of this—the Google suite, to help in their delivering of the education. So they were pioneers and advocates of using that product, so it is driven from them as well. (PD-4)

I_7: Mixed System Infrastructure

The dual existence of an on-premise email system for staff (GroupWise) and the SaaS system for students (GAE) created a mixed IT infrastructure at DELTA. The mixed infrastructure brought some managerial challenges to IT workers, as an IT manager discussed:

> The difficulty we did experience, though, we did have to install some staff accounts manually, and that was one of the other things that we had to do, in respect of looking after it. So we would have to create manually accounts for … some academic staff, probably about 100 out of our staff here of 1500, because they wanted to understand how to use it and how the students were using it, and for them to do that they asked for an account so they could log in. What we didn't want to do, (is to) give staff the impression at DELTA that they could use this email system if they wanted to, because we only wanted to have email information in one system, not spread across different systems, so we had

GroupWise at the time and we were a strong Novell organisation, so it was deemed that … GroupWise was working well for us; there was no actual point in changing. (PD-4)

8.2.4 Summary of DELTA Punctuation Analysis

The three phases: preparation, migration, and integration illustrate critical incidents occurring when moving from the on-premise IT system to the SaaS model at DELTA. Specifically, they describe how the responses to critical incidents brought profound sociotechnical changes in the systems, as illustrated by seven critical incidents.

8.3 DELTA Horizontal Analysis

The trajectories of change that emerged when migrating the on-premise IT system to the SaaS model during the horizontal analysis included the emerging brokering roles of the IT department and users, and skill sets changes. Table 8-6 summarises the trajectories discovered during the horizontal analysis and are discussed below.

Table 8-6

Summary of DELTA Horizontal Analysis

	Systems architecture	Client/server	Cloud computing	Interviewee quote
	Systems type	On-premise IT (Linux system)	SaaS model (GAE)	
Context	Organisational (IT department) narratives	IT Department brokering role →		'We made the executive decision that; that is what we were going to give them' (PD-1). Related incidents: $\mathbf{I}_1$, $\mathbf{I}_2$
Context	Build system (activities)	User brokering role →		'We made that decision based on feedback (from students), that we would go with some Google Apps' (PD-1). Related incidents: $\mathbf{I}_3$

Process	Work system (activities)	New skill set	‘Changes in staff from the point of view that they will need to upskill because I think there’s a lot more functionality’ (PD-1). Related incidents: **I_4, I_7**

8.3.1 Brokering Role

Both IT department staff and users are moving towards a brokering role in the SaaS model. Table 8-7 summarises the key incidents that illustrate these brokering roles.

Table 8-7

DELTA Emerging Brokering Roles

Critical incident	Description	Interviewee quote
I_1, I_2	IT department decided on cloud solutions to address issues of inferior email functionalities	‘So … we made a decision (that), there was no point in us putting together an email system when this facility was being offered free by Google and Microsoft’ (PD-1)
I_3	During system selection, users (students) were consulted, and the decision was based on students’ preference	‘because it was a product … for students, so we went out and consulted with some students’ (PD-1)

IT Department’s Brokering Role

Instead of trying to upgrade the existing on-premise IT system, the IT department decided to adopt a SaaS-based email system on behalf of users, as an IT manager elaborated:

> so we ended up with a situation where we needed to upgrade that and then all of a sudden the products came along and there were two of them, one of them was Google Apps … and … Microsoft, what they used to call it, Live@edu. So … we made a decision well, there was no point in us putting together an email system when this facility was being offered free by Google and Microsoft. (PD-1)

Users' Brokering Role

DELTA consulted with users to choose the preferred SaaS system from between two service providers, Google and Microsoft, as illustrated by an IT manager:

> So we decided that we would not make the decision because it was a product that was being used for students, so we went out and consulted with some students. Moreover, we asked them to review both products. (PD-1)

In addition, users may force the institution to adopt certain applications of a SaaS system. The IT manager explained more:

> Microsoft … made … announcement … 'we are offering your students these free copies of Office, but your organisation has to be registered as part of Office…' So we had students asking— 'How can I download my free copy?' So really, we were forced into that, probably like (other institutions) as well, because I notice that they have… (PD-1)

8.3.2 New Skill Sets

DELTA IT workers underwent upskilling to keep in line with the need to support users in the use of new functionalities of the SaaS system. One IT manager elaborated on this:

> I think that certainly … staff from the point of view … need to up skill because … there is a lot more functionality … So the challenges for our staff … be around upskilling to use the new functionality and technology. (PD-1)

8.3.3 Summary of DELTA Horizontal Analysis

The DELTA horizontal analysis formed three trajectories: IT department and users' brokering roles and skill sets changes, which relate to five critical incidents (I_1, I_2, I_3, I_4 and I_7) identified during the punctuation analysis. Table F4 in the appendices describes the DELTA trajectory visual map of the migration process from the on-premise IT system to the SaaS model.

8.4 DELTA Vertical Analysis

This analysis focuses on the gaps in the sociotechnical system, from activities of both the building system (B_1–B_8) and work system (W_1–W_8) as illustrated in Table 8-8, resulting from critical incidents. Comparing and contrasting the critical incidents with similar gaps results as summarised in Table 8-9.

Table 8-8

DELTA Contrasting Gaps and Incidents

	Structure	Information Technology	People	Task
Tasks				X
People	I_1, I_2, I_6, I_7	I_1, I_2, I_3, I_4, I_5, I_6	X	
Information Technology	I_2, I_5, I_6	X		
Structure	X			

Table 8-8 indicates the analysis of gaps on the four-sociotechnical dimensions to form an interaction matrix. Gaps showing disequilibrium between people (PE) and structure (ST) are listed in the cell of the second row of the first column: I_1, I_2, I_6, and I_7. These incidents describe the tension between PE and ST as an inhibitor, publicity, cooperation and the system. The cell is summarised to describe the 'Control' of the organisational and technological structures over people. Similarly, the cell representing people (PE) and IT (I_1, I_2, I_3, I_4, I_5 and I_6) refers to the tension between people and technology as it relates to the enabler, complement, tool, development, corroboration and partnership. In the same manner, the PE-IT cell is summarised to describe the 'Facilitation' of IT for people. Finally, incidents I_2, I_5, and I_6 describing the tension between IT and ST relate to promotion, validation, and participation. The cell is summarised as 'Regulation' of IT and structure in the use of ISs. Table 8-9 summarises the DELTA vertical analysis and the themes are discussed in the following sections.

Table 8-9

Summary of DELTA Vertical Analysis

	Structure (ST)	Information technology (IT)
People (PE)	Control	Facilitation
Information technology (IT)	Regulation	

8.4.1 Control (PE-ST)

The gap between people (PE) and structure (ST) appeared when both users and management were unhappy with the structure of the legacy system as it offered inferior functionalities and tarnished the DELTA brand. Also, a PE-ST gap was evident when academic staff became frustrated by the inability of the staff and the new student systems to collaborate. Table 8-10 summarises the gaps and incidents on how the structure tends to control people, as it exhibits attributes of an enabler, an inhibitor, or a challenger to functionalities, branding, collaboration, and system support.

Table 8-10

DELTA Gaps between People and Structure

Critical incident	Expression of a gap	Gap (G)
I_1	System structure is seen as an enabler or an inhibitor of the functionalities offered to users	Users (PE) unhappy with the inferior functionalities (ST) provided by the email system
I_2	System structure reflected poorly on the institution’s brand, resulting in complaints and low uptake of students in using the system	Management (PE) perceives an institutional image and an inferior email system tarnish the brand (ST)
I_6	Differences in system structures inhibited collaboration between staff (GroupWise) and students (on GAE)	Staff (PE) frustrated because their on-premise IT system (ST) (GroupWise) unable to collaborate with students on the GAE
I_7	The co-existence of both on-premise and cloud-based systems at DELTA created a mixed IT infrastructure that challenged the expertise of the IT workers; hence they were sent for further training	IT workers (PE) lacked the expertise to support the mixed IT infrastructure (ST)

8.4.2 Facilitation (PE-IT)

The gap between people (PE) and IT at DELTA was seen when technology became an enabler, a booster, or a complementing tool. Table 8-11 summarises gaps and incidents showing how technology facilitated business processes and publicity and may show some repressing attributes as well.

Table 8-11

DELTA Gaps between People and Information Technology

Critical incident	Expression of a gap	Gap (G)
I_1	System structure is seen as an enabler of the functionalities offered to users	Users (PE) unhappy with the inferior functionalities (ST) provided by the email system
I_2	System structure portrayed the brand of the institution, resulting in complaints and low uptake of students in using the system	Management (PE) perceives an institutional image, and an inferior email system tarnishes the brand (ST)
I_3	The two candidate hosted systems had similar functionalities, such that the management team were unable to choose a suitable system for students; instead, students were engaged to pilot the systems and recommend one	Management team (PE) faced a dilemma in selecting a suitable hosted email system (IT) for students
I_4	GAE had new system structure unfamiliar to IT workers; consultants were engaged in migrating student mailboxes from the legacy system to GAE	IT workers (PE) lacked the expertise to migrate student mailboxes from the legacy system to GAE (IT)
I_5	Enabling GAE synchrony with the student registry required a connector as an interface; IT workers were unable to install this, so an independent company did the work	IT workers (PE) unable to set up synchronisation of student accounts on GAE (IT) with the student registry (ST)
I_6	Differences in system structures inhibited collaboration between staff GroupWise) and student (on GAE)	Staff (PE) frustrated because their on-premise IT system (ST) (GroupWise) unable to collaborate with students on GAE

8.4.3 Regulation (IT-ST)

The researcher recognised the gap between IT and structure (ST) by the way technological structure influences the image of the organisation, determines how IT supports, and enhances collaboration (summarised in Table 8-12).

Table 8-12

DELTA Gaps between Information Technology and Structure

Critical incident	Expression of a gap	Gap (G)
I_2	Technology and system structure influenced the image and brand of the institution	Management perceives an institutional image and the brand (ST) at risk due to use of an inferior email system (IT)
I_5	The structure of technology determines how the system is supported and the kind of expertise required	IT workers unable to set up synchronisations of student accounts on GAE (IT) with the student registry (ST)
I_6	Differences in the structure of technologies hampered collaboration between staff (based on GroupWise) and students (on GAE)	Staff frustrated because their on-premise IT system (ST) (GroupWise) unable to collaborate with students on the GAE (IT)

8.4.4 Summary of DELTA Vertical Analysis

The punctuation, horizontal and vertical analysis for DELTA provided unique insights for understanding the implications of moving on-premise IT system to the SaaS model. Table 8-13 provides a summary of the punctuation, horizontal and vertical analyses.

Table 8-13

Summary of DELTA Visual Map Analyses

#	Incident	Gap	Gaps (sociotechnical form)	Gap resolution	Punctuated analysis (phase)	Horizontal analysis (trajectory)	Vertical analysis (theme)
1	Inferior functionalities	Users (PE) unhappy with the inferior functionalities (ST) offered by the legacy email systems (IT)	PE-IT PE-ST	Management decided to migrate students to GAE, whereas staff stayed on an on-premise email system to improve system functionalities		IT department brokering role	Control Facilitation
2	Image and branding	Management (PE) perceives institutional image and brand (ST) as at risk due to use of the inferior email system (IT)	PE-IT PE-ST IT-ST	The institution decided to migrate students to a well-regarded hosted system	Preparation		Control Facilitation Regulation
	System selection	Management team (PE) faced a dilemma in choosing a suitable hosted email system (IT) for students	PE-IT	The institution engaged students selected at random to pilot two hosted email solutions: GAE and Live@edu		User brokering role	Facilitation
4	Moving mailboxes	IT workers (PE) lacked the expertise to migrate student mailboxes from the legacy system to GAE (IT)	PE-IT	The management team engaged consultants to migrate students' mailboxes to GAE	Migratio n	New skills	Facilitation
5	Authentication	IT workers (PE) unable to set up synchronisations of student accounts on GAE (IT) with the student registry (ST)	PE-IT IT-ST	DELTA engaged an external company to install a connector that synchronises students' accounts on GAE with the student registry	Integration		Facilitation Regulation
6	Collaboration tools	Staff (PE) frustrated because their on-premise IT system (ST) (GroupWise) unable to collaborate with students on the GAE (IT)	PE-IT PE-ST IT-ST	Management decided to create ~100 staff accounts on the GAE system for ease of collaboration with students			Control Facilitation Regulation

7	Mixed IT infrastructure	IT workers (PE) lacked the expertise to support the mixed IT infrastructure (ST)	PE-ST	IT management sent IT workers for further training	New skills	Control

Chapter 9: Discussion

9.1 Introduction

This chapter cross-examines the findings from the four cases that emerged from the PSIC visual map analysis presented in the previous chapters. The aim of this chapter is to discuss the findings and address the main objective of this study, which seeks to explain the implications of SaaS for IT workers from a sociomateriality perspective. In particular, three research questions arise from this objective. The first question examines what happens in the process of migrating an on-premise IT system to the SaaS model. The second aims to explain why the migration process changes the roles and skill sets requirements for IT workers and the implications of this for the functions of the IT department. The third examines how human (that is, IT workers) interact with these technologies from a sociomateriality perspective. The remainder of the chapter is organised as follows. Section 9.2 provides ten managerial implications of the migration process of an on-premise IT system to the SaaS model that arises from the PSIC visual map analysis. Section 9.3 discusses the implications of SaaS for the roles and skill sets requirements of IT workers, and for the IT department based on the experiences of IT workers analysed in the previous chapters. Finally, Section 9.4 explains the interactions between IT workers and these technologies from a sociomateriality perspective.

9.2 Learning from the Migration Process

The PSIC visual map analysis provided managerial implications and insights from the four cases. These implications and insights originated from the key incidents and activities analysed through the punctuation, horizontal and vertical analyses of the four cases. Table 9-1 summarises the managerial implications from all phases of the cases that arose from the cross-case analysis of the themes. For example, focusing on the incidents and activities around the first phase of the punctuation process, at ALPHA during the consolidation phase, the project team dealt with disgruntled users and solved systems inefficiencies and inadequacies. As a result, it was clear that the project team had to 'get prepared' to deal with users, systems and organisational policies. Likewise, at BETA, while enforcing the institution policy of centralising all IT services into the IT department, the project team experienced some change resistance from users who had received superior IT services from their faculty service divisions. In response, the project team developed confidence-building strategies to gain support from disgruntled users. In the end, the BETA project team learnt to be prepared when dealing with systems, people, and processes. Similarly, to gain deeper insights, the study examined issues at CHITA and DELTA, which reinforced that project teams need to 'get prepared', as an overall managerial implication in this phase for all the cases.

In the same manner, the study examined all the phases, resulting in ten managerial implications revealed to the researcher through the three analyses of the PSIC model. The punctuation analysis highlighted three managerial implications for IT workers: the need to *Get prepared* when embarking on a system migration process, *manage the migration process* when various issues arise and *coordinate the integration* in the face of different challenges and problems. Similarly, the horizontal analysis highlighted four managerial implications: *Reposition into brokering roles*, *adapt to new skills*, *manage complex systems,* and *realign into new routines*. Finally, the vertical analysis provided insights on three themes: *Discover to recover, use the learning platform,* and *govern to harmonise*. Table 9-1 summarises these ten managerial implications—discussed in the following sections.

9.2.1 Get Prepared

This study suggests that the migration process of an on-premise IT system to the SaaS model demands preparations for the change in three main areas: IT infrastructure, people and processes. First, a change in IT infrastructure is necessary to address various issues identified in the data analysis chapters, including degradation to service delivery, capacity constraints, duplication of services, and ineffectiveness of legacy systems.

Table 9-1

Managerial Implications through the PSIC Model

Analysis	Research cases				
	Chapter 4 ALPHA	Chapter 5 BETA	Chapter 6 CHITA	Chapter 7 DELTA	Managerial Implications
Punctuation analysis (themes)	Consolidation	Centralisation	Hybrid deployment	Preparation	Get prepared
	Implementation	Implementation	Migration	Migration	Manage the migration
	Integration	Integration	Integration	Integration	Coordinate the integration
Horizontal analysis (trajectories)	Role changes	Brokering roles	Support service levels	Department brokering role	Reposition into brokering role
	Skill sets change	Technician /engineer split	Cost issues	User brokering role	Adapt to new skill sets
	System feature changes	Complex IT systems	New skill sets	New skill sets	Manage complex systems
	Routines change				Realign into new routines
Vertical analysis (themes)	Discovering	Governance	Dominance	Control	Discover to recover
	Learning initiatives	Infrastructure	Technological coercion	Facilitation	Use the learning platform
	Institutionalisation System limitations	Harmony		Regulation	Govern to harmonise

For example, at ALPHA, the email system had reached full capacity, so the organisation was forced to upgrade the system to address the resulting degradation in service delivery. The findings suggest how institutions were required to upgrade the email system and the entire IT network infrastructure to address the deterioration in email service delivery. Thus, it was necessary to address some infrastructure issues before migrating to the SaaS model. The study findings agree with those of Dimitrakos (2010), who suggests that the SaaS model requires some IT infrastructure capabilities to be in place during the migration. These include integration, trust and security, and data management capabilities. According to Dimitrakos (2010), integration capabilities help organisations to establish secure, accountable, and efficient collaborations, and to share services, resources, and information. The trust and security capabilities contribute to addressing areas where lack of security appears to inhibit adoption of cloud computing services, such as SaaS. Moreover, data management capabilities enable better storage, access, translation and integration of data (Dimitrakos, 2010).

The second area is the management of the effects of change on people, to build trust and address politics and power issues, as discussed in the data analysis chapters. For example, at BETA, the implementation team had to make firm decisions when managing resistance from people who built legacy systems. Management had to deal with staff who created legacy systems 20 years ago and were not willing for these systems to be changed. This situation created some emotions and politics around the systems migrations. This is in line with the finding of Markus (1983) that people resist IT implementation because of internal factors, poor system design, and the interaction of specific system design features. Internal factors include cognitive style, personality qualities, and human nature. Poor system design is attributed to features that include lack of user friendliness, poor human factors, and poor technical design or implementation. The current study shows that prudent change management, confidence building and tough decisions on people were necessary to address resistance. The management stood firm and demonstrated to users that the change would work well and that they could live without the vanity features of their legacy systems. Other resistant users were told that unfortunately; they could not be different anymore: the system must be the same for all users across the organisation.

Another reason people may resist IT implementation is due to sociotechnical issues such as lack of IT readiness, and political issues. This study suggests that IT workers lacked IT readiness to support the new system in the SaaS model, due to a lack of appropriate skills (Johnston & Carrico, 1988). For example, some IT technicians lacked programming skills to support the SaaS system and some systems engineers lacked people skills, so they were not ready to provide frontline support. One systems engineer admitted that although he has good technical skills, he did not anticipate having to provide frontline support and he is not good at facing and helping people directly.

There may be politics on the interaction of the system with the distribution of intra-organisational power, or a system may have the purpose of changing organisational culture, workflows or business processes (Markus, 1983). This study suggests that changes in workflows and business processes can create resistance. There were some politics and emotions during changes to business processes, in particular for users who were accustomed to their unique email address indicating their faculty subdomain; others had received superior service from their local faculty IT support team compared to what they would reasonably expect from the IT department.

The third area to consider in the preparation phase is changes to business processes and workflows: not only is the SaaS model regarded as a disruptive technology (Keller & Hüsig, 2009); there are differences in structural features of on-premise legacy IT systems compared with SaaS systems. For example, the change service model at BETA meant that people in faculties who spent a considerable amount of time supporting a legacy system were freed to help researchers and assist with teaching and learning activities. Thus, these changes relieved IT workers of their system maintenance duties and allowed them to concentrate on strategic roles such as supporting research and introducing more innovation in faculties.

9.2.2 Manage the Migration

The migration from an on-premise IT system to the SaaS model involves not only IT infrastructure change and data migration but also changes in the mindset, habits, and work practices of both IT workers and users. The mindset and habits also need to be migrated and aligned with new business processes. This study shows that 'the vast majority of the problems has been just people unaccustomed to the new system' (ALPHA IT manager, PA-2), which needs to be managed. Muller (2012, p. 115) advises IT workers and users to change their 'mental model'. A mental model is defined as a 'mechanism whereby humans generate descriptions of system purpose and form, explanations of system functioning and observed system states, and predictions of future system states' (Mathieu et al., 2000, p. 274). A mental model, therefore, helps people to describe, explain, and predict events in their environment (Mathieu et al., 2000).

The IS literature highlights some of the issues that need to be managed when migrating an on-premise IT system to the cloud infrastructure. These issues include latency, the loss of availability and slow down of performance; security, where sensitive data may be at risk in cloud-based storage; interoperability with other systems, to avoid dependence on a single cloud service provider that might cause a lock-in scenario; managing Internet speed, as SaaS systems are accessed via the Internet; and finally integration capability with other on-premise or cloud-based IT systems (Kemmericha, Agrawala, & Momsen, 2015).

9.2.3 Coordinate the Integration

The SaaS model is mostly a web-based application designed for a centralised, shared instance and multi-tenancy application accessed through an Internet browser. However, not all enterprise systems are transformable into the SaaS model due to the challenges of transitioning legacy architectures to a multi-tenant model. Hence, having to integrate the SaaS model with some on-premise IT systems within an organisation is inevitable. And system engineers need to coordinate the integration work, by looking at legal, security and technical issues. SaaS integration leverages a set of APIs published by the SaaS service provider. In the cases examined here, most SaaS systems integrated with the finance, student registration and authentication systems and other third party add-ons by using the API suite. However, legal, security and technical issues need to be coordinated when integrating SaaS with other applications, to comply with IT data security regulations, data privacy laws, audit trail requirements and some business requirements that involve complex data visibility rules (Onwubiko, 2010). This study provides an example of how organisations considered and incorporated these issues into the decision-making. For example, at ALPHA, the new system included the legal requirement to archive all business emails: New Zealand privacy law has changed in recent years, requiring mechanisms to retain business emails for a period.

Similarly, at BETA, the implementation team negotiated with the SaaS service provider on issues that included data sovereignty and privacy. For example, the BETA project team agreed with the SaaS service provider to regard New Zealand's laws as a legal jurisdiction applying to business information in all data centre locations. Agreements and security concerns discussed in the cases echo the findings of IS literature indicating that data security and privacy issues are the major hindrances for organisations to adopt the SaaS model (Heart & Pliskin, 2001).

9.2.4 Reposition into Brokering Role

Empirical evidence in this study identified cloud-brokering roles at two levels, that is, at the departmental and user levels. At the department level, there was a discussion of the role of the IT department in making a decision on behalf of the users regarding the type of system to be migrated to the SaaS model. This position is similar to the *push brokering* concept discussed by Kojo, Maeno, and Seo (2004), who discuss ways of providing computing resources shared among service providers and end users. In Kojo et al (2004) study, in particular, the concept of push brokering refers to cloud intermediaries' roles when providing services from cloud service providers to end users (Böhm et al., 2010). Moreover, that is a common position of the consultancy role IT department aligns itself within their organisation. The IT department is involved in two-way communication with the cloud service provider, usually at the third level of system support while providing first and second level system support to end users. The current study revealed examples of the push brokering role when IT departments took a leading role as brokers to the source, negotiate and manage the use of cloud services with a cloud service provider on behalf of cloud users (see Figure 9-1).

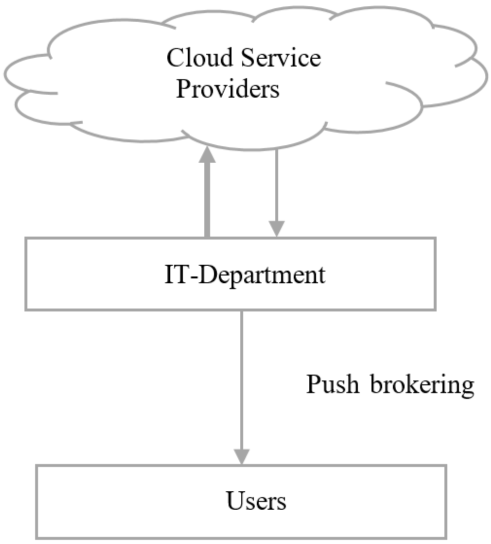


Figure 9-1. Push brokering role.

The push brokering role is typical, as the IT department is viewed as a custodian of all IT products and services within an organisation. For example, in this study, push brokering roles created during the migration of on-premise IT systems to SaaS at both the ALPHA and BETA tertiary organisations, when the IT departments made decisions on the type of SaaS solution required for users. AT ALPHA, for instance, the implementation team sourced an alternative student email system by researching some SaaS service providers including Microsoft, Google, and Oracle. Eventually, the team chose Google as their solution provider. An IT manager at ALPHA explained that they were looking for an alternative solution to remove student email accounts from the on-premise Microsoft Exchange email system to a cloud-based system: IT managers selected GAE and migrated all student emails to that system. The second level of cloud brokering activities occurs at the user level. The user brokering strategy is a new trend where the cloud user sources and deploys (mainly SaaS) services without any involvement of the IT department. This position, referred to as *pull brokering* when computing resources required by a user are ‘brokered among available resources from multiple providers’ (Kojo et al., 2004, p. 59) as illustrated in Figure 9-2. However, pull brokering in the current study is different from that referred to by Kojo and colleagues: here it involves users taking the initiative to meet their business needs by subscribing to SaaS applications without consulting or fully involving the IT department. Typically, SaaS applications are available to end-users by submitting an online subscription request.

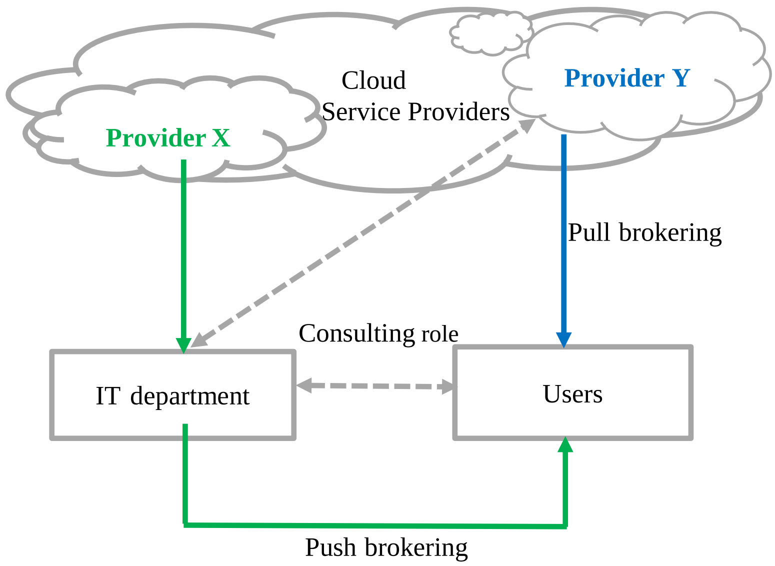
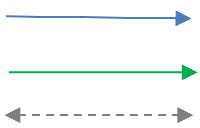


Figure 9-2. Pull brokering strategy.

Legend:



Pull brokering
Push brokering
Consulting

Referring to Figure 9-2, Pull brokering strategy occurs when user(s) source SaaS applications from cloud provider Y, and later the IT department takes a consulting role but at the same time continues with the push brokering role shown in green (e.g. sourcing from cloud provider X) for other IT portfolios required by cloud users. This study provides an example in which there were elements of a cloud Pull brokering strategy. When the institution asked students to select, pilot, and choose a preferred cloud service provider. Another example illustrates a pull cloud-brokering role when students demanded access to the free-hosted O365 SaaS service and thus forced the organisation to enter into a contract with Microsoft for such an offering. Especially, when Microsoft made an announcement to tertiary organisations offering free copies of O365 to students for registered institutions, students began asking for a free download of O365, forcing institutions to enter into an annual fee agreement with Microsoft for such an offering, although for students, O365 was seen as a free product.

At BETA, although all systems were consolidated, some—such as the on-premise library system—was managed and supported by the library staff. A typical pull brokering incident occurred in late 2014, when the library-sourced a SaaS-based library solution from a SaaS service provider on their own, side-lining the IT department, which became partially involved later when contractual disputes arose in relation to the library system malfunctioning. Scholars concur that IT departments are shedding their role as IT leaders and chief gatekeepers for most IT products and services, especially for SaaS applications (Rohmeyer & Tal, 2012; Wyld & Juban, 2010). This change is not only because cloud users in business units may unilaterally subscribe to and deploy SaaS applications such as marketing and library systems, bypassing the IT department; it is also due to the easy access to SaaS solutions, and the variety of needs of users. Bypassing the IT department leaves the IT door wide open for SaaS users to test various SaaS applications. Muller adds that the SaaS model, therefore, gives cloud users the ability to go out and directly subscribe from cloud service providers almost any SaaS application they need, by going around the IT department (Muller, 2012).

9.2.5 Adapt to New Skill Sets

The current study identifies two main types of skill sets required to support the SaaS model: technical and non-technical skills. IT technicians need technical expertise, such as programming skills, to support SaaS applications; whereas, systems engineers require non-technical skills such as people management and leadership skills. The change in skill sets is because, with the SaaS model, systems engineers require direct interaction with SaaS users—who need their SaaS issues be fixed, and hence non-technical skills become necessary. Most SaaS issues need programming skills or advance knowledge in system integrations to fix them, hence requiring systems engineers' support. A systems engineer at ALPHA admitted that he was not aware that he would be responsible for frontline support and was not trained to interact with users. Both scholars and practitioners have called for IT workers to enhance their non-technical skills and reshape their practices to improve participation, collaboration and innovation in the workplace (Rolling, 2012; Wyld, 2009). Also, IT workers need to respond to sociotechnical changes as they separate from the interrelationships with changing legacy systems and the skill sets designed for outdated work practices (Rolling, 2012). Muller advises IT workers not to fight change: 'Don't fight the cloud. Figure out how to embrace it' (Muller, 2012, p.124).

9.2.6 Manage Complex Systems

The integration of on-premise IT systems and other third party applications with the SaaS model creates the need to manage a complex IT infrastructure. Various programming techniques make it possible for systems integrations, which allow different systems and devices to exchange and interpret shared data. The current study suggests that the complexity of a system arises from changes in the organisational and technical structures following integration, driving the need for a new set of skills and support tools. In addition, the current study found that changes in organisational structures were a result of changes in work routines (Feldman & Pentland, 2003) when IT technicians stopped addressing enquiries coming from SaaS users. Instead, they made a permanent change in actions of the work routine by re-routing them to the systems engineers at second or third level user support. Feldman and Pentland (2003) agree that any change in action (performative) of the work routine may modify the structure (ostensive) of the routine. As a result, changes in organisational structure are likely to occur.

The current study further identified changes in technical structures, because of the changes in systems' abstraction layers (i.e. from on-premise to SaaS model). Here, the abstraction layer refers to the structure of the system administration interface, which provides IT workers with the ability to manage systems. The system management interface for an on-premise IT system is different from that of the SaaS model; hence, when IT infrastructure combines two systems with different abstraction layers, this may result in a complex sociomaterial assemblage (Wagner et al., 2010). For this assemblage to function well, the systems have to integrate to exchange and interpret shared data. Such a complex system requires skilled IT workers to manage integration issues such as security, privacy, and lock-in effects, which might become costly and could lead to problems if not detected in advance (Kemmericha et al., 2015). As a systems engineer at ALPHA explained, integration of on-premise and SaaS systems helps with data sharing and automation of processes and takes IT workers away from manual work. Thus, IT workers need managerial skills to take charge of the changes in organisational structures, and technical skills (i.e. programming) to integrate and automate work processes for the complex IT infrastructure.

9.2.7 Realign into New Routines

It is imperative that IT workers align themselves with changes in organisational routines when on-premise IT systems migrate to the SaaS model. This study identifies changes in the actions and structure of routines. As explained earlier, changes in actions when some IT technicians channelled all inquiries directly to systems engineers as frontline supporters brought frustration for one systems engineer at ALPHA, who could not cope with the high volume of enquiries due to this new routine and thus resigned. This systems engineer described how he received constant calls from users and IT technicians, and experienced a high workload. Changes in the structure of routines also occurred when IT workers experienced differences in the setup and structural features between on-premise IT and SaaS systems. The new structural features changed the way SaaS was maintained and supported: although support for the SaaS model changed to the second and third level, the system became more stable than the previous on-premise IT system. These changes freed IT workers to get involved in more strategic jobs. Again, these findings agree with Feldman and Pentland (2003), who suggest that any modifications to either the structure or the actions aspects of a routine result in organisational changes in work practices. Thus, IT workers need to realign with new work practices accordingly.

9.2.8 Discover to Recover

Both organisational and technological structures tend to control and dominate people in work practices (Giddens, 1991; Orlikowski, 2000). This study identified two incidents of this: one at ALPHA and one at CHITA. System consolidation at ALPHA had some elements of a political agenda (i.e. organisational structure). The organisation’s leadership seized the opportunity to enforce organisational structures during system consolidation (i.e. technological structure). The organisational structures included policies on how systems should be owned, operated, and supported in various departments and faculties. Instead of being scattered across departments, the systems were centralised into a single system and managed under one organisational structure (i.e. the IT department). The leadership took the migration of on-premise IT systems to the SaaS model as an opportunity to implement one university-wide policy. The policy aimed to consolidate all IT systems, and did not allow faculties to run their IT systems anymore. IS scholars agree on the organisational implications of the introduction of new technology as they impose organisational and technological structures on people (Orlikowski, 2000; Walsham, 2001).

At CHITA, power and politics (Markus, 1983) were the controlling organisational structure originating from the management, which sabotaged the work of the consultants during the system migration. A project funded by Microsoft to help move mailbox accounts from the on-premise IT system to O365 at CHITA was sabotaged by lack of cooperation from the management. After the assistance offer from Microsoft ended, the IT workers had to undertake the migration themselves. For this reason, IT workers had to learn and implement the migration procedures to rescue the failed project. Similarly, the technological structure of a new complex IT infrastructure challenged IT workers' skills and support capabilities; the consequent upskilling required to navigate around the system's structure enabled them to recover from this dominance, as explained earlier that —the introduction of new IT-enabled service could impose organisational and technological structures on people. The structures disguise in various ways, and IT workers had to discover them and recover the system from an imminent disaster. Therefore, with this understanding, the current study suggests that technology may be seen as an 'embedded system in a complex and dynamic social context' (Orlikowski & Iacono, 2001, p. 126), having some sociotechnical and political aspects to discover and overcome.

9.2.9 Use the Learning Platform

The migration of an on-premise IT system to the SaaS model provides a learning platform for both IT workers and IT departments, not only on data and infrastructural changes but as well as regarding competence in dealing with system compliance, security and legal issues. Also, it challenges the skill sets of IT workers and demands changes in legacy system work practices. For these reasons, an IT manager at BETA suggested that the future of jobs in IT will be based on integration, vendor management and leadership skills; IT workers without such skills will be seen as 'legacy staff'. Also, this study shows that the migration process is an opportunity for an IT department to evaluate the social and technical capabilities of the organisation, and create an entry and exit strategy for SaaS systems. For instance, a BETA IT manager outlined a strategy for how they intended to run parallel SaaS email systems, as they are trying to utilise synergies of both systems to enhance the research, teaching and learning experience of students and faculty staff. While GAE offers free collaborative tools, Microsoft is offering competitive prices for Microsoft Office Suite to tertiary institutions that fit well with the core skills needed by graduates. Hence, Iyer and Henderson (2010) advise organisations to develop cloud strategies for unique competitive benefits.

9.2.10 Govern to Harmonise

The future of enterprise computing is not going to be either purely on-premise or in cloud-based systems. Instead, in many cases, it will exist in interdependent 'harmony' of mixed IT infrastructures (Carraro & Chong, 2006). These different systems will not be in a pure harmony, however, because both the on-premise and cloud-based systems bring some leadership, security and integration challenges originating from changes in the organisational and technological structures (Orlikowski, 1992). As indicated earlier, changes in organisational structure entail variations in the way the adopting organisation manages SaaS. Moreover, this study suggests that variations in the technological structures of an on-premise IT system create integration and security challenges, whereas SaaS structural features introduce some skills, leadership and management challenges, especially in the mixed IT environment. For example, the IT infrastructure at CHITA has become more complex, exacerbated by having two servers to support authentication and synchronisation between the on-premise student registry and the hosted O365 for students' email accounts, and six servers for the on-premise email system for staff. All these systems were integrated, creating a complex IT infrastructure with security and integration issues to manage. The IS literature agrees that the attributes of SaaS as an emerging disruptive innovation add to the alterations in both technological and organisational structures (Lui, Ngai, & Lo, 2016; Lyytinen & Rose, 2003; Sherif, Zmud, & Browne, 2006). Therefore, IT workers need to adapt to such changes to remain in charge of the complex IT infrastructure.

9.3 Implications of SaaS for IT Workers and IT Departments

The following sections address the remaining research questions. Section 9.3.1 discusses the impact of SaaS on roles and skill sets of IT workers. Section 9.3.2 discusses an impact on the functions of IT departments, and Section 9.4 discusses how IT workers interact with these technologies from a sociomateriality perspective. Previous chapters discussed and highlighted these issues through the PSIC visual map analysis, and summarised in Table 9-2.

Table 9-2

PSIC Visual Map Analyses

PSIC visual map analyses	Main themes	Main research question issue (discussion section number)
Punctuation	Consolidation/centralisation Hybrid deployment Preparation Implementation Integration	Integration roles (9.3.2) Leadership roles (9.3.2) Human/technology interaction (9.4)

Horizontal	Role changes Brokering role Support service level	Changes in roles of IT workers (9.3.1) Brokering role (9.3.1) Human/technology interaction (9.4)
	Skill sets change Technician /Engineers split Cost issues User brokering role	Change in role of IT workers (9.3.1) Change in skill sets of IT workers (9.3.1) Brokering role (9.3.2) Human/technology interaction (9.4)
	System features changes Complex IT systems New skill sets	Change in skill sets of IT workers (9.3.2) Human/technology interaction (9.5)
	Routines change	Human/technology interaction (9.5) Change in role of IT workers (9.3.1)
Vertical	Discovering Governance Dominance Control	Leadership role (9.4.3) Human/technology interaction (9.5)
	Learning initiatives Infrastructure Technological coercion Facilitation	Human/technology interaction (9.5) Leadership roles (9.4.3)
	Institutionalisation Harmony Regulation	Human/technology interaction (9.5)
	System limitations	Human/technology interaction (9.5)

9.3.1 Implications for Roles and Skill Sets of IT Workers

This section discusses the underlying reasons for some changes in roles and skill sets of IT workers when an on-premise IT system migrates to the SaaS model. This discussion gains insights from the PSIC visual map analysis and takes an ‘ensemble view’ of technology (Orlikowski & Iacono, 2001, p. 125), as it attempts to unpack the structures and sociotechnical features of the technology.

Changes in Roles of IT Workers

This study suggests that changes in the roles of IT workers in supporting the migration of on-premise IT systems to the SaaS environment are moving from the first and second levels of system support to the third and fourth levels—from hardware IT technicians to integration specialists, from software staff to security experts, and from support staff to strategic leadership roles. The empirical data from this study show four reasons for these changes. First, under the SaaS model, system support and maintenance of hardware and software is the responsibility of the cloud service provider. In other words, IT workers access SaaS only via an Internet browser for the management and customisation of their instance. System management is usually operated at the third and fourth support levels. An IT manager at CHITA explained that when the SaaS system breaks down, it becomes a serious problem because it does not happen at the hardware level—which could be addressed by second level support staff—but rather puts the load on third level support specialists who are capable of troubleshooting in the SaaS virtual environment. The IS literature concurs that most SaaS problems are a result of integration issues and interoperability challenges (Ross, 2011).

Consequently, the second reason for the change in roles happens is that the hardware support role changes to one of integration specialist. The integration role, therefore, is the primary core function in the SaaS environment. An IT manager at BETA agreed that future jobs in cloud-based systems would base on integration, vendor management, and leadership. These are the main skills IT workers are required to possess; otherwise, they might become irrelevant to the organisation. To assist in meeting the competitive strategic goals of an organisation, the SaaS model needs to integrate into various business processes through various programming tools. The SaaS system is capable of integrating with other SaaS applications, on-premise IT systems or third party applications. For example, an ALPHA systems engineer wrote a program that integrates GAE with the on-premise HR system for staff, enabling the synchronisation of staff details (name, room number, phone, postal address, job title, and department) into a single phonebook in real time. The IS literature agrees that integration allows users to access shared data and other services on both cloud-based and on-premise IT systems (Botta et al., 2016).

Third, SaaS applications bring security challenges because they may run from data centres shared by multiple countries. Hence, organisations need security specialists to monitor the integrity of data and manage users' access to system datasets. At ALPHA, for example, the IT department terminated the employment of one IT technician and introduced a new IT security speciality role focusing on security issues. Onwubiko (2010) adds that organisations that are adopting SaaS applications need to evaluate how information security management is implemented, managed, and conducted.

Fourth, the leadership role is different in the SaaS environment because third party cloud broker organisations (integrators, aggregators, and consulting firms) have a stake in meeting the needs of business units in SaaS-adopting organisations. Consequently, IT workers and IT departments, in general, need to prove themselves in leadership roles in the ever-changing technological world. For example, since SaaS adoption, the ALPHA IT department has been focusing more on strategic assignments and projects, rather than undertaking operational and support roles. Muller (2012) concurs that IT leaders need to be business leaders first and technology leaders second because a business leader helps the organisation to work out what it needs and outline long-term strategic goals.

In the SaaS environment, therefore, IT workers' roles include the third or fourth level of system management, integration, and security specialist roles.

Changes in Skills Sets of IT Workers

The migration of an on-premise IT system to the SaaS model has implications for the skill sets of IT workers. This study suggests that programming, people, and leadership skills are essential for supporting systems in the SaaS environment.

Unlike on-premise IT systems, the SaaS model runs on an application architecture that is scalable (i.e., it dynamically acquires, or releases compute resources on demand), multi-tenant efficient (i.e., it maximises resource sharing among tenants but can keep customers' data separate) and configurable (e.g. it can be branded to a customer's look and feel) (Carraro & Chong, 2006). To monitor, manage and configure these features—including integrating SaaS through programming tools with other applications—IT workers thus need programming skills. At ALPHA, for example, to integrate the SaaS system with on-premise IT systems and automate various workflows and processes, IT workers require strong programming skills. Moreover, there are various programming tools on the Internet and consultants to help integrate SaaS with legacy on-premise IT systems.

In addition, IT workers need to acquire interpersonal skills beyond their traditional technical expertise. This set of skills is required as IT workers undertake brokering and vendor management roles, especially in the SaaS environment. The current study shows that when an on-premise IT system migrates to the SaaS model, IT workers move closer to supporting the system at the third or fourth levels, where people skills are necessary. Lack of people skills made a systems engineer at ALPHA to resign when asked to serve as a support frontline staff because he did not see it coming and was not trained or prepared to handle peoples' emotions when resources malfunction. Furthermore, IT workers require people skills because they are tasked with strategic/brokering roles and managing SLA with various cloud service providers. For example, at ALPHA, the IT department assigned the IT workers to more productive and strategic roles, which included managing the SLA with service providers and project management. Joseph et al. (2010) agree that people skills are important for IT workers not only for managing their tasks, careers and self but also those of others, such as peers, users, clients and service providers. For these reasons, Muller (2012) advises IT workers to update their ‘mental model’. Mental model thinking describes how coordinated activities of a group can affect a group system (Muller, 2012).

Leadership and strategic skills are imperative for IT workers for two major reasons. First, they give IT workers the ability to manage others, such as superiors, peers, subordinates, and users. For example, when assigned to short-term strategic and project management roles, IT workers are expected to understand the range of interests, motivations, and knowledge levels of others, such as the project team and stakeholders. The current study provides an example of the challenges IT workers face in managing others: systems engineers explained, he might not be good at providing frontline support for users. The second reason is that when IT workers are promoted to higher managerial or leadership roles and are required to manage service providers or business units, they will need systems integration, managerial and leadership skills, as recommended by IT managers in this study.

9.3.2 Implications for IT Departments

The current study suggests that the SaaS model is transforming IT departments into brokering, integration, and leadership roles; hence, these departments need to consider readjusting to these functions.

Brokering Role

As discussed in Section 5.3.1, IT departments are assuming a brokering role in managing the use, performance, and delivery of cloud services, as well as vendor management. An IT manager at ALPHA outlined the cloud vision for his department in taking on the brokering roles for the institution: the institution is migrating low-priority systems to virtual cloud-based services and retaining on-premise the high-performing systems that need high-security monitoring. This vision creates flexibility within the IT department on how systems are managed and maintained of all cloud offerings.

However, some business units are taking on a pull brokering strategy, sidelining the IT department but at the same time wanting more value-added services from the department. Accordingly, the IT department is realigning the roles of IT workers into more strategic roles, focusing on brokering roles such as systems integrators, solutions architects, security analysts and systems consultants (Böhm et al., 2010). These changes do not solely attribute to technological changes; rather the influence comes from the business units' demand for value-added IT-enabled services. One IT manager explained that business units do not need to know the functionality of the technology, but require the ability to support new business operations and facilitate the understanding of their datasets. However, many organisations do not have enough data analysts or data architects to sustain this. Muller agrees that organisations need to provide value-added IT-enabled services to business units—what is known as a transformational IT strategy (Muller, 2012). This strategy is informed and guided by the understanding that IT should add value internally, through greater efficiency; and externally, through increased revenue (Muller, 2012). As the IS literature indicates, if an IT department is sluggish in taking on a brokering role, the emergence of various SaaS intermediaries and brokers (e.g. consultants, aggregators, integrators) around the SaaS environment may take over the functions of the IT department (Barnes & Hinton, 2007; Böhm et al., 2010; Venkatachalam et al., 2014). The pressure to change therefore comes from all sides of the IT department, and the old mental model is not sustainable (Muller, 2012).

Integration Role

The deployment of the SaaS model and its integration into business processes requires due diligence in addressing three main integration issues at the organisational level: security challenges, legal compliance, and emerging threats. First, the SaaS model presents various security concerns to the adopting organisation. The current study provides examples of how IT departments address security threats and risks during SaaS implementation about data segregation, weak SLAs, data access and controls, data location, data recovery and long-term variability. Security threats on data segregation occur because information in the cloud is typically in a shared environment alongside data from other customers. Moreover, the lack of strong SLAs and contracts worsen the ability to hold a service provider accountable should something happen, like data security breach, or when the service provider goes bankrupt. In this study, because Google was offering free email and collaboration calendar services, Google did not sign SLAs for this. For example, at ALPHA, an SLA was agreed only for the archiving system (Postini) for email communications because that is a paid service. In contrast, CHITA signed an SLA with Microsoft for hosted O365 because it is a paid service for which students get free O365 for the duration of the study.

Data access and control of particularly sensitive data processed outside the organisation brings with it an inherent level of risk, because SaaS services bypass the physical, logical and personnel controls that IT departments exert over on-premise IT systems. In addition, there are some risks due to data location because data in the SaaS model could be shared across data centres; an organisation may not even know the exact location where the data is hosted. For example, at ALPHA, the implementation team observed due diligence on issues related to the allocation of data, and on security. In the end, they had only a verbal agreement with Google, although they pursued methods of data recovery in case of a disaster, such as when the data centre get destroyed by natural disasters or by a terrorist attack. Even if the organisation does not know where their data are held, a cloud service provider should develop a data recovery plan in the event of a disaster. However, because GAE was a free service, Google did not commit to any financial or legal obligation if something happens to data. An IT manager explained that 'it was just pointed out. You are not paying for anything; we are not liable for anything' (PA-3).

There is an issue of long-term viability when an organisation is at risk in case the SaaS provider goes out of business or acquired by a competitor (Iyer & Henderson, 2010). The cost of switching from one service provider to another could be high. However, in the current case studies, fee-free SaaS services offered to the organisations induced them to compromise on some risks—enlightening the gullibility phenomenon on some of these institutions. For example, ALPHA was concerned about the implications of the US Patriot Act. As indicated in Section 5.2.2, technically the law gives the US government access to any data stored within the US: ‘If a third party is hosting the data, the data is to be handed over without the knowledge or permission of the company or person using the hosting service’ (Abadi, 2009, p. 3). However, Google maintained that because GAE is offered free, ALPHA needs to either take it or leave it. For an organisation to accept such an arrangement shows a sign desperation in adopting IT-enabled services.

The second integration issue relates to legal compliance; SaaS-adopting organisations conventionally are responsible for the security and integrity of their data, even when a cloud service provider hosts it (Chen, 2010). As indicated in Section 2.2.7 although cloud service providers are subject to external regulation and security certification standards, this may not guarantee their legal compliance. However, on the current study, IT departments did not seek any regulatory compliance and certification for email services, probably because of the nature of the systems adopted and the way the IT market perceives the service providers. For example, in the current study, cloud service providers were perceived differently: Google is seen under a ‘do no evil banner’, and they have a strong presence as a relatively neutral web player, rather than the ‘heavily corporate Microsoft’ (IT manager PB-1). Those factors came into consideration when choosing a service provider.

The third integration issue relates to emerging threats to cloud computing, which include the vulnerability of hardware to exploitation, and processors and applications of the SaaS systems, as discussed in great detail by Fernandes et al. (2014) and (Onwubiko, 2010). Organisations should, therefore, put preventive measures and mitigation plans in place to address the potential for exploitation during system deployment and integration. In addition, the literature has raised concerns (on issues that an adopting organisation needs to be aware of) with regard to some cloud providers—potentially Amazon, Google and Microsoft—about the lack of reliable security audit standards, lack of clarity on issues related to data lock-in and unclear internal data security procedures (Gellman, 2009; Muller, 2012).

Leadership Role

The IT department needs to exhibit strong and clear leadership acumen in designing a cloud or SaaS strategic plan for business units or the entire organisation (Iyer & Henderson, 2010). Especially when the SaaS model matures, other SaaS intermediaries may take centre stage in the SaaS environment in advising SaaS-adopting organisations. The IT department, therefore, needs to prove itself. Otherwise, their functions could be outsourced to SaaS intermediaries. As discussed earlier, the findings of this study show that IT departments lack critical skilled roles, such as data analysts and architects in playing a consulting role for business units. For these reasons, Muller advises IT departments to be an ‘enterprise leader first, and a technology leader second’ (2012, p. 13). This study suggests that an IT department as a business leader needs to help the organisation determine its needs proactively, and where it should go to be successful in the long term. As an IT leader, it should take an advisory role on how to respond to disruptive technologies and focus on the main things (Muller, 2012).

9.4 Interactions between Human and Technology

Understanding the relationship between human and technology, and how this contributes to organisational change, is a challenge in IS studies (Leonardi, 2012; Orlikowski, 2007; Orlikowski & Scott, 2008). As discussed in Section 2.4, this study employs a sociomateriality lens that describes the constitutive entangling of human and technology in work practices (Orlikowski, 2007). The sociomateriality perspective helps this study in explaining how human and material agencies interact (Leonardi, 2012; Orlikowski, 2007; Orlikowski & Scott, 2008). The sociomateriality debate has attracted many scholars (Kautz & Jensen, 2013; Leonardi, 2012, 2013; MacLeod et al., 2015; Mutch, 2013; Orlikowski, 2009, 2010; Scott & Orlikowski, 2013; Tanggaard, 2013) and for these reasons, Cecez-Kecmanovic et al. (2014) dedicate a 2014 *Management Information Systems Quarterly* special issue to this debate. However, as highlighted in the literature review, this study seeks to examine the space or the level of interaction between human and material agencies, the idea of which is unclear in the sociomateriality debate. In other words, at what interface do human and material agencies interact, and how does this interaction happen?

In this debate, for example, Orlikowski and Scott (2008) argue that human and material agencies interact in an interwoven manner and that the ‘social and material are inherently inseparable’ (Orlikowski & Scott, 2008, p. 456). Such an argument prompts the current study to examine the level at which human and material agencies interweave with one another and to understand why some scholars (Barad, 2003, 2007; Orlikowski, 2009; Orlikowski & Scott, 2008) regard them as inseparable. Similarly, Kautz and Jensen question the inseparability of the social and the material: if they are related, ‘why don’t they then have to be separated to be recognised as part of a relation?’ (Kautz & Jensen, 2013, p. 19). Also, Jones (2014) contends that it makes no sense, that ‘there is no social that is not also material, and no material that is not also social’ Orlikowski

(2007, p. 1437). For that reason, Jones (2014) argues that there will be no need to talk about the social and the material separately from each other if they are one and the same to each other. Leonardi adds that human and material agencies imbricate in a space known as 'sociomaterial practice' (Leonardi, 2012, p. 43). According to Leonardi (2012), in so doing certain imbrications produce changes in social settings, such as roles, skills and work practices (see Figure 2-7). However, the sociomateriality literature remains unclear about the level at which human and material agencies imbricate. Thus, the current study attempts to provide insights into the level at which sociomaterial practices operate. Accordingly, from a sociomateriality perspective, taking the substantiality ontology stance (Emirbayer, 1997), and using Leonardi (2012) concepts of imbrication, this study discusses three aspects of explaining how human and material agencies imbricate. The first is the space or level of imbrication between human and material agencies. The second is how IT workers in this study responded to changes in work practices within these technologies. The last is to gain insights into the capabilities of human and material agencies during the imbrication.

9.4.1 Level of Imbrication between Human and Material Agencies

The level of imbrication between human and material agencies is unclear in the sociomateriality literature. This section attempts to highlight this phenomenon from the SaaS model context in light of this literature. Following the principles of chemistry, material or matter exists in three basic forms: solid, liquid, or gas (Blin-Stoyle, 1997; Ursul, 2008). Primarily, it is of these necessary forms that human interact with any matter or the material artefact (Blin-Stoyle, 1997). By the same reasoning, this study suggests that human and material agencies imbricate each other in work practices in the materiality, virtual and spirit realms. The empirical data collected during the current study suggest how IT technicians, systems engineers, and IT managers imbricate differently at the *materiality*, *virtual* and *spirit* levels of the technology.

Materiality of Technology

Materiality is not only inherent to the technology, and independent of its use and the context in which it is used; it is also the space of imbrication of human and material agencies (Barley & Leonardi, 2008). In other words, materiality provides affordances and constraints to allow imbrication of human and material agencies to happen (Markus & Silver, 2008). For 'materiality' to exist as a concept separate from 'sociomateriality', it implies that some materials are not simultaneously social (Leonardi, 2013). This means that for any material to be simultaneously social, it needs to have affordances or attributes to accord imbrication with the human agency. The current study shows IT workers perform well within the materiality of IT; that is, the hardware and software of the IS, particularly in regards to IT system maintenance and support. More specifically, IT technicians are more comfortable working at the materiality level of technology for the support and maintenance of the IT system, at both the hardware and software components levels. IT technicians, therefore, tend to follow the IT system support routines for 'how to' fix the system and thus imbricate with the materiality of the technology. For example, an IT manager at ALPHA described how IT technicians imbricating at the materiality level were affected when the on-premise IT system migrated to the SaaS model, due to adverse changes in IT structural features of these technologies. For these reasons, IT technicians failed to continue supporting the system in the SaaS model because the new system's interface had unfamiliar structural features accessed at the virtual layer, which requires programming skills to handle. To circumvent this issue, the IT technicians thus shifted SaaS support tasks to the systems engineers capable of imbricating with the SaaS model in the virtual realm.

Virtual Realm of Technology

The virtual realm of technology (Wetmore, 2007) relates to technological features that are malleable and changes according to how the system is used. Unlike materiality of technology, virtual features are inherent to technology but depend on the context and use of the technology. The current study suggests that unlike on-premise IT systems built on a client–server architecture, the SaaS model has characteristic utility features such as configurability, multi-tenancy, elasticity, scalability, and ubiquity. Although SaaS provides web-based applications accessible via a browser (Carraro & Chong, 2006), this does not necessarily mean that traces of the utility features do not exist in the on-premise IT systems; the richness, malleability, and ease of integration of the SaaS functionality through APIs with other IT systems create a different abstraction layer for technology. Hence, the SaaS model demands different IT workers' skills to maintain and support. The current study shows how IT technicians and systems engineers imbricate differently in the virtual realm of technology. IT technicians supporting the SaaS model were unable to go beyond fixing the tool; whereas systems engineers had the ability to go beyond fixing the tool. As systems engineers understand how a tool works, they can change the code of the system design and functional features, and add a different context in which the system may be used.

For example, a systems engineer at ALPHA added system codes to simplify the interface for IT technicians to operate. In so doing, the systems engineer created an interface at the materiality realm for IT technicians to imbricate with the SaaS system. The systems engineer wrote a system code that integrates the on-premise staff-record management system with the adopted SaaS system (GAE). The new interface provided clickable buttons for IT technicians to use when creating or managing user accounts on the SaaS interface. For these reasons, the IT manager elaborated on the difference between an IT technician and an engineer. The difference suggests that IT technicians and systems engineers imbricate differently with technology. While the systems engineer understands how computing works, is trained to adapt, and can even change a system's code, the IT technician is trained to use the interface and regards a system as a tool. However, when the interface or a tool changes, IT technicians tend to fall outside the imbrication space and thus are threatened when the space for imbrication with IT changes from materiality to the virtual level. The literature alludes to these attributes as disruptive features of the SaaS model for IT workers (especially IT technicians) because they change how SaaS is accessed and supported (Keller & Hüsig, 2009). In such circumstances, systems engineers are valued by many organisations, as they have the ability to transcend the tool and imbricate with technology at the virtual realm, and have the capacity to align the new system with organisational strategic goals. Similarly, ALPHA IT technicians were unable to write programming codes or support the SaaS system. As the SaaS system operates at an abstraction layer (virtual realm), the IT technicians were unable to understand it. This implies that IT technicians need the ability to imbricate with technology at the virtual realm to be able to support a new system. Hence, an ALPHA systems engineer received constant calls from IT technicians (at the helpdesk) and users needing help. Eventually, he resigned due to the workload and pressures from both the IT technicians and users. This study thus suggests that IT technicians lack the ability or programming skills to imbricate with the SaaS system at the virtual level and to provide the necessary support to users.

Spirit of Technology

The spirit of a technology refers to its essence or strategic goals (DeSanctis & Poole, 1994). Spirit can be identified by analysing the philosophy of the technology based on the design metaphor underlying the system (e.g. SaaS is ubiquitous and can be used anywhere and on any device access via an Internet browser). The features that SaaS incorporates, and how they are named and presented (e.g. the elasticity, scalability, configurability, and multi-tenancy of SaaS applications) identify the spirit of the technology. The spirit of technology is realised through the nature of the user interface (e.g., SaaS is web-based) and training materials and online guidance facilities (e.g. dashboards and online tutorials). Finally, the spirit of technology is understood through the systems support and maintenance (e.g. the vendor maintains and supports SaaS applications), and integration with other systems (DeSanctis & Poole, 1994). Findings of this study show IT managers imbricate with technology in the spirit realm by analysing the purpose of the system and enforcing organisational routines (rules and guidelines) to align the organisation's strategic goals with the technology. For example, ALPHA's organisational strategic goals of opting for a complete cloud-hosted solution ('zero-server solution') for its email system aimed at reducing operational and HR costs as well as tapping into the latest cloud-based technologies. The organisation searched for cloud-based IT solutions with the strategic aim of eliminating or reducing on-premise IT systems of their email systems. Although ALPHA shortlisted and trialled three solutions (Microsoft, Google and Oracle), the GAE solution was selected because it was a mature system that aligned well with ALPHA's organisational goals. Thus, IT managers imbricate with systems by analysing the spirit of the technology, and align with the organisational goals.

BETA IT managers explained their strategy for mapping advancements in technology with their organisational goals. They attend IT conferences to stay abreast of trends in where new technologies are heading (i.e. they imbricate with the spirit of new technologies). They share conference insights with various business units and in management meetings to position the organisation's vision and goals accordingly. In particular, BETA business units do not necessarily need to know about IT functionality, but they do need to know about the ability of IT systems to support new business functionalities. In other words, business units require IT systems that will align well with the requirements of new business functionalities. Such understanding entails intelligent management in analysing organisational data and providing meaningful interpretations to decision makers. Hence, IT managers need to position themselves by understanding the spirit of technology and organisational goals to give support in the management of the goals. Thus, IT managers regarded as the business and IT leaders, are also seen as custodians ensuring business needs, and IT-driven goals are met (Wyld & Juban, 2010). IT managers analyse the spirit of technology by examining IT resources and the economics of computing capabilities that meet business goals. In the current study, for example, organisations selected a strategic SaaS model because of the elasticity of IT resources made possible through the cloud computing architecture and the economics of SaaS computing, which offers free products and services such as email, storage and collaboration applications (Wyld & Juban, 2010). Moreover, a strategic SaaS model provides an SLA between the adopting organisation and the SaaS service provider, on business values of service delivery. As explained in the literature review, organisations thus adopt a strategic SaaS model (such as GAE and hosted O365), based on a cost–benefit analysis, ROI and risk analysis to put a value on the economics of computing. Moreover, SaaS is designed to be scalable, multi-tenant, and configurable to ensure the elasticity of its IT resources (Chen, 2010).

Hence, this study suggests that human and material agencies imbricate at the materiality, virtual and spirit levels. In other words, humans interact at the materiality, virtual and spirit levels of the technology, which in turn produces changes in social settings such as roles, skills and work practices (Mbuba et al., 2015).

9.4.2 Imbrications of IT Workers and Technology in Work Practices

Previous sociomateriality studies discuss human and technology interaction in work practices (Johri, 2011; Jones, 2014; Wagner et al., 2010). The current study suggests that from a sociomateriality perspective, IT technicians, systems engineers, and IT managers imbricated differently when an on-premise IT system migrated to the SaaS model. Before reflecting on sociomateriality thinking, four critical events analysed through the PSIC model are discussed—showing how IT workers imbricated differently in work practices. First, IT technicians at the IT helpdesk failed to imbricate with the SaaS system at the virtual level. Instead, they changed the structure of the routine or work practice of IT systems support. Rather than responding to users' enquiries, they redirected them to systems engineers at second and third systems support levels. Even after the systems engineer solved the problem and closed the job, IT users bypassed the IT helpdesk and made direct calls to the second or third support level. This change in the structure of work practices remained permanent. The resulting workload on one systems engineer escalated as he consistently received calls from both IT technicians at the helpdesk and users. Due to the amount of work, pressure and much stress, the systems engineer resigned from his job.

The second critical event was that systems engineers not only imbricate at the materiality level but also in the virtual realm of technology, through coding and systems support. Systems engineers tend to think about the architectural design of the technology and find out why the system might be behaving differently and thus have the ability to change the system's code to align the technology with organisational needs. Therefore, this study suggests that coding skills enable systems engineers to manage system changes from on-premise IT to SaaS systems more efficiently than do IT technicians. For example, a systems engineer at BETA was able to use his programming skills to automate SaaS and on-premise IT system functionality for creating users, by integrating the systems through API's programming tools and making a single web interface for creating users in both systems.

The third critical event occurred when some IT technicians were unable to support the system in the virtual realm. In other words, they stopped dealing with the SaaS model altogether because they lacked the appropriate programming skills and hence were made redundant from the IT department. A systems engineer at ALPHA explained how the organisation laid off an IT technician after the migration, and hired another person to fill the new post of security expert. These changes resonate with the IS literature advising organisations adopting SaaS systems to consider employing security experts to deal with security and privacy issues (Onwubiko, 2010).

The fourth event was that changes in technology did not affect the IT managers, because they operate at the spirit level of the technology: when human and material agencies imbricate at the spirit level, the assemblage dissolves the analytical boundaries between human and technology (Orlikowski & Scott, 2008). IT managers also adjusted to the new system's strategic goals and aligned IT workers' roles and skill sets with the organisation's strategic goals. An IT manager at ALPHA explained that they use a 'skills metrics' technique for aligning IT workers' skill sets with different systems that need support. Such an alignment allows the correct mix of skills to cover system support across the organisation, based on the movement of IT workers and where their skills are needed most. This research thus suggests that IT workers imbricate with technologies differently. In particular, IT technicians imbricate well at the materiality of the technology, by supporting it as a tool (i.e., hardware and software assemblage). However, IT technicians in these case studies were unable to support SaaS systems in the virtual realm because of changes in the technological interface, or the system's abstraction layer. In contrast, systems engineers imbricate well both at the materiality and virtual levels of technology because they can change a system's codes, which may alter its goals. Finally, IT managers imbricate well with technology at the spirit level by aligning it with organisational goals.

These findings echo those of sociomateriality studies discussed earlier, that human and technology exist in a relationship and interact in a negotiated practice to form a sociomaterial assemblage (Wagner et al., 2010). The sociomaterial assemblage intends to achieve social outcomes as part of the purpose of negotiation; for example, systems user support staff manages the system's strategic goals or fulfils organisational needs. This study suggests that the negotiation in practice between human and technology happens at the materiality, virtual and spirit level during the imbrication process. In addition, the negotiations in practice between human and technology depend on the skill set of the human imbricating with the technology at a given imbrication level, to form a sociomaterial assemblage. As indicated earlier, an on-premise IT system provides materiality, virtual and spirit levels at which IT workers negotiate in practice with technology to form an ‘on-premise IT assemblage’. This implies that IT technicians negotiate in practice with the on-premise IT system at the materiality level, to provide user support and manage the system; whereas systems engineers negotiate at the materiality and virtual levels of the on-premise IT to position the system to meet organisational goals, and IT managers negotiate in practice at the spirit level of the technology to align the system with the organisation’s strategic goals.

With this understanding, therefore, when an on-premise IT assemblage migrates to the SaaS model, both the social and technical subsystems (Leonardi, 2012) enter into the reorganisation of the assemblage (Wagner et al., 2010). During the reorganisation process, human and technology enter into a new phase of negotiation in practice. However, the technical features of the technology in the SaaS model are different from those of on-premise IT systems, as the SaaS model provides affordances (Markus & Silver, 2008) only at the virtual and spirit levels for negotiation. At this stage, therefore, only system engineers and IT managers continue the negotiations in practice (at virtual and spirit levels respectively) to form an emergent ‘SaaS assemblage’. In contrast, IT technicians are removed from the negotiations in practice—as they are unable to imbricate at the virtual and spirit levels of the SaaS model. As indicated in the sociomateriality literature, that human and technology exist only in relation to each other, and it is not possible to force a human (of fallen out IT technicians) to work in a preferred way with the new sociomaterial assemblage—which in this case is the SaaS assemblage (Wagner et al., 2010). Nevertheless, the current study suggests that IT technicians may re-enter negotiations in practice with the new assemblage in the SaaS model in two ways. First, after undergoing further training, IT technician may be able to afford imbrication with the SaaS model at the virtual level: a systems engineer at ALPHA proposed that IT technician required upskilling to be able to interact with the SaaS system—something the project team should have done better.

The second way of enabling IT technicians to re-enter negotiation in practice with the SaaS model is by creating another materiality abstraction layer that would integrate with the new SaaS assemblage via APIs tools. IT technicians will then be able to negotiate in practice with the generated materiality interface that integrates with the SaaS assemblage. In the end, IT technicians will only negotiate in practice with the materiality interface, which in turn communicate with the SaaS assemblage via the APIs. Systems engineers at ALPHA discussed how they made it possible for IT technicians to enter into the new arrangement of interacting with the SaaS model by creating a new interface via the APIs. The engineers wrote various programmes consisting of over 10,000 lines of codes and incorporated the details on a web interface. At this interface, IT technicians were able to create and manage new user accounts, mailing lists, and aliases across other on-premise IT systems. In fact, IT technicians at the helpdesk just had to click a few buttons on the web page, tick a few boxes, type a username, and submit. Therefore, IT technicians joined the 'SaaS assemblage' via the materiality layer created for them by systems engineers.

9.4.3 Capabilities of Interwoven of Human and Material

As indicated in the Sections 9.4.1 and 9.4.2, the imbrication between human and material agencies depends on the human capability to produce the social outcome (Leonardi, 2012). This section thus discusses human capabilities and social outcomes in the context of the imbrication of human and material agencies at the three levels (materiality, virtual and spirit). This imbrication is further discussed on the five notions of sociomateriality, to deepen our understanding of the social outcome when human and material agencies imbricate at these levels (Jones, 2014).

The current study shows two kinds of human capability during the imbrication process. The first is the human ability to upskill and negotiate in practice with new technologies, such as the SaaS model, to form a new SaaS assemblage (Wagner et al., 2010). The second is the human capacity to influence actions when human and material agencies imbricate (Leonardi, 2011). On the first human capability, this study suggests that there are some challenges considering that IT workers range in their IT skill sets, from the simplest form to the highly educated IT worker, capable of doing all sorts of systems support. For example, an IT manager at DELTA witnessed IT technicians who could not cope with the training and unable to form a SaaS assemblage. Instead, some staff resigned because the new job was too complex a task—in dealing with various programming tools, while others undertook the necessary upskilling, and imbricated well with the SaaS system.

On the second human capability, although both human and material agencies influence people's actions, 'their influence is disproportionate because the human agency always leads, whereas the material agency complements' the actions (Leonardi, 2011, p. 148–150). The leading status of the human agency, therefore, depends on the human capability to perform a given task. Consequently, in a SaaS environment, IT technicians' leading status tends to become weak because they lack appropriate skills to perform their tasks. The introduction of the SaaS model, therefore, changes the ways human and material agencies imbricate at the materiality, virtual and spirit realms of technology. In the end, the imbrications between human and material agencies produce social outcome known as 'organisational residue,' which can be a result of changes in work practices or technologies, and these figurations of new sociomateriality arrangements persist in the absence of their creators (Leonardi, 2011, p. 151). That is, the social outcomes become permanent aspects of the new structure of the system arrangements. In the current study, PSIC analysis showed various organisational residues as the social outcome of the imbrication between human and material agencies. For example, at ALPHA a systems engineer used API tools to build a web interface (for IT technicians to use) for the creation of user accounts on both the SaaS (GAE) and on-premise HR systems. These figurations of the new sociomateriality arrangements remain operational to date.

As discussed in Chapter 2, following Orlikowski and Scott (2008), Jones explains five main notions of sociomateriality: materiality, inseparability, relationality performativity, and practice (Jones, 2014, p. 897). (For definitions of these terms, refer to Section 2.5.) This study examines further the imbrication of human and material agencies at the elementary levels (materiality, virtual and spirit) with respect to the five notions of sociomateriality to gain a deeper understanding of the social outcomes (Jones, 2014). The discussion in the context of the implications of the SaaS model for IT workers' roles and skill sets requirements, and changes in work practices are summarised in Table 9-3. Construction of Table 9-3 raised the question of what it means with respect to the five notions of sociomateriality when human and material agencies imbricate at the materiality, virtual and spirit levels of technology, in the context of both on-premise IT and SaaS systems. It is worth noting some notions of the spirit realm illustrated in Table 9-3.

Regarding the concept of inseparability at the spirit realm, the imbrication of human and material agencies becomes inseparable because in this realm, 'social and material becomes inherently inseparable' (Orlikowski & Scott, 2008, p. 456). In other words, managers' 'quotidian interaction' with technology becomes a subconscious norm in their everyday lives (Leonardi, 2013, p. 63). For example, the investigations in this study show that the major concerns of IT managers were related to the inability of on-premise IT systems to meet users' expectations and organisational goals. Therefore, these concerns become part of their work and social life, because, for these IT managers, the spirit of the technology and strategic goals of the organisation were intertwined in their daily lives. Such interwoven of the spirit of the technology and strategic goals of the organisation were certainly the case for Steve Jobs, who remained inseparable from Apple products; and Bill Gates on Microsoft products. These men imbricate at the spirit level with their products; thus, these people and their products are inseparable.

With respect to relationality, when human and material agencies imbricate at the spirit realm, the sociomaterial assemblage 'dissolves analytical boundaries between human and technology' (Orlikowski & Scott, 2008, p. 455), because the interaction between human and material exists in an intricate assemblage of a human's mind. For example, IT managers may share their on-premise IT system problems with colleagues, family members and vendors, to solicit insights for a comprehensive solution.

With regard to performativity—that is, the ability of human and material agencies to achieve social outcomes (Jones, 2014)—when human and material agencies imbricate at the spirit realm, this forms a human and material assemblage recursively intertwined, with a resulting social outcome. This research shows that IT managers embodied with troubled technological issues have a strong, decisive desire to make changes to the system.

Finally, on practice, the imbrication of human and material in the spirit realm remains an enthusiastic stance of a person, although this differs among individuals. This study suggests that IT managers were passionate about migrating on-premise IT systems to the SaaS model, so as to achieve their technological goals. As IT manager at BETA explained that it did require quite a lot of deliberate change management and demonstrate that the change would be adequate and suitable when resolving people's emotions, politics, and power issues.

Table 9-3

Human and Material Agency Imbrication Levels at the Five Notions of Sociomateriality

Human/material agencies	What does it mean on the five notions of sociomateriality, when human and material agencies imbricate at these levels? Are there any changes when moving from on-premise to the SaaS model?				
Imbrication levels	Notions of sociomateriality (Jones, 2014)				
	Materiality	Inseparability	Relationality	Performativity	Practice
Materiality	Technician level, supporting hardware and software of IT; this level requires experience and 'know how' skills and capabilities Humans/material imbricated at material level, materiality of technology remains unchanged over differences in time and place Example: in the SaaS model, hardware relocates to data centres (the 'cloud'), and software accessed via a web-based virtualised abstraction layer	Human/material agencies remain independent entities when imbricating at the materiality level Example: IT technician may decide to restart the IT system; otherwise it will continue to be 'on' unless some physical or electronic fault occurs	There is a clear boundary between human/material agencies at the materiality level; human and material agencies emerge in their imbrication in specific practices (Leonardi, 2013) Example: human agency or an IT system fault calls for human intervention, which might initiate social activity	Human/material agencies have capabilities to achieve 'social outcomes' (Leonardi, 2013, p. 899); activities are interpreted physically, digitally and by non-physical means Example: human agency might initiate a software application to run or be installed; the software runs to produce desired outcomes	Ability to initiate human/material activities differs in the on-premise and SaaS systems Example: study findings show IT technicians and systems engineers have different capabilities to engage with the SaaS system; IT technicians altered certain organisational routines to circumvent direct support on SaaS
Virtually	When human and material agencies imbricate at the virtual level, the materiality of technology is seen to be malleable; at this level, IT workers need to understand 'why' the system behaves that way, which demands deeper	Imbricating in the virtual realm of technology, human/material agencies remains separable and independent entities across space and time (Leonardi, 2013) Example: multi-tenancy, elasticity and scalability features of SaaS systems remain	Analytical boundaries exist between human/material agencies imbricated at the virtual realm of technology (Leonardi, 2013)	Human/material agencies have capabilities to achieve social outcomes via non-physical and digital means	Human/material agencies imbricated in the virtual realm tend to operate at the coding layer Example: systems engineers create

	IT skills, such as coding skills; the study findings show imbrication at this level is more common in SaaS than in an on-premise IT system Example: IT technician fails to troubleshoot SaaS systems and escalates these issues to systems engineers, showing IT technicians may be unable to imbricate in the virtual realm of IT	independent from IT workers' interventions, and material performance, as these features follow prescribed IT settings	Example: although SaaS has multi-tenancy, elasticity and scalability features, these exist independent of the designer following the virtualisation characteristics of IT	Example: the scaling up or down of IT resources by SaaS systems produces social outcomes as a utility for IT users	APIs to integrate with other organisational systems
Spirit	Human/material agencies imbricating at the spirit level calls for IT managers to understand the ability of the materiality of technology to meet the organisation's strategic goals Example: IT manager opts for a SaaS system to reduce operational and HR costs as well as tap into the latest cloud-based technologies	In the spirit realm, human/material agency imbrication becomes inseparable because at this level, 'social and material becomes inherently inseparable' (Orlikowski & Scott, 2008, p. 456); in other words, managers' 'quotidian interaction' (Leonardi, 2013, p. 63) with technology becomes a subconscious norm of everyday life Example: IT managers concerns about an on-premise IT system's inability to meet user expectations are a major concern in their work/social life: Steve Jobs cannot be separated from Apple products, nor Bill Gates from Microsoft products; these men imbricate at spirit levels with their products and are thus inseparable from them	When human/material agencies imbricate at the spirit level, the assemblage 'dissolves analytical boundaries between human and technology' (Orlikowski & Scott, 2008, p. 455); human/material agencies exist in an intricate assemblage of the human's mind Example: IT managers share their on-premise IT system problems with colleagues, family members and outsiders/vendors to solicit insights for a comprehensive solution	Human/material agencies imbricate at the spirit realm, forming a human/material assemblage recursively intertwined, resulting in a social outcome Example: the study shows that IT managers embodied with troubled technological issues have a strong, decisive desire to make changes to the system	In relation to practice, human/material imbrication in the spirit realm retains an enthusiastic stance and differs among individuals Example: This study consistently shows that IT managers were enthusiastic about migrating on-premise IT systems to the SaaS model

In concluding this section, the current study shows how IT-enabled systems, such as SaaS have some effects on human's roles and skill sets in work practices. These effects bring some organisational changes, especially in the IT department. In addition, how human interact with IT enabled systems at various levels depend on the roles and skill sets of an individual. Thus, the human and technology interaction could be explained in-depth by looking at the levels (materiality, virtual of spirit realm) of the interaction and the capability of a human to form a stable sociomaterial assemblage in work practice.

9.5 Chapter Summary

This chapter examined the study cases to answer the three research questions (see Section 1.3.2). Based on the PSIC analyses, the chapter discussed managerial implications during the SaaS migration process by viewing technology as an embedded system. The chapter also examined the main changes in roles and skill sets of IT workers and the implications for IT department functions. Finally, from a sociomateriality perspective, and taking the substantiality ontology, this chapter discussed the interactions between human and material agencies. In particular, the discussion introduced the new insight that human and material agencies imbricate at the materiality, virtual and spirit levels. In other words, these are the primary levels at which humans interact with the material artefact. Thus, the sociomaterial assemblage is the product of human and technology interaction within the materiality, virtual and spirit realms in negotiated practice (Wagner et al., 2010). This knowledge contributes to the sociomateriality literature, as there is currently a lack of understanding about the level at which human and material agencies interact.

Chapter 10: Conclusions

10.1 Introduction

This chapter concludes the research and is arranged as follows. First, a brief summary is presented and followed by the contextual, methodological, and theoretical contributions of the study. Finally, the chapter discusses the limitations of the research and provides some recommendations for future research.

10.2 Research Summary

The primary objective of this study was to explain the implications of SaaS for IT workers from a sociomateriality perspective. In particular, this explanatory study sought to explain the reasons why the migration of an on-premise IT system to SaaS changes the roles and skill sets of IT workers, and how human and technology interact from a sociomateriality lens. The study drew empirical data from four cases of tertiary institutions in New Zealand and employed a PSIC model as a sensitising device for analysing the data. The study reviewed the concepts of cloud computing, characteristics of the SaaS model and effects on ISs. It also discussed the process approach, principles of hermeneutic cycles used in data interpretation, and concepts of sociomateriality for providing an in-depth understanding of how IT workers interact with technologies.

The study followed the interpretive approach as a philosophical paradigm in the analysis and interpretation of the empirical data. Viewing technology as an ‘embedded system’ (Orlikowski & Iacono, 2001, p. 125), the study suggested ten managerial implications during the migration of on-premise IT systems to the SaaS model and implications for IT workers and the functions of IT departments. In particular, the results highlighted that the mental model of IT workers needs to be updated to include new key skills on coding, people, and leadership. Also, using the cloud intermediary literature (Böhm et al., 2010), the study highlighted key roles—brokering, integration and leadership—that IT departments need to consider and position themselves about the management of the SaaS model. Also, from a sociomateriality perspective, the study suggested three levels of interaction between human and material agencies or technology in work practices. Human interacts with technology in the materiality, virtual and spirit realms of the technology.

10.3 Research Contributions

This research makes contextual, methodological, and theoretical contributions for both researchers and practitioners.

10.3.1 Contextual Contributions—the SaaS Model

The study suggested several contextual and practical implications of the SaaS model for IT workers and the functions of IT departments. Contrary to previous IS studies that focused on the consequences of cloud computing for humans and organisational change in general terms (Ross, 2011), the current study attempted to add to the IS literature by focusing on the implications of the SaaS model, which has changed the way software is sourced, delivered and managed. Hence, the migration process for an on-premise IT system to the SaaS model presents an ideal environment, with the clear contrast of structural features of systems, offering insights into the implications for work practices. This study was a response to IS scholars who stressed the need to examine SaaS effects because of the disruptions and challenges the model brings to HR and the requirements for organisational change (Christensen, 2006; Sood & Tellis, 2011; Wang et al., 2011). Another contribution for practitioners came from the contextual descriptions of the migrations process from on-premise IT systems to the SaaS model in the four cases. The descriptions of the various critical events and issues highlighted a typical migration process. Practitioners can learn from these cases to avoid some of the pitfalls discussed in this study. Also, this study proposed the concept of a pull brokering strategy for SaaS customers. The pull brokering strategy occurs when SaaS customers or users in a business unit subscribe directly to SaaS applications offered by SaaS service providers, without consulting the IT department (see Figure 9-2). When SaaS customers subscribe to SaaS applications directly from service providers, this brings some security challenges to the IT infrastructure. The organisation, therefore, needs to devise a SaaS strategy for managing and addressing these challenges (Iyer & Henderson, 2010). Also contributing to the literature of cloud intermediaries, the concept of a pull brokering strategy of SaaS customers brings significant threats to the responsibilities of the IT department— traditionally regarded as an IT gatekeeper (Barnes & Hinton, 2007; Böhm et al., 2010). This observation is in line with other studies in the IS literature (Muller, 2012). Muller argues that in coming years, business units will be able to source almost any IT service that it needs without the involvement of the IT department (2012). Examining the capabilities of IT workers, the study made a clear distinction between IT workers in the SaaS environment; as either IT technicians or systems engineers. Moreover, the research suggested that IT technicians and systems engineers have different capabilities and respond differently to SaaS structural features. Hence, IT managers need to have a staff strategic plan in place when migrating on-premise IT systems to the SaaS model. Finally, the study identified ten managerial implications from the PSIC data analysis model when migrating on-premise IT systems to the SaaS model. These managerial implications not only provide managerial insights to practitioners; the way these effects emerged yielded two significant contributions. First, the managerial issues inductively emerged from the context of the empirical data through the PSIC analysis process (i.e., the punctuation, horizontal and vertical analysis) (Urquhart, 2012). Second, the managerial issues are the result of the account of the lived experiences of IT workers and IT managers involved in the migration process. Further, the managerial implications supported by *in vivo* quotes from participants produced empirically grounded explanations from the context in which they occurred (Klein & Myers, 1999). Therefore, practitioners could apply these implications when migrating one type of IT-enabled system to another

10.3.2 Methodological Contributions—the PSIC Model

The PSIC model developed by Lyytinen and Newman (2008) is a useful tool in IS research process models because it extends and advances other sociotechnical process models in the IS field (Keen, 1981; Markus & Robey, 1988; Robey & Newman, 1996). In particular, the concepts in PSIC are fully developed, and the use of the visual map provides an in-depth understanding of the entire IS implementation process. In addition, the PSIC model incorporates the Leavitt's model (Keen, 1981), which views organisational systems as multivariate systems of four interacting and aligned components—task, structure, people and technology—and as a measure of changes in organisations when new technology is introduced (Lyytinen & Newman, 2008). Further, the PSIC model uses punctuation, horizontal and vertical analyses in depicting and analysing critical incidents and gaps, providing a powerful visual mapping tool for the in-depth understanding of a phenomenon.

This study has thus contributed to the operationalisation of the PSIC model in the context of the SaaS model and has provided a detailed account of the migration process from on-premise IT systems to the SaaS model. This account, which is rather technical in nature, allowed the reader to follow the method by which the data were analysed to arrive at the implications discussed. Also, the model traced the trajectory of the changes in structural features of these technologies (i.e., on-premise IT systems and the SaaS model) and their effects (see Figures F1, F2, F3 and F4 in the appendices). The changes in systems brought by these technologies interrelated with critical incidents, gaps and significant variations in the roles and skills of IT workers, and highlighted the point at which IT technicians could no longer support the SaaS model. In the same vein, it provided an example of the interactions of IT workers with these technologies, thereby aiding discussions of the interactions between human and technology from the sociomateriality perspective. This research, therefore, answered the call for incorporating technologies (i.e., artefact or matter) in IS studies (Barad, 1998; Orlikowski, 2010; Orlikowski & Iacono, 2001).

10.3.3 Theoretical Contributions—Sociomateriality

The current study has added three explanatory contributions to the sociomateriality literature. First, the study suggested the new insight that the materiality, virtual and spirit realm of technology provide the elementary levels at which human and material agencies imbricate (Mbuba et al., 2015). As discussed in Chapter 9, this concept contributes to the sociomateriality literature on the levels at which human and material agencies imbricate. In other words, when human and technology imbricate to produce an outcome, where does this imbrication happen? Moreover, how does it differ from one-skill sets to another when humans interact with the same technology? The empirical data collected in this study suggested that IT technicians imbricate well at the materiality of technology, as they tend to follow IT system support activities on how to fix systems, mainly at the hardware and software levels of the technology. In contrast, system engineers not only imbricate at the materiality level but they extend this imbrication to the virtual realm of technology, having the capability to modify the code and the functional design of the technology. IT managers imbricate at the spirit realm of technology, by spearheading its purpose (spirit) in fulfilling the organisation's strategic goals. Understanding the elementary levels at which human and material agencies imbricate is useful as it reminds us that the type of outcome or 'organisational residue' (Leonardi, 2011, p. 151) of the imbrication depends on the elementary level at which the imbrication happens. With this understanding, an outcome at the materiality level—when IT technicians imbricate with technology—is that the technology may be fixed or maintained; whereas systems engineers imbricating with technology at the virtual level can alter its code or design. Leonardi (2011) agrees that such imbrication can change technologies, resulting in a re-organised system or a different sociomaterial assemblage, and these figurations persist outside their creators. On the other hand, for IT managers, imbricating with technology at the spirit level may result in changing/replacing the technology altogether, to meet new organisational strategic goals: the spirit of the technology may not be aligning with the organisational goals, or the technology may be unable to be altered/transformed to meet new challenges for the organisation. By the same reasoning, this study has shown how IT managers decided to change on-premise IT systems to the SaaS model, to meet users' expectations and new organisational goals.

Second, the results suggest that the elementary levels at which human and material agencies imbricate depend on the capability or skill sets of an individual (Leonardi, 2012). As indicated in the previous sections, IT technicians have the technical expertise to fix and support the materiality of technology (i.e., hardware and software), whereas systems engineers go beyond the materiality of the technology, as they have programming skills to change the system code, which may alter the strategic goals of the technology. Moreover, IT managers have leadership and managerial skills to align their organisation's strategic goals with the spirit of the technology (Mbuba et al., 2015). Third, the research shows the way technological artefacts entangled with sociomaterial practices can change human responses to the performative aspects of work practices. This study showed that change happened when IT technicians altered work practices or routines in IT system support in the SaaS environment. Instead of helping users, they re-routed user queries to systems engineers. This was a permanent change and thus altered the work practices of the IT system support. Leonardi argues that human and material agencies interweave in ways that create or change work practices (Leonardi, 2011).

This study has thus contributed to the existing sociomateriality literature by providing a better understanding of the levels at which human and technology interact. The human and technology interactions at these levels may result in different performative outcomes, as this study suggests when an on-premise IT system migrates to the SaaS model.

On a higher abstraction, this study contributes to the literature of cloud computing domain and sociomateriality theory. The study shows that when an organisation migrates an IT enabled system to a cloud computing area, there are changes in system's structural features, as cloud computing features (such as rapid elasticity, resource pooling, broad network access, on-demand self-service, measure service), become institutionalised into business processes. The new features that emerge might have some effects on human and organisational arrangements. In the same vein, Lewin's (1951) 3-stage change model provides sequential anchors (Unfreezing, Changing, and Refreezing) in understanding the adoption of the cloud computing, especially, the SaaS model. The PSIC model illustrates the critical incidents (unfreezing stage), punctuated into new phases (changing stage) and achieving system stability by integrating the features of the new system into business processes (as a refreezing stage).

In addition, the study contributes to the sociomateriality theory in understanding the human and technology interactions. The current study provides vocabularies to explain the levels at which human and technology interact, and how the sociomaterial assemblage is formed. As discussed earlier, the sociomaterial assemblage of the same IT enabled system may differ from one person to another depending on the level (materiality, virtual or spirit realm) at which the sociomaterial assemblage is formed and the roles and skill sets of an individual. This understanding highlights how managers, system engineers, and IT technicians interact with technology differently.

10.4 Limitations of the Study and Future Research

Although this study provided insights and contributions, several limitations need to be highlighted. First, it was a multi-case study in need of further in-depth longitudinal studies. Second, the unique nature of the SaaS model requires further examination in association with other technologies. Third, this study accounted for individual experiences of IT workers and did not account for a wider range of people at the organisational level, such as IT users. Nonetheless, the study examined the experiences of IT workers involved in system migration projects.

The PSIC model also has some limitations (Lyytinen & Newman, 2008). First, the data required for PSIC analysis are burdensome to collect as it calls for detailed accounts from participants and project documents on processes around the phenomenon in question. Such details are regarded as confidential in most organisations, especially when a researcher, considered as postgraduate student participates in the data collection. Second, there are coding ambiguities relating to which events or incidents will count as punctuations, which events will lead to which outcomes, and how to code interactions between events and states at different levels. Coding requires in-depth expertise in the field of study to map interactions. Third, it is unclear in some areas that the derived sociotechnical models truly reflect the deep structures of the examined systems. Moreover, the large quantity of empirical data describing critical events and gaps is complex to handle and analyse. Fourth, in theory, the gaps are treated within and between levels in an asymmetrical way, contrary to the real-life scenarios—where sociotechnical gaps occur randomly and not easily aligned symmetrically.

The results suggest several opportunities for future research. First, to extend the implications of the SaaS model for IT workers, future studies should consider changes in other technologies, because this study examined only the migration of on-premise email systems to SaaS systems, such as GAE and hosted O365. Future studies, therefore, could consider the migration of other systems, such as ERP or CRM systems. Second, there may be other changes in work practices that need further investigation about the migration of on-premise IT system to SaaS model or other IT-enabled services. The current study focused on changes in the roles and skill sets of IT workers so that future studies might consider changes in other areas of work practice. Third, from a sociomateriality perspective, the results suggest it may be useful to carry out a deeper examination of other micro-level work practices that might inform how human and technology imbricate as a result of the introduction of new technologies. Finally, further consideration of changes in work practices as a result of changes in the sociomateriality of technology in different contexts could be explored, for example, in IS studies of the Internet of Things (IoT), dealing with big data, autonomous machines, human implant devices or virtual reality innovations.

10.5 Concluding Remarks

A sociomateriality stream of research in the ever-changing sociotechnological world is inevitable. This study attempted to explain how human and material agencies interact in work practices. The research employed the PSIC model, which provided an in-depth analysis of the migration of an on-premise IT system to the SaaS model in four unique case studies. The study adopted concepts of structuration theory and sociomateriality perspectives to establish trajectories of the projects' narratives and to provide an explanatory discussion of this complex phenomenon. Therefore, understanding the levels (materiality, virtual and spirit realm) at which human and material agencies interact provided fine grain vocabularies of explaining the 'recursive intertwining of human and technology in practice' (Orlikowski, 2007, p. 1437). In addition, this research suggests that the 'social and material are inherently inseparable' (Orlikowski & Scott, 2008, p. 456) only at the spirit realm of the interaction—the interactions of social and material at the materiality and virtual levels remain separable.

To the best of my knowledge, this study is the first in the sociomateriality literature to examine the levels at which human and material agencies interact. As a researcher, this is an exciting moment to join the IS community of scholars.

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Appendices

Appendix A Letter of Ethics Approval

A U T E C

S E C R E T A R I A T

2 December 2013

William Wang

Faculty of Business and Law

Dear William

Re Ethics Application: **13/333 Software as a Service (SaaS) Adoption: Implications on IT workers and functions of IT departments: The case of tertiary institutions.**

Thank you for providing evidence as requested, which satisfies the points raised by the AUT University Ethics Committee (AUTEC).

Your ethics application has been approved for three years until 2 December 2016.

As part of the ethics approval process, you are required to submit the following to AUTEC:

- A brief annual progress report using form EA2, which is available online throughhttp://www.aut.ac.nz/researchethics. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 2 December 2016;
- A brief report on the status of the project using form EA3, which is available online through http://www.aut.ac.nz/researchethics. This report is to be submitted either when the approval expires on 2 December 2016 or on completion of the project.

It is a condition of approval that AUTEC is notified of any adverse events or if the research does not commence. AUTEC approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply there.

To enable us to provide you with efficient service, please use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

Kate O'Connor

Executive Secretary

Auckland University of Technology Ethics Committee

Cc: Freddie Mbuba: fmbuba@aut.ac.nz

Auckland University of Technology Ethics Committee

WA505F Level 5 WA Building City Campus

Private Bag 92006 Auckland 1142 Ph: +64-9-921-9999 ext 8316 email ethics@aut.ac.nz

Appendix B Participant Information Sheet

AUT UNIVERSITY
TE WĀNANGA ARONUI O TAMAKI MAKAU RAU

Participant Information Sheet

Date Information Sheet Produced:

02 January 2014

Project Title

Software as a Service (SaaS) Adoption: Implications On IT Workers and Functions of IT Departments: The Case Of Tertiary Institutions.

An Invitation

My name is Freddie Mbuba and I am a doctoral candidate in the Department of Business Information Systems at Auckland University of Technology (AUT). This study is part of the requirement of the award of my PhD (Doctor of Philosophy) in Information Systems. I invite you to participate in this study. Your participation is voluntary and you may withdraw from this research at any time prior to the completion of the data collection.

What is the purpose of this research?

Software as a Service (SaaS), a type of cloud computing is based on Information Technology (IT) capabilities that allows computing resources to be scaled-up or down according to the demand, at relatively low costs as compared to in-house or on-premise IT systems. Consequently, organisations may decide to adopt SaaS based on these potential benefits. However, these benefits may have some implications on the roles and skill set of IT workers and effects on the functions on IT department.

The purpose of this research therefore, is to investigate why the migration of an on-premise IT system to SaaS may change the roles and skill set requirements of IT workers, as well as the implications of this for functions of the IT department, when an organisation moves its on-premise IT system to the SaaS environment.

How was I identified and why am I being invited to participate in this research?

This study involves a number of organisations who have moved on-premise IT system to the SaaS environment. Your organisation was selected because it fits this profile.

You were identified from your public organisation's website, as an IT staff or involved in IT systems. In addition, your name in this interview will not be known by either your colleagues or your organisation. You are assured that your identity will be kept confidential and your real name will not be used in the data, but rather you will be given pseudonym (fake name) to represent your opinions and the information.

What will happen in this research?

A Consent Form will be sent to you. You will be required to read, understand, sign and return back to the researcher. Once the Consent Form is received, you will be asked to propose a time, place and date you will be available for the interview.

The interview session will take approximately one hour of your time. As the interview proceeds, you are free to discuss issues related to how SaaS adoption in an organisation may change IT-workers' roles and tasks, and the impact of this on the functions of IT department, when an organisation moves its on-premise

IT system to the SaaS environment. You may choose either to respond or not to any of the questions during the interview session.

What are the discomforts and risks?

Minimal discomfort or risk is anticipated for you as a participant. The issue to be discussed (*implications of SaaS adoption on IT workers' roles and task and impact of this on functions of IT department*) may cause minimal discomfort to you, especially if you are a staff in the IT department. This is because some of the implications might have affected you or your colleague.

How will these discomforts and risks be alleviated?

You are assured that your identity will be kept confidential. Your name will not be reported with the data; rather, you will be given a pseudonym (false name) to represent your opinions as well as information disclosed. In addition, you may withdraw at any time you feel uncomfortable with the discussion. All the information regarding your participation will be kept strictly confidential.

What are the benefits?

This research will contribute new knowledge for researchers to better understand SaaS adoption and its implications to functions of IT department and IT workers' roles and tasks. In addition, the findings will inform managers, participants, and wider community on potential opportunities, risks and changes to adopting organisation, so they can prepare appropriate resources to address them.

How will my privacy be protected?

Confidentiality of the data will be as follows:

- You and your organisation will not be identified with your real name. Instead, pseudonyms will be assigned to you and your organisation in the presentation of data, analysis and in any published material based on this study.
- Your contact details were obtained from your organisation's website and hence your name in this interview will not be known by either your colleagues or your organisation. In addition, this interview will be conducted on a public café outside your organisation.
- The raw data or transcripts will not be made available to your organisation or any other individual or organisation (except the researcher and his PhD supervisors).
- All recorded and printed data will be stored in password-protected files. Data will be destroyed six years after the final date of thesis submission.

What are the costs of participating in this research?

The only cost of participation in the interview is your time

What opportunity do I have to consider this invitation?

Kindly inform the researcher within seven days if you would like to participate in the research. Your participation is fully voluntary and you have an opportunity to seek further information when required by contacting the researcher.

How do I agree to participate in this research?

You will need to complete a Consent Form and return to the researcher during the interview session.

Will I receive feedback on the results of this research?

Feedback of the research findings will be emailed to participants who indicated so in the Consent Form. Otherwise participants are welcome to contact the researcher -Freddie Mbuba (fmbuba@aut.ac.nz), if they do not want this emailed to them.

What do I do if I have concerns about this research?

Any concerns regarding the nature of this project should be notified in the first instance to the Project Supervisor, Assoc. Prof. William Wang, William.wang@aut.ac.nz, (+64)-9 921 9999 ext. 5048.

Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, Kate O'Connor, *ethics@aut.ac.nz* , (+64)-9 921 9999 ext 6038.

Whom do I contact for further information about this research?

Researcher Contact Details:

Freddie Mbuba
Email: fmbuba@aut.ac.nz
Phone: (+64)-9 921 9999 ext. 8285
Mobile: (+64)-21 116 8997

Project Supervisor Contact Details:

Assoc Prof William Wang
Email: William.wang@aut.ac.nz,
Phone: (+64)-9 921 9999 ext. 5048

Approved by the Auckland University of Technology Ethics Committee on 2 December 2013 AUTEC Reference number 13/333

Appendix C Consent Form

Consent Form

(Manager- for Organisation)

Project Title:

Software as a Service (SaaS) Adoption: Implications On IT Workers and Functions of IT Departments: The Case of Tertiary Institutions.

Project Supervisor: **Assoc Prof William Wang**

Researcher: **Freddie Mbuba**

- ○ I have read and understood the information provided about this research project in the Information Sheet dated ***2 January 2014***
- ○ I have had an opportunity to ask questions and to have them answered.
- ○ I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- ○ I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- ○ If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- ○ I agree to take part in this research.
- ○ I wish to receive a copy of the report from the research (please tick one): ***Yes:*** *○* ***No:*** *○*

Manager's Signature: ……………………………………………………………………………………

Manager's Name: ……………………………………………………………………………………

Manager's Contact Details (if appropriate) :

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

Date: ______________________

Approved by the Auckland University of Technology Ethics Committee on 2 December 2013 AUTEC Reference number 13/333

Note: The Participant should retain a copy of this form.

Consent Form
(Participants)

Project Title:

Software as a Service (SaaS) Adoption: Implications On IT Workers and Functions of IT Departments: The Case of Tertiary Institutions.

Project Supervisor: **Assoc Prof William Wang**

Researcher: **Freddie Mbuba**

- O I have read and understood the information provided about this research project in the Information Sheet dated ***02 January 2014***
- O I have had an opportunity to ask questions and to have them answered.
- O I understand that notes will be taken during the interviews and that they will also be audio-taped and transcribed.
- O I understand that I may withdraw myself or any information that I have provided for this project at any time prior to completion of data collection, without being disadvantaged in any way.
- O If I withdraw, I understand that all relevant information including tapes and transcripts, or parts thereof, will be destroyed.
- O I agree to take part in this research.
- O I wish to receive a copy of the report from the research (please tick one): ***Yes:*** *O* ***No:*** *O*

Participant's Signature: ....

Participant's Name: ....

Participant's Contact Details (if appropriate):

....

Approved by the Auckland University of Technology Ethics Committee on 2 December 2013 AUTEC Reference number 13/333

Note: The Participant should retain a copy of this form.

Appendix D Interview Protocol

Sample Interview Questions

(IT-Managers/Decision Makers)

Date Interview Sheet Produced:

02 January 2014

Project Title

Software as a Service (SaaS) Adoption: Implications on IT Workers and Functions of IT Departments: The Case of Tertiary Institutions.

Interview Overview

This study investigates the implications after an organisation moves on-premise (in-house) IT system to SaaS model. The focus is to find out: "Why does migration of an on-premise IT system to the SaaS model change the roles and skill set requirements of IT workers, and what are the implications of this for the functions of IT departments? More specifically, what are the changes in roles and skill set of IT-workers when moving on-premise IT system to an SaaS environment? Why and how does SaaS adoption trigger changes in functions (resources and processes) of an IT-department? These are semi-structured interview questions. Not every interview question is relevant to participants' group members. Interviewees are under no obligation to answer every interview question.

(A) SaaS Adoption Environment

1. Describe to me what type/kind of on-premise (in-house) IT system you had?
2. Talk about factors/things that prompted this system to be changed or migrated to other system?

On-premise Sources of Structure

3. Describe how the on-premise IT system was used or facilitated in learning, teaching and research?

Internal Sources of Structure

4. What organisational influences, external to IT department attributed to the changes of the on-premise IT System? What about cost related issues such as infrastructural (server room space, electricity, etc.), System licenses and HR support? Please explain?
5. How did individuals (staff & students) interact with the on-premise IT system?

External Sources of Structures

6. How did government policies, financial costs/support/budget, TEC and other stakeholders' external to the institution affected on-premise IT system?

(B) Decsion Process

7. Describe how members of decision-making team made a choice among various systems' options from vendors?

Appropriation of Structures

8. *How has this system affected the way IT system was used and accessed (by staff & students), and supported by IT workers?*

Application of SaaS to Business Processes

9. What role SaaS vendor plays in the new system? How does the SaaS vendor collaborate with IT workers & IT Dept at large? Please describe?

Emergent Structures

10. What type of changes/issues happened after SaaS system implementation?

(C) Implications after SaaS Adoption

11. Compared to old system (on-premise), how are capital and operations costs related to: infrastructural, system licenses and support? Please explain?
12. How do individuals (staff & students) interact with the SaaS system?

SaaS sources of Structures

13. Describe how SaaS system facilitates in learning and teaching? How is this compared with old system?

New Structures

14. What was the attitude of the IT Workers regarding implementing the SaaS systems? Has that attitude changed?
15. Discuss new things introduced to functions of IT department (SLA management, Security monitoring/audit, manage pricing options, created new roles; added or reduced IT workers, etc.)

Any other comments?

Thank you for your time!

Sample Interview Questions

(IT Workers)

Date Interview Sheet Produced:

02 January 2014

Project Title

Software as a Service (SaaS) Adoption: Implications on IT Workers and Functions of IT Departments: The Case of Tertiary Institutions.

Interview Overview

This study investigates the implications after an organisation moves on-premise (in-house) IT system to SaaS model. The focus is to find out: "Why does migration of an on-premise IT system to the SaaS model change the roles and skill set requirements of IT workers, and what are the implications of this for the functions of IT departments? More specifically, what are the changes in roles and skill set of IT-workers when moving on-premise IT system to a SaaS environment? Why and how does SaaS adoption trigger changes in functions (resources and processes) of an IT-department? These are semi-structured interview questions. Not every interview question is relevant to participants' group members. Interviewees are under no obligation to answer every interview question.

(A) SaaS Adoption Environment

1. Describe to me what type/kind of on-premise (in-house) IT system you had?
2. Talk about factors/things that prompted this system to be changed or migrated to other system?

On-premise Sources of Structure

3. What factors associated with on-premise IT system affected the decision to migrate to SaaS model? (*Note: support, ease of use, upgrades, amount of knowledge required to use the systems, collaboration features, online capability & availability, resource capacity, etc.*)

Internal Sources of Structure

4. What organisational influences, external to IT department attributed to the changes of the on-premise IT System? What about cost related issues such as infrastructural (server room space, electricity, etc.), System licenses and HR support? Please explain?
5. How IT workers (from IT Dept) did interact with on-premise IT system? What were the major complements, complaints or issues raised?

External Sources of Structures

6. Describe if competition in tertiary education sector influenced these changes? To what extent was this? Please explain?

(B) Decsion Process

7. To what extent were you involved in the implementation of the new system?

Appropriation of Structures

8. Describe the type of SaaS system the institution migrated to? *(Types of SaaS: ad-hoc, defined, managed & strategic)*
9. *How has this system affected the way IT system was used and accessed (by staff & students), and supported by IT workers?*

Application of SaaS to Business Processes

10. How was SaaS system implemented? Did you use an external consultant/SaaS vendor or IT Dept?

Emergent Structures

11. What type of changes/issues happened after SaaS system implementation?

(C) Implications after SaaS Adoption

12. How does IT workers interact with on-premise IT system?

SaaS sources of Structures

13. What are the positive and negative aspects of using SaaS system?
14. What happened to the informal relationships of IT department with other business units?

New Structures

15. Discuss new things introduced to IT Workers (New roles, tasks, skill set requirement, redeployment, redundancy, etc.)

Any other comments?

Thank you for your time!

Appendix E Definitions of Key Terms

Term	Definitions	References
Antecedent conditions	Necessary and sufficient conditions to trigger an event	(Lyytinen & Newman, 2008)
Building system	A sociotechnical system – separated by space and time from work system – that commands and enacts a set of resources and routines through explicit rules and regulations and tacit and embedded competencies of individuals to generate IS change	
Cloud broker	An entity that manages the use, performance and delivery of cloud services, and negotiates relationships between cloud providers and cloud consumers	(Pawlowski & Robey, 2004)
Cloud provider	An organisation responsible for making a service available to interested parties, for example, Google Corporation in our case	
Cloud user	A person or an organisation that maintains a business relationship with, and uses service from cloud providers	
Critical incident	An event that results in a gap	(Lyytinen & Newman, 2008)
Environmental context	An environment, which covers the organisation's social, economic, political, regulatory and competitive environments and which influences and is influenced by all other systems during IS change	
Event	Any changes to the system state that can be observed	
Gap	A property of a system state that affects systems' behaviour and its repertoire of responses. A gap is any situation in the system if left unattended that will deteriorate the system's performance, or threaten its long-term survivability	
Google Apps for Education (GAE)	Web-based Google applications for education offered to institutions for free. Applications include Gmail, Calendar, Google Talk, Sites, Google Docs (document, spreadsheet, drawing and presentation applications) with document collaboration and publishing capabilities	(Google, 2012)
Grounded theory (GT)	'The discovery of theory from data – systematically obtained and analysed in social research.'	(Glaser and Strauss 1967: 1)
Grounded theory method (GTM)	is a method of qualitative data analysis that produces grounded theory	(Annells, 1996)
Horizontal analysis	A process of analysing interactions at a single level, for example, development activities, or work processes, or	(Lyytinen & Newman, 2008)

	organisational activities	
Incremental change	Gradual and stepwise adaptation of one or several system components as a response to a gap	(Lyytinen & Newman, 2008)
Intervention/Event	A planned measure was taken towards one or more sociotechnical elements or a system as a whole at some system level as to mitigate against or remove an observed gap	
New Zealand Tertiary education institutions (TEIs)	Public institutions that receive government funding to deliver tertiary education by their specific roles, as defined in the Education Act 1989, comprising New Zealand's eight universities, 18 institutes of technology and polytechnics and three wānanga	(TEC, 2014)
Hosted Office 365 (Hosted O365)	Online provisioning of Microsoft Office Suite offered to users by subscription. Applications include Microsoft Word, Excel, Access, PowerPoint, OneNote, Publisher, Lync and Outlook	(Carraro & Chong, 2006)
Organisational context	The immediate organisational environment of the building system that covers the resource, authority, culture, political systems in which the IS change unfolds	(Lyytinen & Newman, 2008)
Ostensive	Ostensive defines the structure or abstract idea of routines It describes abstract regularities and expectations that enable humans to refer to specific performances of routine Ostensive aspects are not written rules or procedures, but rather consists of the understandings embodied and cognition of the actors	(Feldman & Pentland, 2003)
Patterns	A set of consecutive sociotechnical system states that have a regular form across time or systems. If such consecutive states can be explained by causal causes the patterns, follow causal laws. In other regular cases, the patterns are chaotic. If no patterns are observed the system behaviour is random	(Lyytinen & Newman, 2008)
Phase	A temporary period between punctuations	
Sociotechnical punctuation	Sociotechnical elements and their interactions are reconfigured so that the system exhibits an entirely new range of responses and thus exhibits new emergent properties	
Sociotechnical system	Any organisational system viewed as a multivariate system consisting of four interacting and aligned components – task, structure, actor, and technology	
Sociotechnical system instability	A state of a sociotechnical system where the four components are not aligned and the system is unbalanced in that the system responses are not predictable, or its performance is deteriorated	

Sociotechnical system stability	A state of a sociotechnical system where the four components are aligned and the system is balanced in that the system responses or its performance is not deteriorated	(Lyytinen & Newman, 2008)
Sociotechnical system state	The properties of sociotechnical components and their systemic relationships in a given sociotechnical system at any point in time	
Spirit of a technology	Refers to the general intent of the technology concerning values and goals underlying the structural features of the application and needs of the organisation	(DeSanctis & Poole, 1994, p. 126)
Structuration	Is the process of which the structures are produced and reproduced by people to maintain a social system	(Orlikowski, 1992)
Structures	Rules and resources organised as properties of systems. Structure only exists as 'structural properties'	(DeSanctis & Poole, 1994)
System stability	Stability consists of maintaining and carrying out these choices made with regard to a deep structure where the elements are aligned to the extent that the deep structure prevails	(Lyytinen & Newman, 2008)
Vertical analysis	A process of unpacking interdependencies between two consecutive system levels as to explain IS change	
Work system	A sociotechnical system that executes coordinates and manages information-related work activities	

Appendix F BETA Vertical Analysis: Formulation of Themes

Incident	Subtitle	Related keywords	Theme
PE-ST			
I_1	High operation costs	Exorbitant, pricey, expensive, overcrowding,	Governance
I_3	Ineffectiveness	ineffectuality, ineffectualness,	
I_4	Uncertainty	Ambiguity, dubiety, incertitude, doubtfulness, doubt, dubiousness, precariousness	
I_{11}	Collaboration tools	Partnership, Association cooperation, teamwork, forums, solidarity, coordination, coaction	
IT-ST			
I_7	Email for life	Email for: Lifetime, generation, lifelong,	Infrastructure
I_9	Communication policy	Communiqué, guidelines, dispatch, expedition, expeditiousness	
I_{10}	Student registry	Register, management, administration, registration, organisation, record, catalogue, inventory	
I_{11}	Collaboration tools	Coaction, cooperation, synergy, Quislingism, collaborationism	
PE-IT			
I_1	High operation costs	Exorbitant, pricey, expensive, overcrowding,	Harmony
I_3	Ineffectiveness	Ineffectuality, ineffectualness,	
I_4	Uncertainty	Ambiguity, dubiety, incertitude, doubtfulness, doubt, dubiousness, precariousness	
I_5	Vendor selection	Assortment, survival, filling, alternative, exception, picking, choice, plectrum, option, woof, plectrum, excerpt, survival of the fittest, natural selection, weft, pickaxe, pickaxe	
I_6	Expandable	Abundant, broad, comfortable, commodious, comprehensive dilatable, distensible, expansive, extended, generous liberal, plentiful, roomy, sizable spacious, substantial, vast	
I_7	Email for life	Email for: Lifetime, generation, lifelong,	
I_{11}	Collaboration tools	Coaction, cooperation, synergy, Quislingism, collaborationism	
I_{12}	Enterprise applications	Propositions, models, offers, governing, control, enforcement, execution, rule, provision, jurisdiction, power, guidance, tools	

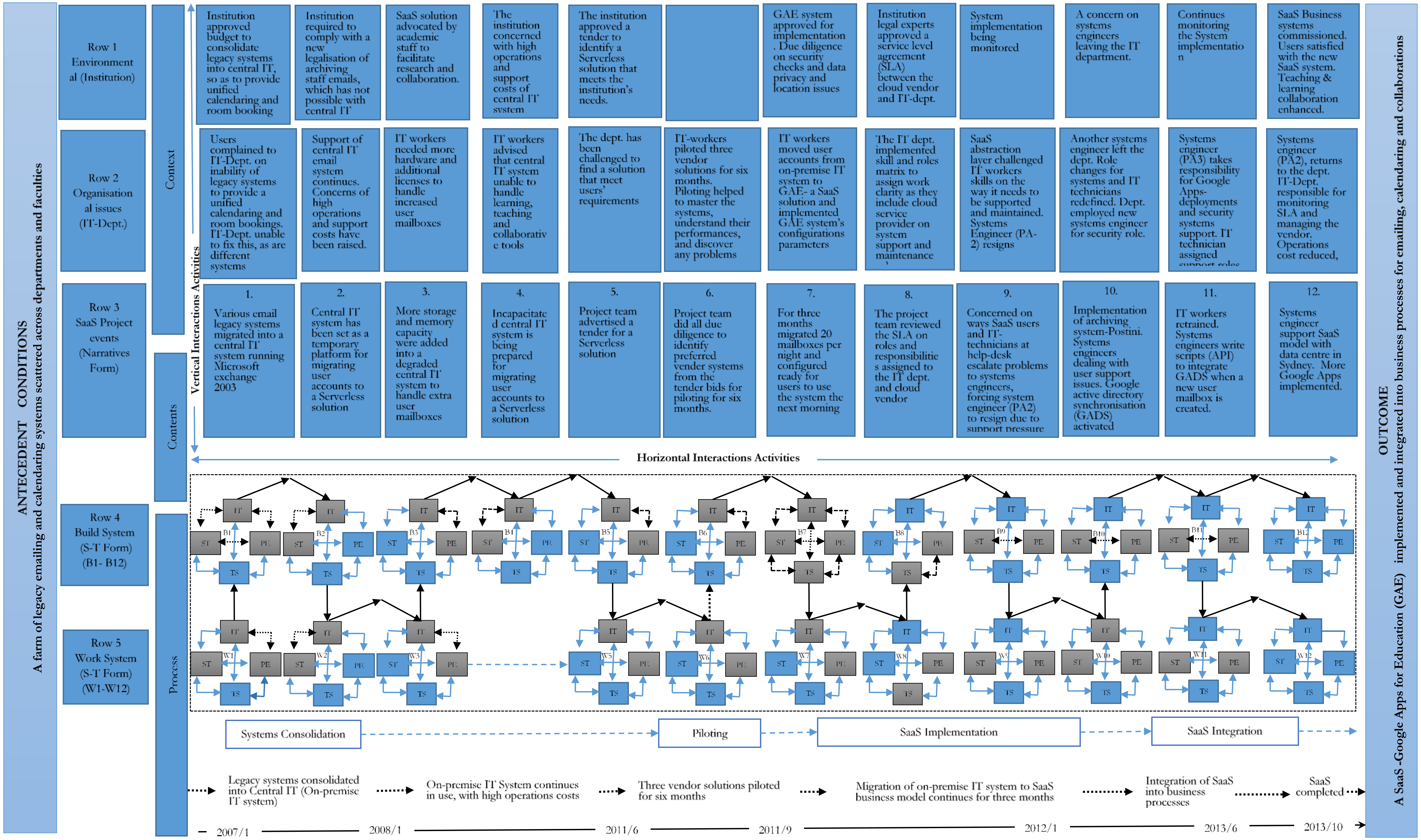

Figure F-1 ALPHA Trajectory Visual Map

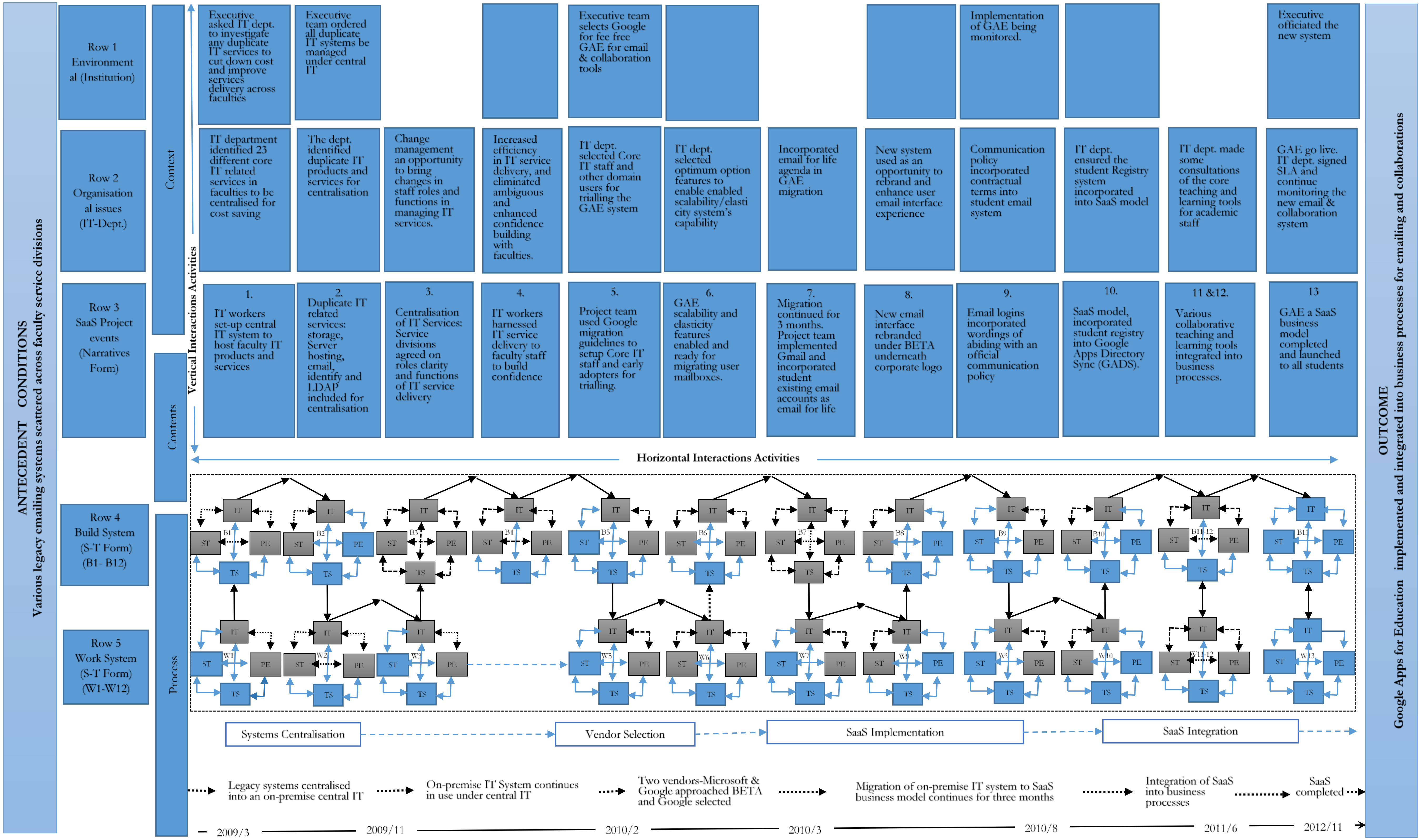

Figure F-2 BETA Trajectory Visual Map

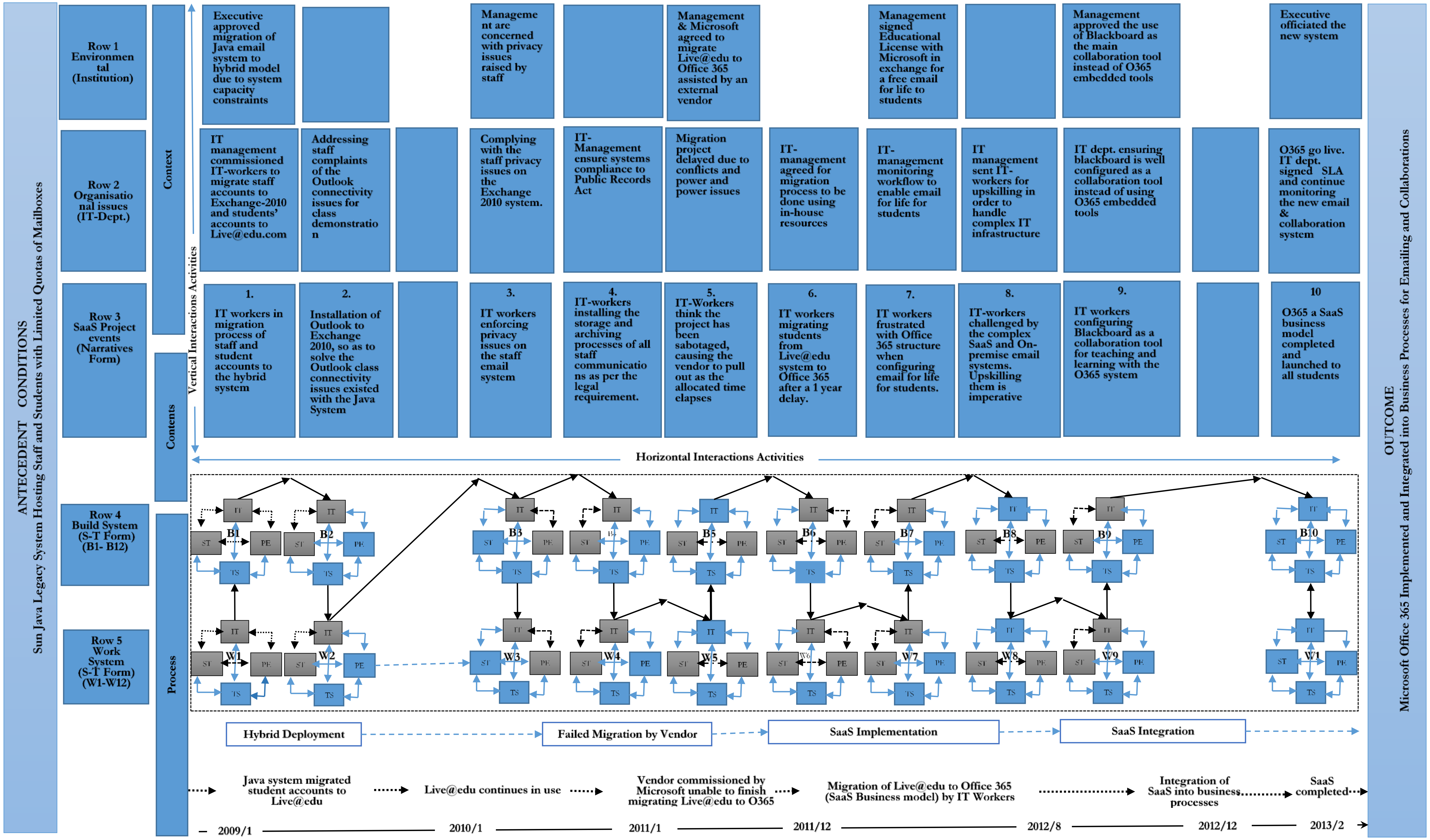

Figure F-3 CHITA Trajectory Visual Map

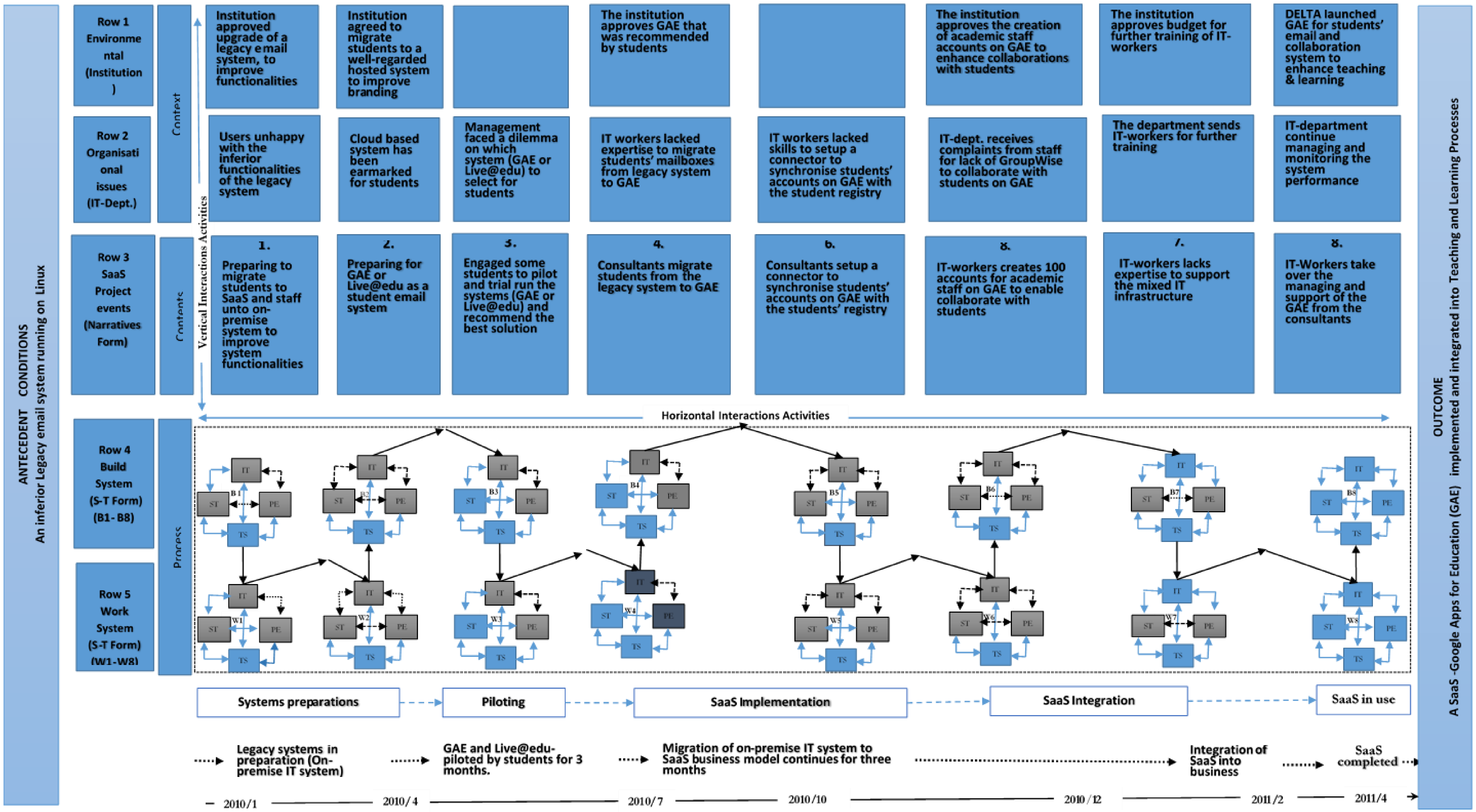

Figure F-4 DELTA Trajectory Visual Map

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AM Jones: discussed with student via email

Student ID No	1244554	**Name**	Freddie Mbuba
Faculty	Faculty of Business, Economics and Law	**School/Dept**	Business Information Systems
Programme	Doctor of Philosophy	**Date of submission for examination**	2016
Research Output	**Thesis** ☒ **Dissertation** ☐	**Exegesis** ☐	**Points Value** 360
Thesis Title	Implications of Software as a Service Adoption for IT Workers' Roles and Skill Sets from a Sociomateriality Perspective		

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Student	Freddie Mbuba	Signature	[signature]	Date	01/02/2017
Primary Supervisor	Dr William Yu Chung Wang	Signature	Wang Yu Chung	Date	01/02/2017
Secondary Supervisor	Dr Karin Olesen	Signature	[signature]	Date	01/02/2017
Additional Supervisor/Mentor		Signature		Date	

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Understanding the boundaries in scientific research and publishing is a key step in making sure your work gets off to the best start. Scientific misconduct and breach of publishing ethics can take different forms, and be committed knowingly or unknowingly. Examples of misconduct and breaches include:

- **Authorship disputes** – deliberately misrepresenting a scientist's relationship with published work
- **Conflict of interest** – not disclosing to a journal that you have a direct or indirect conflict which prevents you from being unbiased
- **Plagiarism** – passing off another's work or idea as your own
- **Simultaneous submission** – submitting a paper to more than one publication at the same time
- **Research fraud** – including fabrication (making up research data) and falsification (manipulating research data, tables or images)
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Tips for SEO include:

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- Add titles or subheadings (with keywords) to the different sections of your article
- Make sure there are as many links as possible to your article, e.g., from your institute's website, Wikipedia, LinkedIn, blogs and social media

For more detailed information on how to use SEO, see our guidelines on the Publishing Campus, College of Skills Training: publishingcampus.com.

Scott Pilkington

From: Andy Godfrey
Sent: Friday, 10 February 2017 3:44 p.m.
To: Scott Pilkington
Cc: Eathar Abdul-Ghani
Subject: FW: PGR16 Freddie Mbuba 1244554

Hi Scott – the first point about the examiners was not explicitly discussed with Freddie but it must be assumed that the examiners had and have access to the thesis; this could be emphasised to Freddie in the approval. I simply received the PGR16 but recommended that Freddie attach evidence from the proposed journal that there were IP implications for publication. It sounds as if he has submitted more generic material.

Regards
Andy

From: Scott Pilkington
Sent: Friday, 10 February 2017 9:32 AM
To: Eathar Abdul-Ghani <eathar.abdul-ghani@aut.ac.nz>
Subject: PGR16 Freddie Mbuba 1244554

Hi Eathar,

I've just received the PGR16 for Freddie.

Is he aware that this embargo won't apply to the examiners who have already read his thesis?

There's also a second page attached, taken from a book about understanding the publishing process, but I can't figure out what the connection is to the embargo request – are you able to clarify?

Thanks,
Scott

Scott Pilkington
Postgraduate Coordinator
Graduate Research School
Auckland University of Technology

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Scott Pilkington

From: Freddie Mbuba
Sent: Monday, 13 February 2017 4:11 p.m.
To: Postgraduate Research Mailbox
Subject: RE: PGR16 embargo request for Freddie Mbuba 1244554

Hi Scott,

I received an email way back in 2013/14 from the editor (Elsevier), but seems I can't find it now. The editor was referring to my ongoing research work mentioned in one of my conference papers. By the then, the editor asked for my finished work to be published through them before making it public. The email aimed to avoid double plagiarism—whereby one extracts some of his/her own published work. Thus, to be safe from such, I decided to embargo the Thesis duration the reviewing/publishing process of the Journal paper.

Yes, I understand, the Thesis has been made public to the Examiners, but at least it won't be made public. In addition one of the examiners strongly suggested this work to be published as a Journal paper or a Book.

Best regards,
-Freddie

From: Postgraduate Research Mailbox
Sent: Monday, 13 February 2017 15:40
To: Freddie Mbuba <freddie.mbuba@aut.ac.nz>
Subject: PGR16 embargo request for Freddie Mbuba 1244554

Kia ora Freddie,

I've just received your PGR16 embargo request, and there are just a couple of points we need to clarify with you.

Please be aware that this embargo won't apply to anyone who has already read your thesis, including your examiners. Your examination was confidential, so examiners would not normally share any of the contents of your thesis anyway, but in this instance they are not bound by the embargo/restriction.

Andy Godfrey indicated that he suggested you attach evidence from the journal you propose to submit to that there were IP implications for publication. What we received from you instead was a page from the guide "Understanding the Publishing Process", which made no mention of IP or embargoes. If you have been asked by a journal editor or publisher to embargo your thesis until a journal has been published, please send us a copy of that email/letter/notice.

Nga mihi,
Scott

AUT

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Auckland University of Technology

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