

How Irish SMEs Can Derive Value From The Adoption Of Cloud Computing

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Declaration

I declare that the work described in this dissertation is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at this or any other university. I further declare that this research has been carried out in full compliance with the ethical research requirements of the School of Computer Science and Statistics.

Signed: _____

Robert Kenny

5th September 2013

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Abstract

Cloud computing is one of the most important technological advances over the last decade and has the potential to revolutionise the delivery of IT services to consumers (Brynjolfsson and Jordan, 2010; Marston et al., 2010). The main driver in the adoption of cloud computing services is the ability to optimise IT services with small upfront costs. This is particularly attractive to SMEs as it gives them access to innovative solutions that they previously could not afford due to skill shortages and financial budgets. However, key barriers prevent SMEs from deriving value in their adoption of cloud computing. The aim of the research study is to determine how Irish SMEs can derive value in the adoption of cloud computing.

The method for data collection for this research is a multiple case study approach, using interviews as the main data collection method and supported by pre-interview pilot testing of the research instrument used. As the bulk of the data collected in the study will be from interviews it will be of a qualitative nature. A thematic analysis will be used to pull the common threads of the interviews together to coherent conclusions.

A key consideration that has been taken into account for SMEs is the suitability of cloud computing for their organisation. It is hoped that this research will assist SMEs choose an approach most suitable in deriving value based on the organisational, financial, technical and security/data privacy themes associated with cloud computing.

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Abbreviations

APAC	Asia-Pacific Economic Cooperation
AWS	Amazon Web Services
CAPEX	Capital Expenditures
CPU	Central Processing Unit
CRM	Customer Relation Management
CSA	Cloud Security Alliance
DR	Disaster recovery
EC	European Commission
ENISA	European Network and Information Security Agency
EU	European Union
GDP	Gross Domestic product
GVA	Gross Value Added
IaaS	Infrastructure as a Service
ICT	Information and Communication technology
IDC	International Data Corporation
IEC	International Electrotechnical Commission
ISMS	Information Security Management System
ISO	International Organization for Standardization
IT	Information Technology
ITIF	Information Technology & Innovation Foundation
ITSM	Information Technology Service Models
MDM	Mobile Device Management
NIST	National Institute of Standards and Technology
NSA	National Security Agency
OECD	Organisation for Economic Co-Operation and Development
PaaS	Platform as a Service
PRISM	Probability Risk and Impact System

ROI	Return on investment
SaaS	Software as a Service
SBA	Small Business Act
SLA	Service Level Agreement
SME	Small-Medium Enterprise
TCO	Total Cost of Ownership
US	United States of America

1: Introduction

1.1 Background and Context

Today, senior management teams within SMEs find themselves caught between driving business growth and the need to expand their IT capabilities. This is further complicated by limited IT budgets and the need to clearly demonstrate/achieve value in the investments in information technology. Cloud computing is arguably one of the most important technological advances over the last decade and has the potential to revolutionise the delivery of IT services within SMEs (Brynjolfsson and Jordan, 2010; Marston et al., 2010). One of the main drivers in the adoption of cloud computing services is the ability to optimise IT services with small upfront costs and reduced need for deep technical skills. This is particularly attractive to SMEs as it gives them access to innovative IT services that were previously not affordable due to skill shortages and financial budgets. Cloud computing gives SMEs the opportunity to develop highly innovative products and compete in profitable markets that were previously not accessible (European Commission, 2012b).

1.2 Importance of this Research

The purpose of this research study is to understand how Irish SMEs can derive value in the adoption of Cloud Computing. It is important to note the Irish SME sector has been seriously affected by the current international economic recession and several Irish government reports state that Irish SMEs must undergo fundamental transformation in their business model to survive, remain competitive and prosper. It is hoped that this research will assist SMEs choose an approach most suitable to their organisation's needs in deriving value from the use of cloud computing. Such a study may also give insights into how SMEs can use Information technology to enhance business performance and aid economic recovery within the Irish SME sector.

1.3 Who will benefit from this research

This research is aimed at SMEs that would like to gain greater understanding of the benefits and barriers associated with the adoption and use of cloud computing. The majority of research conducted around the topic of cloud computing is in relation to larger corporations and there is a lack of research in this area for SMEs. A key consideration that has been taken into account for SMEs is the suitability of cloud computing for their organisation. It is hoped that this research will assist SMEs choose an approach most suitable in deriving value based on the financial, organisational, technical and security/data privacy themes associated with cloud computing. Cloud computing service

providers may find the research useful because it gives them an insight into the barriers associated with cloud computing within the SME market.

1.4 Scope and Boundaries

The EU definition for a small and medium-sized enterprise (SME) is an organisation that employs fewer than 250 persons with an annual turnover not exceeding €50 million, or an annual balance sheet total not exceeding €43 million. Therefore, this definition will be the inclusion criteria for SME organisations forming part of this research.

1.5 Chapter Roadmap

The following is an outline of the contents of this dissertation:

- Chapter 1
This introduction chapter provides a summary on the context and relevance of the research question.
- Chapter 2
The literature review chapter will examine the literature relating to cloud computing adoption practices and how value is often measured in IT investments. This section will also explore existing literature on the SME industry sector and the challenges associated with managing IT services within an SME are also highlighted. Finally, benefits and barriers in the adoption of cloud computing for SMEs will be outlined.
- Chapter 3
The research methodology chapter will describe the various methodological approaches available for this study. It will outline why a specific methodology was chosen and how the research was conducted. The techniques used for data collection in this study and the interview process will also be discussed.
- Chapter 4
The findings and analysis chapter will outline how the data collected in the study was analysed and interpreted in a rigorous manner. Findings are presented to determine how SMEs can derive value from the adoption of cloud computing based on organisational, financial, technical and security/data privacy themes.
- Chapter 5
The conclusions chapter will contain the recommendations from the research findings and demonstrate that the research question has been answered and outline the limitations of the research. Furthermore, the author will highlight the

limitations of this research, advances in the current knowledge and outline possible future directions for research in this area

2. Literature Review

2.1 Introduction

This chapter examines the literature relating to the adoption of cloud computing within the SME sector. At the outset, it is necessary to clarify what cloud computing is, due to the confusion which has given rise to multiple definitions within the literature and across industry.

The next section will provide an overview of the Irish SME sector and will attempt to understand the particular characteristics that influence the adoption of IT by SMEs, in comparison to larger enterprise organisations. Once defined, the benefits of and barriers to the adoption of cloud computing technologies SME are outlined based on existing literature.

The current trends in the cloud computing market for SMEs are then examined. This chapter will also provide an overview of existing research studies into the adoption of cloud computing by SMEs based in the EU. The researcher will conclude with a synopsis of the aims and objectives of the research to be undertaken and presented in the remaining chapters of this dissertation.

2.2 Overview of Cloud Computing

Cloud computing is arguably one of the most important technological advances in how information technology (IT) is delivered to consumers (Brynjolfsson and Jordan, 2010; Marston et al 2010). Traditionally, organisations needed to invest heavily in their internal IT infrastructure and services to support and optimise their business processes. Additionally, a large IT workforce was required to support and maintain these services due to the diverse skills required for the infrastructure and services. One major driver for the adoption of cloud computing in SMEs is the reduction in costs and operational overheads associated with the support and maintenance of internal company-owned IT infrastructure and services (Chen, Lin 2012; Sultan, 2011; ENISA 2009a).

SMEs also benefit from greater flexibility with the adoption of cloud computing because it gives them the opportunity to utilise a wide range of technologies on demand that were not previously affordable to smaller organisations with limited financial budgets and

staffing resources (Chen and Lin, 2012; Sultan, 2011; Ferreira and Moreira, 2012; ENISA 2009a).

The literature highlights that SMEs are slowly reducing their investment in in-house IT infrastructure and have commenced using cloud computing to meet their business needs. However, key barriers associated with data privacy, inadequate service level commitments, interoperability and security continue to hinder the widespread adoption of cloud computing within SMEs (ENISA, 2009a; Chen, Lin 2012; European Commission, 2012a).

2.2.1 Definition of Cloud Computing

Several researchers suggest that there is no consensus on the definition of cloud computing. (Grossman, 2009; Voas and Zhang, 2009). However, the literature does indicate that the definition of the National Institute of Standards and Technology (NIST) is the closest and most accurate (Ferreira and Moreira, 2012; Cloud Security Alliance, 2009; European Union, 2012). It is important to note that while NIST is a US government organisation, the selection of this definition should not be interpreted to suggest the exclusion of other points of view or geographies (Cloud Security Alliance, 2009). The NIST cloud definition is composed of five essential characteristics outlined below (NIST, 2011):

- **On-demand self-service:** A consumer can increase or decrease computing resources when required without requiring human interaction with the cloud service provider (NIST, 2011; Sultan, 2011; European Union, 2012).
- **Broad network access:** Computing resources are available over the network and can be accessed anywhere, anytime through standard mechanisms that promote use by various types of client platforms such as mobile phones, tablets, laptops, and workstations (NIST, 2011; Sultan, 2011; European Union, 2012)
- **Resource pooling:** The computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and realigned according to consumer demand. The client does not control the actual location of the resources that you are using, and has only access to information such as the country or the data centre. Examples of resources include storage, processing, memory, and network bandwidth (NIST, 2011; Sultan, 2011; European Union, 2012).

- **Rapid elasticity:** Computing resources can be provisioned with speed and agility to scale rapidly based on consumer demand. To the consumer, the resources available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time (NIST, 2011; Sultan, 2011; Brynjolfsson and Jordan, 2010).
- **Measured service:** Resource usage can be monitored, controlled, and reported based on a pay-per-use metering model. This provides transparency for both the provider and consumer of the utilised service (NIST, 2011) and allows the consumer to optimise their consumption and their use of the cloud service (Brynjolfsson and Jordan, 2010; Sultan, 2011; European Union, 2012).

2.2.2 *Cloud Computing Provisioning and Service Models*

Cloud computing can be provisioned in four different ways based on the customer's security and management requirements (NIST, 2011; Sultan, 2011; Cloud Security Alliance, 2009; Kloch, Peterson and Madsen, 2011):

- **Public Cloud:** A public cloud is hosted by the service provider at the service provider's premises. The customer has no visibility or control over the service and shares the resources with other customers in a multi-tenant environment. However, the costs and management overheads are lower than other provisioning models which attracts customers (NIST, 2011; Chen and Lin, 2012; Armburst et al., 2009).
- **Private Cloud:** A private cloud is dedicated to a single customer, which is more secure but costs and management overheads associated with a private cloud model are higher (Kloch, Peterson and Madsen, 2011; Chen and Lin, 2012).
- **Hybrid Cloud:** The provisioning of both private and public clouds together is called a hybrid cloud model, whereby a customer uses their own internal IT services for normal usage, but accesses a public cloud model during peak periods (Kloch, Peterson and Madsen, 2011; Chen and Lin, 2012).
- **Community Cloud:** A community cloud involves the sharing of cloud services between organisations within a 'community' that shares common business objectives (NIST, 2011; Sultan, 2011; Cloud Security Alliance, 2009; Chen and Lin, 2012).

Cloud computing services can be offered to customers utilising three distinct service models (Kloch, Peterson and Madsen, 2011; Chen and Lin, 2012):

- **Infrastructure as a Service (IaaS):** Under this model, computing infrastructure services are provided over the Internet including, but not limited to, servers, storage and networking services. The IaaS service provider is only responsible for supporting the underlying infrastructure services, while the IaaS consumer is responsible for the management of the data, applications, operating system, middleware and security controls built 'on top' of the underlying IaaS service components (NIST, 2011; Chen and Lin, 2012; Armburst et al., 2009). Established market leaders in the IaaS market are Amazon Web Services (AWS) and Rackspace (Sultan, 2011).
- **Platform as a Service (PaaS):** Under this model, the middleware, database, operating system components, security controls as well as the underlying infrastructure services are provided over the Internet by the PaaS service provider. With the PaaS model, consumers are only responsible for the application and data components that are built 'on top' of a PaaS platform (NIST, 2011; Chen and Lin, 2012; Armburst et al., 2009) This model is commonly adopted by software development and software testing teams. Established market leaders in the PaaS market are Amazon Web Services (AWS), Microsoft and Salesforce.com (Sultan, 2011).
- **Software as a Service (SaaS):** Under this model, software applications are delivered over the Internet as a service. SaaS customers can access the application service via an internet web browser. This attracts customers because the cloud service provider is responsible for the complete delivery of the application service and manages all of the underlying service components including, but not limited to, middleware, database, operating systems, virtualisation, storage, networking and security controls (NIST, 2011; Chen and Lin, 2012; Armburst et al., 2009; Kloch, Peterson and Madsen, 2011). Established leaders in the SaaS market are Microsoft and Salesforce.com (Sultan, 2011)

2.3 Overview of the SME Sector

To address the research question, an analysis of previous literature was undertaken to give an overview of the Irish SME sector and understand the particular characteristics that influence the adoption of IT within SMEs when compared with other industry sectors.

2.3.1 The Irish SME Sector

The EU definition of a small and medium-sized enterprise (SME) is an organisation that employs fewer than 250 persons, with an annual turnover not exceeding €50 million, or an annual balance sheet total not exceeding €43 million (EU, 2012). The Organisation for Economic Co-Operation and Development (OECD), of which Ireland is a member, states that SMEs play a very important economic role in all countries (OECD, 1993) which matches the findings from the European Commission (2012b). In particular, it has been recognised that their dynamism, related in part to the technological and economic changes which have occurred, has made an important contribution to the creation of new jobs, the economic revival of certain regions and also to technological progress (OECD, 1993; Fink, 1998; European Commission, 2012b). In Ireland, SMEs form a significant component of the economy, the SME sector provides 72% of all employment opportunities and 52% of Gross Value Added (GVA) and investment. This makes an invaluable contribution to entrepreneurship, innovation and GDP (Lawless, McCann and Calder, 2012).

The Irish SME sector has been impacted significantly by the economic downturn (Lawless, McCann and Calder, 2012; European Commission 2011). According to the EU's Small Business Act (SBA), Ireland's SME sector lost 15% of its total workforce between 2007 and 2010. The final output (GVA) shrank 18%. By comparison, large enterprises lost 9% of their work force and just 6% of final output (Lawless, McCann and Calder, 2012). Access to finance has become increasingly limited for the Irish SME sector since the global economic recession started in 2008 (European Commission, 2011). This has exacerbated the typical challenges that Irish SMEs already confront as Irish SMEs tend to be less diversified in their business activities and have a weaker financial structure (Irish Department of Finance, 2012; Lawless, McCann and Calder, 2012). As a result, these difficult economic conditions, combined with aggressive global competition, are forcing Irish SMEs to undergo fundamental transformations in their business model to survive and prosper (European Union, 2010) In this endeavour, internet-based technologies play an increasingly important role in facilitating the introduction of new products or services, in improving operational processes and maximising revenue opportunities (European Commission, 2012b; Chen and Lin, 2012).

2.3.2 IT Adoption Patterns for the SME Sector

Evidence has shown that SMEs have different technology adoption patterns than larger enterprise organisations (Fink 1998; Lester and Tran, 2008). SMEs are regarded as being

ineffective in terms of their investment in people, finance and material resources when compared to larger organisations (Küller et al., 2012; Fink 1998). SMEs tend to have centralised structures and to employ generalists rather than specialists, and this results in a lack of advanced technical skills within the organisation (Küller et al., 2012). Research has shown that SMEs lack the financial and human resources to absorb the impact of an unsuccessful investment in IT. SMEs are therefore under increasing pressure to employ IT effectively in order not only to remain competitive but also simply to survive in rapidly changing business environments (Küller et al., 2012; Lester and Tran, 2008). Decision making tends to be short-term and intuitive, focusing on reaction rather than anticipation. Suitable IT in such situations needs to be robust and readily available. From a psychosociological perspective, the organisation owner plays a dominant role in the organisation, thereby shaping the organisational culture with respect to the use of IT (Fink, 1998).

A key differentiator for IT management within the SME sector is that larger organisations are highly sensitive to the protection of their confidential data and intellectual property (Park et al., 2008). Due to strict data privacy regulations and legislation in many jurisdictions and across industries, large organisations are less willing than SMEs to have their data leave their premises (Sultan, 2011; Park et al., 2008). There is still a challenge in the application of Information Technology Service Models (ITSM) in many SMEs. Previous research (Szabo and Feher, 2010) on Hungary indicates that only 52% of all SME are aware of ITSM frameworks and fewer than 10% apply them (Szabo and Feher, 2010). This poses a major risk when implementing an effective information system strategy as many SMEs lack the productivity metrics to measure the value of their operations according to business processes (Szabo and Feher, 2010).

2.4 Realising 'Value' in the Adoption of IT

To address the research question, an analysis of previous literature and theories was undertaken to identify the various methods used to measure value in the adoption of Information technology. The evaluation of information technology (IT) is fraught with misconception as there is a lack of understanding of appropriate IT evaluation methods and techniques (Bannister and Remenyi, 1999). Much of the literature on IT evaluation indicates that the concept of value is taken to be self-evident and the absence of a clear definition of value can lead to some serious misconceptions about the usefulness of metrics and frameworks used to measure 'value' (Bannister and Remenyi, 1999; Strassman, 1997). One commonly accepted definition of value in previous literature is Porter's Value Chain, which states that value may be summarised as the ability of IT to

enhance the business performance of the enterprise (Millar and Porter, 1985; Gartner 2006). Therefore, the benefits, costs and risks of IT need to be identified, managed and controlled if businesses are to derive value from their IT investments (Love et al, 2004).

There is a growing awareness of the need to derive value from IT investments. This is especially the case for SMEs, as poor IT investment decisions can have a critical impact on profitability (Lester and Tran 2008; Costello, Stone and Moreton 2007). This is only exacerbated in modern times as IT is now one of the world's fastest-changing industries, and rapidly changing business needs can force major architectural changes to IT environments (IDC, 2007). Gartner states that IT management teams are under increasing pressure to show the business value delivered to their organisation and value can be demonstrated by identifying the percentage of IT spending that directly contributes to business growth. The challenge for IT leaders is to reduce their spending on sustaining the business and invest more in innovative ways that drive business growth and support strategic business goals (Gartner, 2006).

A simple approach recommended by Gartner to show the business value that technology brings to an organisation is to focus on the IT Investments that enhance productivity and growth within the organisation. According to Gartner (2006; 2011), investment in IT projects that simply sustain the business does not directly contribute to business growth or enhance competitive advantage. As a result, Gartner (2006) states that organisations should identify how much of their IT expenditure is spent in the following three ways.

- Sustaining the business;
- Supporting the growth of the current business;
- Driving innovation within the business.

Gartner (2006) states that the IT expenditure invested in simply sustaining the business can be over 80% or higher in many organisations and IT management teams must aim to reduce this to 60% to truly deliver value within an organisation.

2.5 Key Benefits in the Adoption of Cloud Computing for the SME Sector

To address the research question, an analysis of previous literature and theories was undertaken to identify the benefits that can be realised by SMEs in the adoption of cloud computing. The headings below describe the benefits of the adoption of cloud computing within the SME sector.

2.5.1 *Organisational*

- Cloud service providers have the capabilities to provide an infinite amount of on-demand computing resources to meet the needs of the customers (Kloch, Peterson and Madsen, 2011; Misra and Mondal, 2011).
- This gives customers the ability to focus on their core business activities, which contributes to organisation efficiency as the cloud service provider is responsible for the maintenance and support of the cloud service. This allows the customer to focus on their core competences and higher-value strategic tasks that benefit the organisation (Misra and Mondal, 2011; Chen and Lin, 2012).
- Armburst et al. (2009) states that cloud computing provides new opportunities for IT professionals to progress their careers and increase job satisfaction by working with advanced, enterprise standard technology.
- In general, cloud computing services provide an open business platform which allows users to access services anytime from any geographical location. This allows employees to be more flexible and react quicker to business needs as they can access cloud computing services on mobile computing devices from any location (Kloch, Peterson and Madsen, 2011; Sultan, 2011; Chen and Lin, 2012). Cloud computing can be used to allow SMEs to use business tools that they did not previously have access to and enhance operational efficiency (Kloch, Peterson and Madsen, 2011; Sultan, 2011; Chen and Lin, 2012).

2.5.2 *Financial*

- Previous research indicates that cloud computing allows efficient operation, with significant cost reduction/savings, as cloud computing solutions will minimise the SMEs' investment in their own hardware, licensing, software and system maintenance (Chen and Lin, 2012; Armburst et al., 2009, Brumec and Vrcek, 2012). Cloud computing reduces the need for large capital expenditure as it can transform these costs into operational expenditure, which simplifies cash-flow management and asset management (Chen and Lin, 2012; Sultan, 2011; Armburst et al, 2009). This allows customers to be more flexible in their ICT investments as it is based on a pay-per-use model, whereby customers only pay for the services they use (Kloch, Peterson and Madsen, 2010).
- Cost benefits from the adoption of cloud computing were highlighted in surveys completed by the European Commission (2012b), which indicate that 80% of EU organisations reduce their IT costs by 10-20%. McKinsey, a global management

consulting and research firm, reported that small businesses can reduce their costs by approximately 20-25% over five years by using SaaS-based CRM solutions instead of 'on-premise' CRM solutions (McKinsey, 2011)

- A benefit in cloud computing is the ability to get products and services to market faster and more effectively. Misra and Mondal (2010) give the example of an Amazon test case which highlighted that customers can complete huge batch processing jobs in one hour on an Amazon IaaS Cloud that would take 1000 hours on a single server hosted internally within a customer organisation. The scalability associated with cloud computing can then result in getting services to market faster and capturing a bigger share of the target market. This research is consistent with previous literature by the European Commission (2012a) and Kloch, Peterson and Madsen (2011).
- Due to the limited financial power of SMEs in comparison with large organisations, the cost factor seems to be even more relevant to the SME as many SMEs lack technical and financial resources (Lin Chen, 2011; Sultan, 2011; Brumec and Vrcek, 2012).

2.5.3 *Technical*

- The reliability of IT services provided utilising cloud computing is improved through the use of redundant sites hosted by cloud computing providers because cloud computing services are hosted and replicated between multiple geographical locations (Kloch, Peterson and Madsen, 2011; Sultan, 2011; Chen and Lin, 2010). Scalability is similarly improved through dynamic provisioning of resources within the cloud service (Chen and Lin, 2010; Kloch, Peterson and Madsen, 2011). This allows cloud computing providers to provide services that are available anytime from any geographical location. This attracts customers in the SME sector who previously could not deliver these capabilities on internal company-owned infrastructure due to financial costs, technical complexity and staffing shortages (Kloch, Peterson and Madsen, 2011; Sultan, 2011). Cloud computing services also allow customers to be more flexible in how they manage their IT operations by allowing them to increase or decrease their cloud service requirements without service maintenance and disruption (Kloch, Peterson and Madsen, 2010; Armburst et al., 2009).
- Existing literature indicates that disaster recovery (DR) is a very important factor for the adoption of cloud computing within the SME sector. It is estimated that larger enterprise organisations spend between 2% and 4% of their IT budget and

SMEs traditionally spend up to 25% of their IT budget on disaster recovery planning to achieve the same level of DR capabilities (Misra and Mondal, 2010). Misra and Mondal (2010) state that of organisations that had a major loss of business data, 43% are forced to close immediately, 51% close within two years, and only 6% survive long-term. This is a key technical benefit for the adoption of cloud computing within the SME sector because customer data stored on a cloud service is continually replicated to multiple data centres for business continuity reasons. This greatly reduces the risk of data loss and business disruption to SMEs (Misra and Mondal, 2010).

- Another key advantage is the ability to experiment with new technology that was not previously affordable to SMEs. This is expected to drive economic and employment growth within EU-based SMEs and drive innovation within the EU (European Commission, 2012a).

2.5.4 Security and Data Privacy

Research by ENISA (2009) has noted that greater security is possible with cloud computing, as economies of scale associated with the technology make security processes more affordable and accessible to the SME sector (NIST, 2011; ENISA, 2009a). The biggest beneficiaries are likely to be smaller organisations that have limited expertise in information security controls and standards (NIST, 2011; ENISA, 2009a; ENISA, 2009b). Security processes include but are not limited to data encryption, security controls, data confidentiality, forensics, identity management and evidence-gathering mechanisms (ENISA, 2009a; ENISA, 2009b; Cloud Security Alliance, 2009).

2.6 Key Barriers to the Adoption of Cloud Computing for the SME Sector

To address the research question, an analysis of previous literature and theories was undertaken to identify the barriers SMEs face in the adoption of cloud computing. The headings below describe the barriers to the adoption of cloud computing within the SME sector.

2.6.1 Organisational

- Park et al. (2008) argue that many SMEs have limited understanding of IT service delivery models and best practice in this area. This impedes their ability to make informed decisions, which often results in higher project failure rates within the SME sector. This presents a substantial risk to the SME when considering the migration of their core IT business services to a cloud-based service model.

- Research indicates that IT governance can become more complex to manage as individual departments or business units can purchase and utilise cloud computing resources without explicit approval from senior management (ENISA, 2009a;).

2.6.2 *Financial*

- Research indicates that SMEs are finding that external cloud services can be more expensive than hosting these services on internal 'on-premise' platforms, depending on the pattern and intensity of computing resources usage such as large, sustained demand for computing resources rather than fluctuating demand with high peaks (Dargha, 2010; Leavitt, 2009; European Commission, 2012a).
- Many Return on investment (ROI) frameworks have been proposed to allow an SME decide on whether it is more cost effective to keep certain information services managed 'in-house' or migrated to the 'cloud' (Brumec and Vrcek, 2012; Misra and Mondal, 2011). However, a large majority of these investment frameworks cannot be effectively adopted by SMEs because of the level of complexity within these frameworks. (Dargha, 2010; Misra and Mondal, 2011).).
- There may be variation in financial costs from estimates provided by cloud service providers because of errors made in financial projections by SMEs during the planning processes for the development of cloud-based solutions (Dargha, 2010; Misra and Mondal, 2011).

2.6.3 *Technical*

- Vendor lock-in is a major obstacle to the widespread adoption of cloud computing services. Due to a lack of interoperability standards and regulation, consumers cannot easily extract their data and move to another supplier in the cloud (Sultan, 2011; NIST, 2012).
- The European Network and Information Security Agency (ENISA) report the lack of interoperability and compatibility standards between cloud service providers as a major issue for SMEs. Both ENISA and the European Commission state that governments must promote open, international standards for the cloud computing industry so that cloud service customers can switch to other service providers with minimal risk (European Commission, 2012a; ENISA, 2009a).
- The lack of control over critical business services hosted on cloud-based solutions poses a risk as many SMEs lack understanding of IT service delivery frameworks, data protection procedures and incident management to protect themselves

adequately against unplanned disruption to their business (European Commission, 2012a).

2.6.4 *Security and Data Privacy*

- Research indicates that cloud computing presents many threats and potential breaches of data protection legislation, particularly those concerning the conditions under which data can be stored, processed and managed (Kloch, Peterson and Madsen, 2011; European Commission, 2012a; ENISA, 2009a; Cloud Security Alliance, 2009). Data Protection laws may well determine the success or failure of many cloud services (ENISA, 2009a; NIST, 2011) as issues of data privacy are complicated by the location of data in a number of different jurisdictions with differing levels of protection (European Commission, 2012a). European consumers have expressed concern that the USA Patriot Act (the “Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001” or “Patriot Act”) allows US authorities full access to customer-owned data stored by US cloud service providers in any jurisdiction (European Commission, 2012a; Mayer Brown, 2012). To address these issues, the US Department of Commerce and European Commission developed the “Safe Harbor” framework. By adhering to the terms of the EU-US Safe Harbor Agreement, US organisations can demonstrate that their data protection practices meet EU data protection requirements. European organisations can then share data with US participants in the Safe Harbor agreement without violating their home country data protection laws (Export.Gov, 2013; Mayer Brown, 2012).
- This has also led to the European Commission (EC) recommendation for the creation of EU data protection standards for data stored within the EU by cloud service providers (European Union, 2012). They also recommend the creation of an EU cloud computing industry to compete against US-owned Cloud service providers, who currently dominate all cloud computing markets (European Union, 2012; ITIF, 2013; Mayer Brown, 2012).
- Data privacy concerns have been raised considerably by revelations in June 2013 regarding the US Government’s invasive data surveillance program called PRISM (Financial Times, 2013; ITIF, 2013; Wikipedia, 2013). This has forced many cloud computing customers to reconsider their adoption and investment strategy in cloud computing. The Information Technology & Innovation Foundation (ITIF), which is an independent policy research organisation, estimates that US-owned cloud service providers could lose between \$21.5bn and \$35bn by 2016 because of the controversy surrounding PRISM and other data-gathering programs (ITIF, 2013).

- In comparison to large enterprise organisations, SMEs typically have limited staffing resources and less expertise in strategic and operational IT security policies and tasks. Their IT infrastructure is usually not maintained adequately regarding IT security as many SMEs are not accustomed to information security standards (Park et al., 2008). These challenges are only exacerbated with the adoption of cloud computing as the risks associated with cloud computing are not assessed correctly (ENISA, 2009a; 2009b).
- Security forensics in the cloud raise a number of new issues in regards to how information security breaches are reported and investigated by service providers (NIST, 2012). A 2009 ENISA report on cloud computing concluded that the massive concentration of data resources hosted by a cloud service provider presents an attractive target for a wide range of security attacks (ENISA, 2009a). ENISA (2009a) concludes that the policies, processes, and adherence to information security standards such as ISO/IEC 27000 must to be extended or modified as cloud computing raises new security risks that have not been previously addressed.
- The default service level agreements (SLA) offered by many cloud service providers provide limited guarantees on service reliability and the standard of service delivery (NIST, 2012; European Commission, 2012a; ENISA, 2009a).

2.7 Cloud Computing Market Trends for the SME Sector

To address the research question, an analysis of previous literature was undertaken to identify the current trends within the cloud computing market for the SME sector.

The European Commission (2012a) state that the public cloud business market in the EU in 2011 reached €3.5 billion for SaaS services, and €1.1 billion for IaaS services. Estimates for the PaaS market were not included because adoption rates are far lower than SaaS and IaaS services (European Commission, 2012a). Public cloud services accounted for just 1.6% of total IT expenditure within EU organisations in 2011 but investment in cloud computing is increasing rapidly and it is estimated that the public cloud services market will reach €11 billion in revenue by 2014. This will then account for 3.6% of the total IT expenditure within the EU (European Commission, 2012a). In 2011, SMEs spent 20% of the IT expenditure on public cloud computing services within the EU while larger enterprise organisations (over 250 employees), account for approximately 80% of current cloud spending (European Commission, 2012a). Larger SMEs with 100-249 employees are expected to increase their investments in cloud computing faster than smaller SMEs.

The European Commission (2012a; 2012b) states that cost is an important factor in migration of business service to the cloud for the SME sector. However, innovation, business agility and the ability to focus on core business competencies are also key drivers for the migration of IT services to a cloud-based service model. An EU report (European Union, 2012) indicates that SMEs favour SaaS-based services over PaaS or IaaS, and the most popular SaaS tools adopted by SMEs are business productivity tools such as CRM, email and project management software. However, the largest increase in usage is likely to be in the IaaS services market (European Union, 2012). Previous literature indicates that the PaaS market is the least evolved in terms of product development and size (European Union, 2012).

However, the literature review indicates that key barriers will impact the EU cloud computing market if barriers surrounding security and data protection, interoperability, service provider liability and legal jurisdiction are not addressed (European Commission, 2012a; 2012b). The European SME industry sector is mostly likely to be affected if actions are not taken to address these barriers and the gap of SMEs' cloud adoption with larger enterprise organisations would widen. In this scenario, the SME share of total public cloud spending within the EU would decrease from 20% in 2011 to 16% in 2014 and 13% in 2020 (European Commission, 2012a; 2012b).

However, it is predicted that the share of SMEs spending in the cloud computing market within the EU could increase from 20% in 2011 to 25% in 2020 if action is taken to address these barriers (European Commission 2012a; 2012b). The main reason for the large increase in spending in this scenario is the huge potential for SMEs to offer their services in an open marketplace and increase revenue opportunities (European Commission, 2012a; 2012b).

2.8 Cloud Computing Adoption Research within the SME Sector

In recent years, cloud computing has been viewed as the key IT development that will improve profitability and the optimisation of information systems; however, the adoption of cloud computing technologies within the SME industry has often produced disappointing outcomes, which is a major obstacle to the widespread adoption of these services within the SME industry sector. The research studies below include existing literature on the adoption of cloud computing services within SMEs in Ireland and other EU countries with similar population demographics and economic challenges.

2.8.1 Cloud Computing Adoption within the Portuguese SME Sector

In a 2012 qualitative survey among 160 organisations on the adoption of cloud computing technologies within the Portuguese SME sector, Ferreira and Moreira (2012) established the following:

- **The type of cloud provisioning and service models adopted:** The most common cloud provisioning model adopted was public cloud with 45% of participants stating that they adopted a public cloud service. The second most common service model was private cloud with 25% of participants stating that they had already implemented a private cloud, which shows an advanced knowledge of cloud computing. Adoption rates among participants for hybrid and community cloud service model were 5% each. The SaaS service model was the most popular service model and participants favoured email and file sharing services over other SaaS service offerings (Ferreira and Moreira, 2012)..
- **The main drivers and barriers for the adoption of cloud computing:** 25% stated that the main driver for adoption was cost reduction, including spending on hardware, software licensing, maintenance and support services. 17% stated that the main driver was increased computing resources. The respondents interviewed did not rate business continuity and disaster recovery as main drivers for the adoption of cloud computing. The main barriers to the adoption of cloud computing services were data privacy issues and the need to control access to confidential data (Ferreira and Moreira, 2012).

This research study was able to provide information in breadth from a large number of survey respondents. However, the weakness in this research was that their quantitative research approach was unable to explore the specific barriers and benefits to the adoption of cloud computing in depth (Saunders, Lewis and Thornhill, 2009). In terms of adoption rates, the paper did not indicate how much of the IT budget is spent on cloud computing when compared with 'in-house' IT services managed, hosted and maintained by their internal IT services teams.

The lack of depth results in the inability to explore and probe the respondents' attitudes and perceptions in the adoption of cloud computing services, which is a key component of this research question.

2.8.2 *Cloud Computing Adoption within the Irish Construction SME Sector*

A 2010 quantitative survey was carried out to illustrate the drivers, barriers, and perceived benefits of cloud computing within the Irish Construction SME industry (Redmond, Hore and West, 2010). Almost 90 SMEs were included in the survey to establish the following information:

- **The standard types of drivers associated with the adoption of cloud computing by SMEs in the construction industry:** In a list of ten standard drivers, the highest ranked score for the main drivers in the adoption of cloud computing was improved standards in business product/value-added service, increased market share and cost reduction. The lowest ranked score was green energy (Redmond, Hore and West, 2010).
- **The perceived barriers that prevent the adoption of cloud computing by Irish SMEs within the construction industry:** In a list of ten standard barriers, the lack of awareness or knowledge of cloud computing within their organisation and security concerns were the highest ranked scores in the survey sample. The lowest ranked scores were contractual concerns and complex pricing models (Redmond, Hore and West, 2010).
- **The perceived benefits in the adoption of cloud computing by Irish SMEs in the construction industry:** In a list of ten standard benefits, the benefits of reducing capital cost in IT expenditure and limited contractual obligations scored highly (Redmond, Hore and West, 2010).

This research study was able to provide information in breadth from a large number of survey respondents. However, the weakness of this research is that their research approach was unable to explore the challenges in the adoption of cloud computing in depth. This is partly because there is a limit to how many variables can be studied in any one quantitative study (Saunders, Lewis and Thornhill, 2009). Many key variables to be considered in the adoption of cloud computing for SMEs were not included because the researcher limited each survey to ten variables only. Key barriers in the adoption of cloud computing such as information security, IT governance and complexity of pricing models were not included in the surveys. Key drivers for the adoption of cloud computing such as organisation agility and business transformation barriers were also not included in the surveys.

2.9 Conclusion

The previous sections in this chapter have served to critique existing literature to determine how Irish SMEs can derive value from the adoption of cloud computing.

Cloud computing can be provisioned on a public, private, hybrid or community model and the selection of provisioning model is dependent on the customer's security, financial and management requirements. The literature also reveals that the three cloud computing service models are infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). The cloud computing market for the SME sector is expanding and most of the investment by SMEs is currently in the public Software as a Service (SaaS) market. Previous literature also indicates that there is strong demand by SMEs for IaaS-based services while there is limited adoption of PaaS-based services.

From the literature review, it can be seen that the cloud computing IT service model allows SMEs to use IT in a more effective manner. The benefits in the adoption of cloud computing are substantial and wide ranging in terms of organisational, financial, technical and security/data privacy factors. Cloud computing is attractive to SMEs as it gives them access to innovative technology that they previously could not afford due to skill shortages and financial budgets. This allows SMEs to interact with customers in new ways, introduce new products or services, improve operational performance and increase revenue opportunities.

It is important to note that the Irish SME sector has been seriously affected by the 2008 economic recession and many Irish SMEs are struggling to survive. The Irish SME sector lost 15% of its total workforce between 2007 and 2010 and the final output (gross value added) shrank 18%. EU report findings state that SMEs must undergo fundamental transformations in their business model to survive and prosper.

However, key barriers continue to hinder the widespread adoption of cloud computing with the SME industry sector. Concerns over data privacy, IT governance, service reliability, information security risks, interoperability issues and the lack of control over critical business assets are well documented in existing literature. Cost reduction is highly dependent upon the level and pattern of cloud service usage. Previous literature indicates that the cloud computing costs increase rapidly when the cloud service usage is consistently high over a long period of time. It is also evident that the use of cloud computing resources can be difficult to predict which results in unexpected costs.

The characteristics that influence the adoption of IT within SMEs were assessed. Evidence has shown that SMEs have different technology adoption patterns than larger enterprise organisations. SMEs are regarded as being poor in terms of their investment in people, finance and material resources and decision making tends to be short-term and intuitive, focusing on reaction rather than anticipation. The literature reviewed also examined how value can be measured in IT investment. Much of the literature on IT evaluation indicates that the concept of value is taken to be self-evident and the absence of a clear definition of value can lead to some serious misconceptions about the usefulness of metrics and frameworks used to measure value. One commonly accepted definition of value states that value may be summarised as the ability of IT to enhance the business performance of the enterprise.

Previous research studies into the adoption of cloud computing by EU-based SMEs were also explored. A 2012 quantitative survey into the adoption of cloud computing with Portuguese SMEs revealed their main reason for adoption was related to cost reduction, including spending on hardware, software licensing, maintenance and support services. The survey also revealed that the main obstacles in the adoption of specific cloud computing services were data privacy issues and the loss of control of confidential information. A 2010 quantitative survey carried out to illustrate the drivers, barriers, and perceived benefits of cloud computing within the Irish construction SME industry indicated the main drivers in the adoption of cloud computing services were value-added service, increased market share and cost reduction. The main barriers preventing the adoption of cloud computing by Irish SMEs within the construction industry were the lack of awareness and knowledge of cloud computing within their organisations and security concerns. The main benefits highlighted in this survey were the reduction of capital costs in IT expenditure and limited contractual obligations.

These quantitative-based research studies are important in understanding how Irish SMEs can realise value in the adoption of cloud computing. However, more qualitative research is required to give an in-depth understanding of how this can be achieved within Irish SMEs, which is the primary objective of the research question..

3 Methodology and Fieldwork

3.1 Introduction

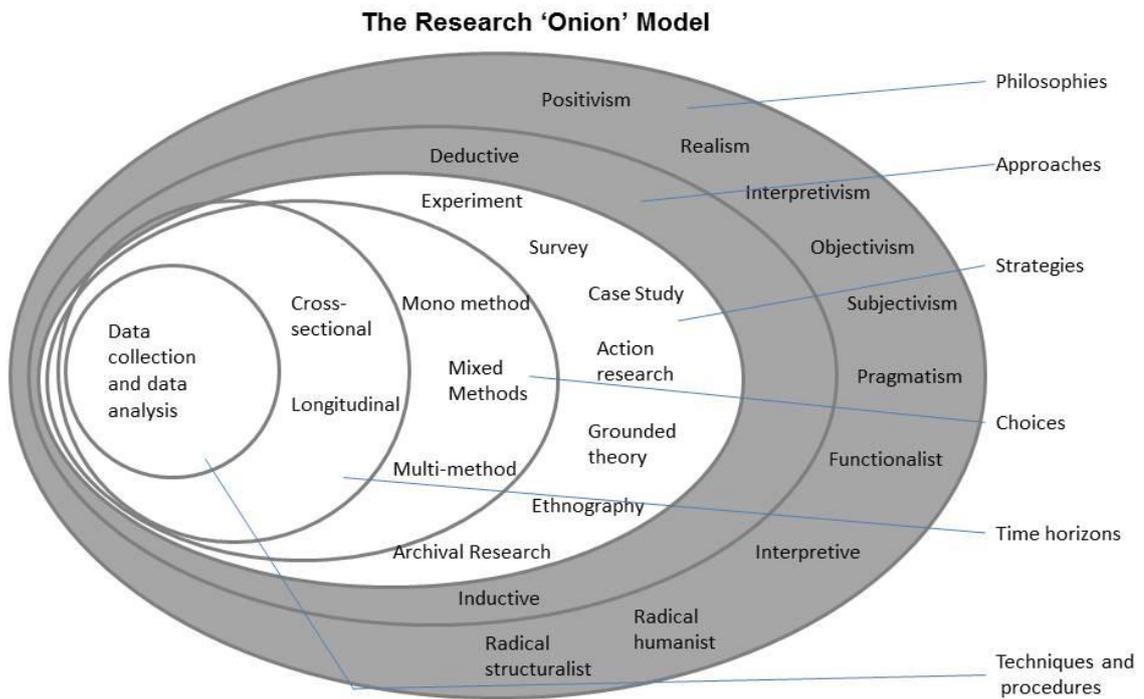
A research methodology is a structured framework used to describe, explain and justify the various methods for conducting research (Saunders, Lewis, & Thornhill, 2009). This research aims to investigate how Irish SMEs can derive value from the adoption of cloud computing. This chapter outlines the methodological approaches considered and why a qualitative case study was the method chosen by the researcher for investigation. This is followed by a description of how the research strategy was implemented using data collection and analysis, lessons learnt and the ethical considerations taken into account during the research process.

3.2 Purpose of the Research

The purpose of this research study is to understand how Irish SMEs can derive value in the adoption of Cloud Computing. It is important to note the Irish SME sector has been seriously affected by the current international economic recession and several Irish government reports state that Irish SMEs must undergo fundamental transformation in their business model to survive, remain competitive and prosper. It is hoped that this research will assist SMEs choose an approach most suitable to their organisation's needs in deriving value from the use of cloud computing. Such a study may also give insights into how SMEs can use information technology to enhance business performance and aid economic recovery within the Irish SME sector.

3.3 Research Philosophy Underpinning Research

A research philosophy describes how the data within a research study is collected, analysed and interpreted (Yin, 2003). Saunders, Lewis and Thornhill (2009) divide the research process into six stages including philosophies, approaches, strategies, choices, time horizons, and techniques and procedures. They propose a model called 'the research onion' to diagrammatically represent each of these phases; the model is shown below in Figure 3.1.



Source: Saunders, Lewis and Thornhill 2009.

FIGURE 3.1 - The Research Onion Model

There are a number of philosophies that underpin research. The most commonly used for business management research include positivism, interpretivism, realism and pragmatism (Saunders, Lewis, and Thornhill 2009). Researchers who adopt a positivist approach are concerned with generating a research strategy to collect data to develop a hypothesis that can be quantified using an existing proven theory. These hypotheses will be tested, analysed and either proven or unproven, thereby resulting in the further development of an existing theory. It is common that researchers who work from a positivist perspective do so using structured quantitative methods that can be measured and the replication of results can be clearly demonstrated. (Saunders, Lewis, and Thornhill, 2009; Guest, Namey and Mitchell 2013). Positivism has a strong association with scientific research, whereby a quantitative approach is commonly used. Previous research (Saunders, Lewis, and Thornhill, 2009; Guest, Namey and Mitchell, 2013) indicates that positivism is not always suitable for social science where there is a need to interpret deeper meaning in discourse that is represented in a collection of observed behaviours and activities (Guest, Namey and Mitchell 2013).

Realism is another research philosophy that is similar in many ways to positivism. The objective of realism is to generate a reasonable approximation of reality close to the subject that is being observed. Realists take a scientific approach to the collection, analysis and development of data but view their findings as evidence-based probabilities. (Saunders, Lewis, and Thornhill, 2009; Guest, Namey and Mitchell 2013).

Interpretivism is a research philosophy that takes a very different approach to positivism in the collection, analysis and interpretation of data. Interpretivism takes the view that describing and understanding complex phenomena cannot be done effectively through objective quantitative methods (Guest, Namey and Mitchell 2013). It is evident from previous literature (Saunders, Lewis, and Thornhill, 2009) that Interpretivism is a more suitable philosophy for business and management research studies that involve organisational behaviour and the need to capture the rich complexity of social situations.

Due to the complexity of IT management within the SME sector (Fink, 1998), it was considered appropriate by the researcher that an interpretivist approach be used to explore the organisational, financial, technical and security/data privacy factors in how value can be derived by SME's in the adoption of cloud computing. As outlined in the sections below the research strategy employed for data collection is a multiple case study approach, using semi-structured interviews as the data collection method.

Pragmatism is a research approach that uses both qualitative and quantitative research methods to better understand social phenomena. Pragmatism argues that the most important determinant in the selection of the research philosophy is the research question and the use of mixed methods can be very suitable for certain research studies (Saunders, Lewis, and Thornhill, 2009). A pragmatist approach was not used in this research due to time constraints but, more importantly, neither was a positivist approach used because the researcher was seeking to understand in detail the critical factors that determine adoption of cloud computing within the Irish SME sector. In addition, there is a dearth of literature within the Irish SME context on data related to the reasons for adoption of cloud computing. Therefore a qualitative approach was considered more appropriate for this study as the objective was to understand the current situation in Irish SMES with the purpose of generating theories as to how Irish SMEs can derive value from cloud computing. The study did not have the objective of proving an existing theory using statistical evidence-based methods, therefore a quantitative methodology was not used.

Deductive reasoning involves the development of a theory that is subjected to a rigorous test. It is the most common research approach in the natural sciences, where the data collection and analysis techniques need to be structured in a way that enables facts to be measured quantitatively (Saunders, Lewis, and Thornhill, 2009). Another key characteristic of deduction is the need to select samples of sufficient numerical size for generalisation and data validation (Saunders, Lewis, and Thornhill, 2009). An alternative research approach is induction, which is commonly used in social science. Inductive reasoning is based on probability that cannot be clearly measured using quantitative methods and it is used to develop an explanation for phenomena observed or determine future predictions based upon the phenomena observed (Saunders, Lewis, and Thornhill, 2009; Guest, Namey and Mitchell 2013). Inductive reasoning is an essential component of qualitative research because of the exploratory and inductive style of questioning and observation associated with qualitative research methods (Guest, Namey and Mitchell, 2013). Based on the qualitative, explorative nature of this research study in how Irish SMEs can derive value from cloud computing, an inductive approach was considered most appropriate.

3.4 Research Strategy and Methodological Approaches Adopted

Common research strategies used in business management research include case study, grounded theory, archival review, cross-sectional studies and longitudinal studies (Saunders, Lewis and Thornhill, 2009; Easterby-Smith, Thorpe and Jackson, 2008). From these various strategies, this study used the case study as the appropriate strategy for this research and the sections below will justify the selection of a case strategy as opposed to other strategies.

3.4.1 Case Study as a Research Strategy

A case study examines a phenomenon within its real-life context and the primary purpose of a case study is to understand something that is not clearly evident and unique to the case (Guest, Namey and Mitchell, 2013; Yin 2003). Saunders, Lewis and Thornhill (2009) state that the case study approach allows for far more detail to be developed within a study, and avoids the risk of missing critical data findings.

The limitations of a case study method are that the study of a small number of cases offers no grounds for establishing the reliability of findings and it can be difficult for a case study to support or reject a scientific hypothesis due to their reliance on qualitative data (Saunders, Lewis and Thornhill, 2009).

As highlighted in the previous chapter, the approach taken by SMEs in IT management and investment varies substantially. A key reason for the selection of a multiple case study was the need to examine how generalisable the findings may be for validation. It is important to note that a longitudinal survey was not selected due to time constraints, therefore a cross-sectional approach was employed. Ethnography is a holistic approach, based on the belief that human behaviour and culture are complicated phenomena and influenced by many factors (Guest, Namey and Mitchell, 2013). Ethnography would involve the researcher's immersion within each of the participant organisations for a prolonged period of time. This was not possible because the researcher could only spend a limited amount of time with each participant organisation involved in the study and previous literature would indicate that the time frame for ethnographic study is often a year or more (Guest, Namey and Mitchell, 2013). Finally, archival research was not possible as the researcher was not given permission to extract evidence from commercially sensitive documentation owned by the participant organisations.

3.4.2 Semi-Structured Interviews

Interviews are an appropriate method to use when the researcher's objective is to understand the participants' experiences and views on a specific topic (Easterby-Smith, Thorpe, Jackson, 2008). A semi-structured interview is a research method commonly used in qualitative research (Saunders, Lewis and Thornhill, 2009). It is preferred over a structured interview method because it gives the researcher the ability to use a set of structured themes and questions associated with structured interviews, while keeping enough flexibility to enable the interviewee to elaborate on any subject raised during the interview process (Easterby-Smith, Thorpe, Jackson, 2008). Therefore, it was considered most appropriate to use a semi-structured interview method for this research study because it allowed the researcher to collaborate more effectively with each interview participant and gain a deeper understanding of how Irish SMEs derive value from the adoption of cloud computing.

3.5 Sample Selection and Data Collection

3.5.1 Description of Study Sample

A total of six organisations from the SME sector in Ireland were selected to participate in the research. In keeping with the EU definition of an SME, the inclusion criteria for this research will be participants in Irish organisations that employ fewer than 250 persons, with an annual turnover not exceeding €50 million, or an annual balance sheet total not exceeding €43 million.

A brief description of the characteristics of the organisations selected to be included in the research is presented in Table 3.1 below.

TABLE 3.1 - Characteristics of organisations included in the research

Organisation	Industry	Employee Numbers	No. of Managers Interviewed	Location of Organisation
1	Telecoms	150	4	Ireland
2	Telecoms	170	1	Ireland
3	Consulting	18	2	Ireland
4	Insurance	12	2	Ireland
5	Charity	240	1	Ireland
6	E-Commerce	190	2	Ireland

3.5.2 Sample Selection Process

The target subjects for this study are SMEs in Ireland. Subjects were identified by the researcher using a snowballing sampling technique whereby a small group of initial informants nominated potential subjects who met the participant criteria for the research study. A non-probability sampling technique was used because the researcher was unable to access the target population using other sampling techniques within the time frame of the study. Employees who work in senior management roles and influence decision making in IT investments were selected as suitable participants for the research. Each participant was sent an introductory email outlining the purpose of the study and requesting their permission to be interviewed on behalf of their organisation for the research. The researcher then contacted each selected participant by phone call or email to confirm their organisation fulfilled the inclusion criteria for the study and their willingness to participate in the research study.

A total of 12 participants within six Irish SMEs were selected to participate in the study. Yin (2003) states that if too few participants are selected in a multi-case study then the findings cannot be generalisable. However, the purpose of the research strategy employed is to gain an understanding of the issue being researched and more than six organisations would have not been possible within the time frame of the study.

3.5.3 Data Collection

Data was collected using semi-structured interviews. Each Interview was approximately 60 minutes in length and each informant was interviewed once. An interview guide was used to guide the interview process; a copy of the question guide is included in Appendix Two. The initial questions focused on organisational, financial, technical, and security and data privacy themes. Audio recordings were taken during each interview and notes from the interview were inserted alongside text for future analysis.

Myers and Newman (2007) highlighted the qualitative interview as a common method used to collect data. There are a number of biases with using a semi structured interview to collect data including lack of time and trust between the researcher and interviewee. Furthermore, the level at which participants are employed with an organisation may impact their ability to answer certain interview questions. Issues surrounding confidentiality may impact on a participant's willingness to divulge certain information. Finally, there may be bias from the participant's ability to recall certain information Myers and Newman (2007).

The researcher in this study attempted to overcome bias by attempting to interview more than one participant in each organisation. Participants employed at a management level were included in the case study. In an attempt to address recall bias, the researcher questioned participants on recent developments within their organisations. All participants were also made aware of their rights to privacy, their right to withdraw from the research study at any time and the procedures to safeguard data in the course of the research to ensure confidentiality

3.5.4 Data Coding and Analysis

The transcripts from each of the interviews was organised and coded thematically through the use of concept cards. The coded data was categorised based on the organisational, financial, technical, and security and data privacy themes.

3.6 Methodology Limitations

It must be noted that this case study was a cross-sectional study and it only observed the adoption of cloud computing with these participant organisations at one specific point in time. While cross-sectional studies are very useful in identifying trends, a case study over 12-24 months would allow for a more rigorous comparison analysis to 'measure' the

business value delivered by the adoption of cloud computing within each participant organisation.

A larger sample size of participants may have been beneficial for data analysis as it would be more representative of the SME sector. This would increase the validity of the research findings regarding the potential value that can be derived from the adoption of cloud computing. Unfortunately this was not possible due to time constraints and a more comprehensive study would rectify these limitations.

3.7 Data Validity and Reliability

Saunders, Lewis, and Thornhill (2009) define validity as the extent to which a data collection method or conclusion accurately measures what it was intended to measure. Reliability is defined as the extent to which a data collection technique will yield consistent findings and there is transparency in how the data collected was interpreted (Saunders, Lewis, and Thornhill 2009). Therefore, it is important for qualitative studies to enhance the scientific method used for data validity and reliability. To reduce the risk of errors in data collection and interpretation, audio recordings and written transcripts were taken for each participant interview to verify that all information obtained from the participant was accurate.

3.8 Ethical Considerations

Research ethics involves the application of fundamental ethical principles in academic research (Saunders, Lewis and Thornhill, 2009). Ethical approval was obtained from the School of Computer Science and Statistics Research Ethics Committee prior to the commencement of the study. In respect of participants involved in the research study for the purpose of collecting data, informed consent was obtained in all cases. The informed consent process informed the participant about the purpose of the research study and the risks and benefits to participation in the case study. All participants were made aware of their rights to privacy, their right to withdraw from the research study at any time and the procedures to safeguard data in the course of the research to ensure confidentiality. Finally, it was agreed that the results of the research would not include the identity of the participants in any public forum or research presentation.

3.9 Lessons Learnt

A mixed-method approach, incorporating case study and surveys can increase the validity of the case study findings by examining the same phenomenon in different ways, which

minimises the weaknesses in any single approach (Yin, 2003). Therefore, a mixed-method approach would possibly promote greater understanding of the research findings as quantitative data would also provide an overall statistical view of the research subject within each participant organisation.

3.10 Conclusion

Previous literature indicate that common research strategies used in business management research include case study, grounded theory, archival review, cross-sectional studies and longitudinal studies. Due to the complexity of IT management within the SME sector, it was considered appropriate by the researcher that an interpretivist approach be used to explore the organisational, financial, technical and security/data privacy factors associated with cloud computing adoption by SMEs. The target subjects for this study are SMEs in Ireland. Subjects were identified by the researcher using a snowballing sampling technique because the researcher was unable to access the target population using other sampling techniques within the timeframe of the study.

As outlined in the above sections, the research strategy employed for data collection is a multiple case study approach, using semi-structured interviews as the single data collection method. To reduce the risk of errors in data collection and interpretation, audio recordings and written transcripts were taken for each participant interview to verify that all information obtained from the participant was accurate. Ethical approval was obtained from the School of Computer Science and Statistics Research Ethics Committee prior to the commencement of the study. In respect of participants involved in the research study for the purpose of collecting data, informed consent was obtained in all cases

4. Findings and Analysis

4.1 Analysis and Interpretation of Data

This chapter outlines the findings and analysis from the data collected as part of the research. The chapter will provide the details of the qualitative research from the interviews with employees in senior IT management positions within the Irish SME sector.

4.1.1 Research Methodology

As outlined in the previous chapter, the research method was qualitative research through face-to-face interviews with senior IT managers. This research method allowed easy comparable analysis of the results from the qualitative research captured in the interviews. The details of each participant interview were recorded using a Dictaphone, along with additional notes taken during the interview. The recordings and notes were reviewed and analysed after each interview.

4.1.2 Theme Development

From an analysis of the interview recordings and notes, common trends and observations emerged, some of which were identified across all organisations, whilst others were only identified in the majority of the organisations. Themes were developed based on these trends and observations in the case study findings. The development of the themes was an iterative process; some points clearly fitted together and others required new themes or sub themes to be developed within a main theme. The four main themes were organisational, financial, technical, and security and data privacy.

4.1.3 Initial Observations

The case study examined the views of a sample of 12 participants from 6 Irish SMEs on how value can be derived from the cloud computing. The majority of participants in the study stated that they currently use cloud computing within their organisation. The findings outlined in this section demonstrate the ongoing and potential growth for utilisation of cloud technology across the Irish SME sector.

The results of the case study, described in subsequent sections, identified several important factors underpinning both the lack of utilisation and the adoption of cloud computing across the SME sector in Ireland. Furthermore, the research revealed that Irish SMEs are under increasing pressure to derive value from their investment in IT because of aggressive global competition and difficult economic times. As a result, they are

adopting cloud computing service models to derive significant value in the form of TCO, innovation, professional development for employees, business agility and the ability to gain competitive advantage in emerging markets

However, the challenges SMEs face in adopting cloud services include information security controls, data privacy and immature IaaS service platforms. In addition, the difficulties organisations face in changing cloud service providers once they have negotiated a service level agreement with a provider is a significant challenge to the adoption of cloud computing services within participant organisations.

4.1.4 Cloud Computing Models

In the case study, the researcher analysed data from each of the interviews to assess the cloud computing models used within each participant organisation.

- One participant organisation has not adopted any form of cloud computing. Both participants from this organisation acknowledged that they have a very limited understanding of cloud computing and they have no immediate plans to adopt cloud computing-based services. This organisation will hereinafter be referred to as the 'non adoptee' organisation.
- Five of the participant organisations have adopted at least two SaaS-based services across the organisation and spent between 5% and 15% of their budget on cloud computing services. The IT budget estimates from adoptee organisations did not include internal staffing salaries. All five organisations have also adopted IaaS services for pilot projects to determine the level of service maturity offered by multiple IaaS service providers. These five organisations will hereinafter be referred to as the 'adoptee' organisations.

Among the five 'adoptee' organisations, the public Software as a Service (SaaS) service is the most frequently used cloud service model. CRM and web conferencing SaaS-based services were adopted by the five adoptee organisations, while other SaaS-based business productivity tools such as email, project management and data backup services are being used in several of the adoptee organisations. This matches the findings by McKinsey (2011), who states that small-to-medium-sized businesses in North America are most likely to adopt SaaS-based business productivity tools. Only two adoptee organisations are using Infrastructure as a Service (IaaS) to host production services, while three remaining adoptee organisations are using IaaS for Proof of Concept and pilot

projects. One of the five adoptee organisations is using PaaS-based cloud services. This was an interesting observation as the other four adoptee organisations have development and testing environments that could be migrated to a PaaS-based service. Their main concerns were the perceived integration challenges associated with the migration of their development and testing environments to a PaaS-based service.

There was a wide range of cloud deployment models within the adoptee organisations based on business requirements. While all five adoptee organisations use a public SaaS cloud model for web conferencing and CRM services, three of the adoptee organisations have deployed private cloud models that are hosted and managed in remote data centres. Two of the adoptee organisations plan to deploy a hybrid cloud to gain the benefits of multiple deployment models. This will allow them to host their IT services on their internally managed infrastructure and ‘burst’ into a Microsoft Azure public IaaS cloud when the demand for computing capacity increases substantially. This indicates that two of the adoptee organisations are using a more advanced cloud computing service model because they have customised their cloud-based services to fully integrate with their internally managed software and infrastructure services. This matches the assertions of NIST (2012) who state that advanced technical knowledge is required to successfully deploy a hybrid cloud service model.

A brief description of the characteristics of the organisations selected to be included in the research is presented in the tables below

TABLE 4.1 - Characteristics of participant organisations included in the research

Organisation	Industry	Employee Numbers	No. of Managers Interviewed	IT Budget Spending on Cloud Computing
1	Telecoms	150	4	5%
2	Telecoms	170	1	12%
3	Consulting	18	2	10%
4	Insurance	12	2	0%
5	Charity	240	1	15%
6	E-Commerce	190	2	15%

TABLE 4.2 - Cloud Service Model Profile of Participant Organisations

Organisation	Industry	IaaS deployed,	PaaS deployed	SaaS deployed.
1	Telecoms	x		x
2	Telecoms	x		x
3	Consulting	x		x
4	Insurance			
5	Charity	x	x	x
6	E-Commerce	x		x

TABLE 4.3 - Cloud Provisioning Model Profile of Participant Organisations

Organisation	Industry	Public Cloud Model	Private Cloud Model	Hybrid Cloud Model	Community Cloud Model.
1	Telecoms	x			
2	Telecoms	x			
3	Consulting	x			
4	Insurance				
5	Charity	x	x	x	
6	E-Commerce	x	x	x	

4.2 Responses and Analysis – Organisational Theme

Organisational factors were found to be a central theme in determining whether an organisation adopted cloud services. Participants were asked a series of questions that would identify the organisational factors that would support and/or prevent their organisation from deriving value in the adoption of cloud computing. The main organisational factors included employee productivity, business agility, followed by professional development.

4.2.1 Employee Productivity

Three of the adoptee organisations were attracted to the always-on, always connected features of SaaS services. They believe cloud computing provides new opportunities for communication. As a result they believe their employees are more productive because cloud services are accessible and available from any location on multiple client devices, e.g., smartphones, tablets, laptops, and workstations. As a result they believe their employees are more productive because cloud services are accessible and available from any location on mobile computing devices.

An example given by four adoptee organisations was Salesforce.com's SaaS service, which provides a suite of mobile device software applications that allow sales staff to access business information and communicate with co-workers from any geographical location. This allows the adoptee organisations to interact with customers and co-ordinate business operations in a more effective manner. The same four organisations stated that it would not be possible to achieve the same level of productivity on their internal services due to cost, technical complexity and limited staff resource availability and expertise within their organisation. Participants from the fifth adoptee organisation disagreed because comparable 'always on, always connected' features can be enabled on internally managed IT services and they have a high-skilled, well-resourced IT operations team that can provide these capabilities on internal IT services. The 'non adoptee' organisation stated that the 'always on, always connected' features of cloud computing services would improve employee productivity substantially as none of their internal IT services include 'always on, always connected' features, which affected their ability to share information quickly and effectively among business teams.

Kloch, Peterson and Madsen (2011) and Sultan (2011) also found employee productivity and the always-on, always connected features on mobile computing devices to be a key determinant of cloud computing adoption.

4.2.2 Business Agility

All five adoptee organisations believe that cloud computing allows their IT service model to become more flexible and responsive to rapidly changing business demands. All five organisations cited that financial and staffing shortages prevented their technical teams from providing a highly flexible IT service model to meet rapidly changing business demands. The ability to experiment with cloud computing services on a pay-per-use model allows adoptee organisations to determine what IaaS and SaaS services are the most suitable for their business needs. In many cases, adoptees were able to conduct free trials with SaaS cloud service providers to assess the potential benefits delivered to the organisation, which increased IT project success rates. An example given by three of the adoptee organisations was SaaS-based web conferencing services, which allowed employees to collaborate online with new and existing customers. A key advantage for the three adoptee organisations was the limited time required to deploy the service as all service components were deployed, managed and supported by the service provider and their technical teams could focus on other project tasks. This helped reduce

telecommunication costs and allowed the three adoptee organisation to collaborate with their customer base in a more interactive manner at minimal cost.

All five adoptee organisations agreed that public IaaS services provided greater flexibility in how new services and products were delivered to their target markets. All commented that IT management are under pressure to effectively deploy IT services that allow organisations to rapidly respond to customer needs and changes in their business environment. All five were endeavouring to use cloud computing services as a strategic tool to optimise their business operations. This supports the assertions by Kloch, Peterson and Madsen (2011) and the European Commission (2012b) which found that cloud computing provides greater flexibility to SMEs in achieving their business objectives.

Four of the five adoptee organisations reported that the use of IaaS-based services improved their ability to provide innovative products and services more effectively to customers in global markets. One adoptee organisation, for example, was a telecoms security organisation that traditionally sold mobile security services to customers in the telecommunications sector. Their revenue stream has reduced significantly in recent years because their biggest customers have experienced very difficult economic conditions in North America and Europe. As a result, one of their key business objectives in 2014 is to target new customers in order to build a reliable and consistent revenue stream. As a result, one of their key business objectives in 2014 is to move to a subscription-based model and more consistent revenue stream. They hope that this will create a reliable and consistent revenue stream and an IaaS-based service will allow them to diversify in new markets quickly. This finding is also supported in previous literature (European Commission, 2010) stating that difficult economic conditions combined with aggressive competition in the marketplace is driving SMEs to undergo fundamental transformations in their business model.

The adoption of cloud computing is forcing the above adoptee organisation to move towards a subscription business model, therefore they are currently building Proof of Concept services on IaaS services that target smartphone application users instead of large telecom operators. A key reason for the organisation building the Proof of Concept products on an IaaS model was to reduce the time to market for product development and gain competitive advantage in new markets. It also allowed their technical engineering and development teams to focus on their strengths by channelling the organisation's skilled resources towards developing highly innovative products by outsourcing the management of the infrastructure platforms to an IaaS service provider. The experience of

the above organisation is supported by research by Chen and Lin (2012) and Kloch, Peterson and Madsen (2011) which demonstrated that the adoption of cloud computing supported organisations in developing innovative products and building their customer base in previously untapped markets.

4.2.3 Professional Development

All five adoptee organisations felt that working with cloud computing technologies has provided new opportunities for their technical teams to progress their careers. They also noted that their technical teams enjoy working with a wider, powerful range of technologies. This is in line with the research of Marston et al. (2010). All five adoptee organisations state that the majority of skills possessed by the technical staffing teams are still relevant but the transition in supporting IT services in the cloud requires an extension of IT capabilities within their technical teams. This is in line with the research of Hosseini et al. (2012). They acknowledge that there will be less focus on IT administration and hardware maintenance with a cloud service model and more focus on vendor relationships, IT governance and customisation with cloud service platforms. All five adoptee organisations also stated that cloud computing will become the dominant IT service model in the future and that change in skills and capabilities is inevitable for SMEs.

4.3 Responses and Analysis – Financial Theme

The second central theme that emerged from the data analysis that determined whether organisations adopted cloud computing was finance. Participants were asked a series of questions that would identify the financial factors that both support and prevent their organisation from deriving value in the adoption of cloud computing.

A key observation is that all five adoptee organisations are currently spending only 5-15% of their IT budget on cloud services, excluding staff salaries. The increase in spending in four of the five adoptee organisations is dependent on the barriers that is currently curtailing their investment in cloud computing. These include but are not limited to data privacy, trust, inadequate service level agreements and immature IaaS cloud service offerings.

This supports the assertions by the European Commission (2011), who state that cloud computing adoption rates are increasing in the EU but key barriers may limit the full potential of public cloud services adoption. The fifth adoptee organisation will increase

their spending in cloud computing rapidly in the next three years because they are not being hindered by the same data privacy, SLA and technical barriers as the other adoptee organisations. They plan to adopt a full cloud computing IT service model by 2017. The sixth organisation that did not adopt cloud computing services believes there is no available funding within the organisation to invest in cloud computing and that senior management were keen to reduce their costs in a difficult economic environment.

4.3.1 Cost Reduction

SaaS services:

The cost associated with SaaS was a complex issue among the five adoptee organisations. It was clear that cost reduction is a key factor in the migration of software services to a SaaS-based model within each of the five adoptee organisations. However, the total cost of ownership (TCO) and the ability to focus on core competencies are also critical factors in the decision-making process. TCO and the ability to focus on core competencies will be discussed in further detail in section 4.4.2.

According to all five adoptee organisations, the cost comparison between internally managed software application and a comparable SaaS service offering must be done on a case-by-case basis. Depending on the use case, it can make strong financial sense to migrate to a SaaS-based service model, and in other cases it can make strong financial sense to keep software services hosted and managed internally. A key part of the decision-making process in all five adoptee organisations is the clear understanding of the software services provided by their technical teams and the associated costs to deliver those services.

All five organisations highlighted that there were substantial cost savings in providing Customer Relationship Management (CRM) software solutions on a SaaS-based model because of the high level of technical expertise and maintenance required. Four of the five adoptee organisations using Salesforce CRM gave examples of SaaS services which required a high level of technical expertise to manage efficiently. They discovered that the cost savings were substantial when compared against deploying a comparable CRM solution on their internal IT infrastructure. The main costs were reduced software licensing, consulting, training and staffing costs.

However, four of the adoptee organisations agreed that it is not always cheaper to use a SaaS-based model and costs associated with certain SaaS-based subscription models

need to be monitored closely. In certain use cases, SaaS service can be significantly higher over a three-year period when compared against the costs associated with managing a comparable software service internally. The same four adoptee organisations also argued that there are no available SaaS service offerings to compare the costs associated with their highly customised internal software services. This is a key reason why many of their mission-critical software services will continue to be hosted and managed internally.

The fifth adoptee organisation highlighted that all of their software services were suitable for migration to a SaaS-based model including but not limited to email, web conferencing and collaboration tools. Another strong financial driver for this adoptee organisation was the heavily discounted SaaS service pricing offered by Microsoft. It is important to highlight that the discounts were as high as 40% when compared against the pricing offered to other Irish SMEs in the same price bracket. This is a key factor in why SaaS services were consistently cheaper than a traditional IT service model for this adoptee organisation and a strong financial driver for the migration of all software services to a cloud computing IT service model by 2017. The other four adoptee organisations did not receive discounted pricing from Microsoft and Salesforce, which explains why they are less incentivized to migrate the majority of their office and business productivity services to a cloud-based model.

IaaS services:

All five adoptee organisations agreed that cost reductions on IaaS services are highly dependent upon the level and pattern of service usage. All five adoptee organisations noted that IaaS services are considerably cheaper in cases whereby the pattern and usage of computing resources fluctuates regularly for a particular service. An example given by one of the adoptee organisations is the use of a hybrid IaaS cloud model, whereby they use their own internal infrastructure for normal usage, but have the capabilities to access a public IaaS cloud service during high peaks of usage. An IaaS hybrid model achieves high cost savings as public IaaS services can provide additional infrastructure services when required and the adoptee organisation reduces the need to purchase additional infrastructure for high peaks of usage. This explains why their expenditure on cloud computing is 5-15%, because their consumption of public IaaS cloud services is consistently low and based on cyclical demand. This is in agreement with the claims of Dargha (2011) and Misra, Mondal (2011) who highlight that cloud computing is a cheaper option when the pattern and intensity of resource usage fluctuates considerably.

However, all five adoptee organisations highlighted the need to review the costs associated with IaaS closely because the cost of public IaaS resources can be extremely high in 'use models', whereby the pattern and intensity of computing resource usage remains consistently high over 2-3 years. The key reason is the pay-per-use IaaS pricing model, whereby costs increase rapidly when large amounts of storage, network and server infrastructure resources are being consumed on a pay-per-use model over a long period of time. Another issue for two adoptee organisations was the inability to predict the demand for public IaaS services for certain 'use models' because they regularly notice IaaS resources being consumed at a higher rate than expected, which results in unexpected costs. This is a key reason why they continue to host the majority of their heavily utilised infrastructure services on internal company-owned assets. This supports the assertions by Dargha (2011) and Misra and Mondal (2011) regarding the misleading costs associated with cloud computing. The other three adoptee organisations used public IaaS services less frequently and were able to predict the demand for public IaaS services more accurately.

It was clear that cost reduction is a key decision-making factor in the use of public IaaS services within all five adoptee organisations. However, TCO, business agility, increase in revenue opportunities and the ability to deploy new services to customers are strong financial drivers for the use of public IaaS cloud service within four of the five adoptee organisations. This will be discussed further in sections 4.4.2 and 4.4.3.

PaaS services:

Four of the five adoptee organisations do not invest in PaaS services as they did not see the financial or technical benefits in doing so. The fifth adoptee organisation invested in a PaaS-based security management service because it allowed secure access for its remote workers. However, they did not highlight any financial benefits in choosing a PaaS service.

4.3.2 Cloud Sourcing Strategy

Four of the adoptee organisations shared the same financial sourcing strategy for IT services. They view cloud computing as another sourcing option to achieve business objectives and while it did have advantages in certain scenarios this was not always the best option. In their opinion, the key to a successful IT sourcing strategy is having an understanding of when and why cloud services need to be adopted and then tendering for the most suitable cloud service provider. This supports the assertions by Misra and Mondal (2011) regarding the need to 'use cases' when comparing cloud computing

against other sourcing options. As the four organisations adopted cloud-based services, they realised that they are simply expanding their IT service model to use cloud computing services

Similarly, the same four adoptee organisations acknowledged that substantial cost savings on cloud-based services could only be achieved through the widespread migration of their IT services to a cloud computing service model. Many felt that this is very unlikely to happen and most of their existing infrastructure would be retained internally for the foreseeable future. As a result, they will also need to retain their IT workforce to manage a wide range of mission-critical 'internal' IT services. Therefore, IT services costs are not likely to be reduced substantially within these four adoptee organisations without the large-scale migration of internal IT services to a cloud computing service model.

The fifth adoptee believed that all IT services can be moved to a cloud computing-based IT service model by 2017, which will reduce their financial overheads substantially. The same organisation noted that the cost savings will be achieved by decommissioning all existing IT infrastructure over the next four years. They also highlighted that €150,000 in cost savings on computer hardware and software has been achieved with the adoption of cloud computing. They believe that costs will not be reduced on technical staffing and their technical teams will simply focus more on strategic, higher-value tasks.

4.3.3 Total Cost of Ownership (TCO)

While the financial costs associated with IaaS and SaaS services are not always lower than internally managed IT services within the five adoptee organisations, the ability to focus on core competencies and higher-value strategic tasks are key factors in the investment in cloud computing. All five adoptee organisations stated they would invest in a 'pay-per-use' cloud service model to reduce the operational overheads on their technical teams.

A key benefit of SaaS services highlighted by all five adoptee organisations is the transparent, subscription-based pricing model, whereby they pay a subscription fee per month per user that covers all service components required to operate, support and maintain the services. This model provides a consistent level of operational expenditure, which eliminates the need for internally managed computer hardware and software licenses. One adoptee organisation highlighted their frustration with the need to buy two copies of all software for their critical business productivity systems as two licenses are required for their test and production environments.

The level of available technical staffing plays a key role in TCO in all five adoptee organisations, highlighting the large amount of technical team resources consumed in the maintenance of internally managed infrastructure, software and network services. Four of the five adoptee organisations highlighted the heavy demands on their technical team resources and the related challenges in keeping up with innovative technology that is essential in supporting business objectives. All four adoptee organisations believe that cloud computing delivers many financial benefits to their organisation because many of the time-consuming, lower-value strategic tasks can be outsourced to a cloud computing service provider. There was disagreement within the fifth adoptee organisation on TCO and the adequate resourcing of technical team resources. One of the participants in this organisation strongly believed that their internal technical teams were adequately resourced and funded to provide the necessary IT capabilities in supporting business objectives. The other participant believed that a considerable amount of time was wasted on the maintenance of internal infrastructure, software and network services. The same participant considered this directly resulted in slower deployment times for many of their customer-facing services and it could be resolved by outsourcing lower-value strategic tasks to a cloud computing service provider. This supports the assertions by Armburst et al (2009) and Sultan (2012) regarding the TCO benefits associated with cloud computing.

While the use of cloud applications may not be less costly, all five adoptee organisations believe that the adoption of cloud computing technologies can be far more cost effective when compared with 'all costs' associated with 'internal' IT services hosted with company assets. This supports the assertions by Kloch, Peterson and Madsen (2011) and Sultan (2011) regarding the TCO benefits associated with cloud computing.

A key financial factor in the adoption of the cloud computing service model highlighted by all five adoptee organisations is the elimination of expensive 'costs' associated with purchasing and maintaining operating systems, software licensing, servers and software applications. One adoptee organisation highlighted their frustration with the need to buy two copies of all software for their critical business productivity systems as two licenses are required for their test and production environments.

Four of the five adoptee organisations stated they invest in a 'pay per use' cloud service model to reduce the operational overheads on their IT and technical teams. Cloud services facilitate them in reducing the man hours and effort required to maintain and

support server hardware, network storage, data backup systems and disaster recovery strategies associated with 'in-house' systems.

All five adoptee organisations highlighted the need to include their existing IT operational overheads when different IT sourcing options are assessed. As stated in the previous section the cloud service model removes a huge volume of repetitive low value-added tasks from the technical teams and allows them to concentrate on more strategic, value-added services. A key example is the adoptee organisation that aims to use a full cloud computing service model by 2017. They believe that a cloud computing service model will allow their internal technical teams to focus on optimising business productivity systems and reduce the operational overheads associated with maintaining their technical infrastructure.

4.3.4 Business Transformation

All five adoptee organisations conclude that the fast deployment times associated with public IaaS services makes it easier for them to attract new customers and increase revenue opportunities. It was evident from the interviews that four adoptee organisations were at the early stages of implementing highly innovative IaaS-based services to diversify into new markets. Four of the adoptee organisations highlighted that they were at present using a limited amount of cloud computing services but the use of public IaaS services could play a key role in their future business model.

Given that four of the five adoptee organisations believe that cloud computing is not necessarily cheaper than the traditional IT service model, it was critical to establish what other financial drivers were driving this change in their business model. All four organisations believe that cloud computing makes it easier to diversify into new markets and enhance operational efficiency. Participants from these four adoptee organisations believe it makes strong financial sense to build new innovative services on IaaS-based platforms.

IaaS services allow organisations access to modern, innovative technologies for minimal upfront costs. The four adoptee organisations believe that the same standard of modern, innovative technologies was less likely to be purchased for internally managed systems because of the high capital expenditure required. This is also in agreement with research by Sultan (2011).

One example given by an adoptee organisation was the very fast deployment times associated with building an E-commerce application on the Amazon AWS IaaS platform. They stated that AWS offers an affordable, highly scalable E-commerce service that can be deployed within several working days, which includes a credit card payment feature for customer payment transactions. The adoptee organisation concluded that it is not possible to deliver the same standard of E-Commerce services on internal managed infrastructure because of the high capital expenditure and technical staffing resources involved.

IaaS services allow organisations to receive, for small upfront costs access to modern, cutting-edge technologies that realistically could not be sourced on a capital expenditure model due to budget restrictions. This supports research by Chen and Lin (2012) and Sultan (2013), who state that cloud computing services allow customers to be more agile in their IT investments as it is based on a pay-per-use model whereby customers only pay for the services they use.

As a result, the same four adoptee organisations are actively building new services and product prototypes on IaaS services with minimal costs incurred. Three adoptee organisations believed that the financial risks associated with changing their business models are greatly reduced with the adoption of cloud computing services. These three organisations believe that cloud computing reduces the financial risk traditionally associated with business transformation projects as these projects can now be started with minimal upfront costs and limited contractual obligations on a cloud computing service model. This is also in agreement with research by Sultan (2011).

The same three participant organisations also noted that the use of IaaS services allows smaller organisations to be more innovative and attentive to customer needs; the main reason being that cloud computing gives them the opportunity to design and build technical architectures on multiple IaaS service platforms until they find the right solution to support their business needs. As a result, they are receiving more support from their finance teams for business transformation projects as the investment required in hardware, licensing, software and system support contracts is reduced substantially on a cloud computing service model.

4.4 Responses and Analysis – Technical Theme

The third central theme concerns technical factors that determine the adoption of cloud services within participant organisations. Participants were asked a series of questions that would identify the technical factors that both support and prevent their organisation from deriving value in the adoption of cloud computing.

4.4.1 Service Scalability

All five adoptee organisations noted that scalability was a major driver for the adoption of IaaS and SaaS-based services as computing resources could be provisioned with speed and agility to scale rapidly based on consumer demand. A key example given by one of the adoptee organisations was the use of a hybrid IaaS cloud model for their disaster recovery (DR) service. They built their DR service on a Microsoft Azure IaaS platform because the elasticity characteristics associated with IaaS services makes it ideal for DR operations. This hybrid allows them to rapidly deploy their critical IT services on a public IaaS cloud service in the event of a disaster and increase the infrastructure resource needs when required.

This is in agreement with the claims of Misra and Mondal (2011), who state that cloud computing solutions can offer strong scaling advantages over traditional IT service model solutions. According to all five of the adoptee organisations in the study, the main differentiator is that internal IT infrastructure platforms used in traditional IT service models must be sourced, installed and configured before services can be deployed. Such a process is time consuming, resource intensive and expensive. This again is in agreement with the findings of Kloch, Peterson and Madsen (2011), who demonstrated that scalability and ‘elasticity’ of cloud computing services was a critical factor in organisations successfully adopting cloud services.

One notable observation was that three of the participant organisations were actively building their own customer-facing services on IaaS infrastructure. A key reason for choosing an IaaS service model was that large IaaS service providers offer participant organisations both horizontal and vertical scalability. Horizontal scalability allows the organisations to rapidly change the number of separate servers’ instances to match changes in demand. Vertical scalability allows the participant organisation to rapidly change the size of server instances themselves in a flexible way. One adoptee organisation is currently developing their Mobile Device Management (MDM) solution for their international customer base. The ability to build their prototype MDM service on

multiple infrastructure architectures was an essential requirement for the development of their new services. IaaS service providers such as Amazon, IBM and Joyent allowed the participant organisation to build the MDM prototype services in a more flexible, agile manner, without the very high capital costs associated with a traditional IT service model. Furthermore, IaaS services allowed them to deploy multiple instances of the MDM prototype service in different geographical locations worldwide to attract new customers in the APAC, North American and EU markets. Critically, the elasticity associated with IaaS allowed the adoptee organisation to downscale quickly when the resource demands for prototype services decreased in each geographical location. To summarise, they are adopting IaaS-based service to support business growth within the organisation.

4.4.2 Service Availability

All five organisations agreed that the reliability of IT services can be improved on cloud-based platforms through the use of redundant sites. This is in agreement with the claims of Kloch, Peterson and Madsen (2011) and Sultan (2011), who concluded that the availability of IT services can improve on cloud-based platforms. All five adoptee organisations assessed multiple cloud computing-based service offerings to address their service availability concerns regarding denial of service attacks, hardware failure, human error and natural disasters.

A key finding was that all five adoptee organisations experienced outages and performance slowdowns on the majority of their cloud computing-based services. However, three of the five adoptee organisations noted that their SaaS and IaaS-based services are much more resilient when compared with the large majority of their internally managed services. The same three adoptee organisations reported that it was quicker and more efficient to recover from cloud-based service outages compared with internal IT services. According to the three adoptee organisations, a key reason for quicker recovery is that data backup and disaster recovery capabilities were integrated into the initial service design of cloud-based services adopted by their organisation. The two remaining adoptee organisations did not agree that cloud computing services were quicker and easier to recover because they had already invested sufficiently in data backup and disaster recovery capabilities for their 'internal' services.

4.4.3 Technical Limitations

While there were many legal and security reasons why certain business services should be hosted primarily on company-owned assets, two of the five adoptee organisations were unable to implement key components of their system architecture on IaaS-based

platforms. Both organisations stated that firewall and network capabilities provided by cloud service providers were unable to cope with the volume and type of network traffic routed through their customer-facing systems. This resulted in service connectivity failures and both organisations will continue to host these services internally on company-owned infrastructure to reduce the risk of service disruption. This is in agreement with the European Commission (2011), who state that many cloud service providers still lack maturity in some of their technical service features and capabilities.

4.4.4 Technology Management

The 'ease of management' associated with cloud computing services was a very strong benefit for all five adoptee organisations. All five adoptee organisations are finding it increasingly difficult to keep up with new, innovative technologies that are essential in supporting business objectives. Participants highlighted that the cloud-based services greatly simplify the IT management and maintenance of IT systems within their organisations. The majority of adoptee organisations highlight the shortage of IT personnel within their organisation and it is a challenge for IT teams to 'be all things to all people' within the organisation. A further technical challenge highlighted by all five adoptee organisations is the large amount of resources used to maintain their internal infrastructure, software and database services. Service maintenance and upgrades for 'internal' services have also become more complex due to the requirement to upgrade services without interruption, or at least within a short time frame, for maintenance. This precludes the participant organisations from performing lengthy operations that may be necessary in the upgrade of internal IT services. A further concern highlighted by organisations was the limited availability of testing environments for maintenance events on 'in-house' IT services due to infrastructure, licensing and staff resource limitations.

In relation to the above finding, the non-adoptee organisation further demonstrated the internal inefficiencies that can arise in an organisation that does not invest adequately in their IT services. The non-adoptee highlighted the difficult challenges in maintaining the legacy IT services within the organisation and reported that employees were regularly experiencing substantial disruption to key business services hosted on 'internal' services. A key reason for the high frequency of service outages is the limited technical staffing resources available to maintain their internal IT services. Both participants from the non-adoptee organisation believed that the legacy database systems were too old to migrate to a cloud-based vendor but also acknowledged that limited research has been done on potential service providers.

Four of the five adoptee organisations reported that cloud service providers follow structured change management processes to ensure their customers are not disrupted by service upgrades. They claim that it is more difficult to allow the same level of change control processes for maintenance on 'internal' services because of the additional training and resources required by internal IT support teams, who are already overburdened with existing projects and tasks. However, the remaining organisation did not agree that it was more difficult to implement the same level of change control procedures for maintenance on 'internal' services because they have a very large well-resourced IT support team who undergo regular training.

4.4.5 Interoperability Concerns

According to four of the five adoptee organisations, the biggest challenge with IaaS cloud platforms has been the migration of their existing system architecture for customer-facing services. All four organisations felt the IaaS migration was time consuming and technically complex for both prototype and production services. However, participants feel that the move to IaaS services is worthwhile because the move is inevitable for their organisation. This is a major decision-making factor when selecting an IaaS service provider, as the quality and standards of the products offered by different IaaS service providers varied considerably.

All five adoptee organisations highlighted the need to proactively and dynamically move IaaS services between IaaS service providers because they did not want to be 'locked in' to one IaaS service provider. According to all five adoptee organisation, the IaaS market is still being dominated by Amazon AWS and this service uses their own proprietary standards to prevent customers moving to other IaaS service providers. As a result, the process of migrating Amazon AWS IaaS components to another IaaS service provider is time consuming and complex. Four adoptee organisations believe that an alternative to Amazon AWS is emerging with the development of a common IaaS interoperability standard called OpenStack. OpenStack is free open source software used to promote open interoperable standards among other large IaaS service providers. However the majority of participants reported that they believe OpenStack is currently an immature cloud platform with a basic set of IaaS interoperable features. Nevertheless, they believe this may change in the future owing to the significant investment by large Openstack-based IaaS service providers such as IBM, Rackspace, Cisco and HP.

Vendor lock-in concerns over SaaS services continues to be an issue for four adoptee organisations. Due to a lack of interoperability standards and regulation, the adoptee

organisations cannot easily extract their data and move to another SaaS-based provider in many 'use cases'. As a result, four of the adoptee organisations are reluctant to move critical services to a SaaS-based service model because of the risks of being 'locked in' with the service provider. An example of vendor lock-in was Salesforce.com's CRM system, which is used by four of the five adoptee organisations. One of the adoptee organisations highlighted that Salesforce.com customers only have ownership of the data itself but Salesforce owns the database, business analytics and reporting tools included in service offering. This makes it difficult for the adoptee organisation to migrate their data to another CRM provider as they must recreate all their reporting and analytics features, which is time consuming and resource intensive. This finding regarding the risks of being 'locked' into a SaaS-based service is supported by ENISA (2009).

4.4.6 Alternatives to Cloud Computing

Four of the adoptee organisations stated that it is becoming increasingly difficult for their internal technical staff to manage their rapidly changing technology environments. The organisations cannot ignore the potential business value that certain technological advances can bring to their organisation but they cannot financially afford to continually change, update and manage complex IT environments. All five adoptee organisations felt that cloud computing is 'taking away a lot of the pain' associated with keeping up with new technology developments and it enables their business and technical teams to focus on higher-value strategic work duties. They feel there is no alternative to cloud computing in providing the same levels of IT capabilities without major investment in their internal IT services and technical staffing teams.

Furthermore the participants from the 'non-adoptee' organisation acknowledged that their organisation had invested minimally in their IT infrastructure and clearly identified this as problematic into the future. They are aware that their legacy IT services will not continue to operate in the medium to long term and their organisation will be forced to evaluate and assess sourcing options, including cloud computing.

4.4.7 Broadband

One of the key barriers for the non-adoptee organisation is the limited broadband and internet connectivity across their departments. Their organisation is located in an old office building in south Dublin and they are unable to change to another internet service provider. As a result, they regularly experience internet outages on their office connection,

which affects their access to internet resources. This is another reason why they are unlikely to adopt a cloud-based IT service model in the short term.

4.5 Responses and Analysis – Security and Data Privacy Theme

The fourth central theme concerns security and data privacy factors that determine the adoption of cloud services within participant organisations. Participants were asked a series of questions that would identify the security and data privacy factors that both support and prevent their organisation from deriving value in the adoption of cloud computing.

4.5.1 Data Privacy and Compliance

While all adoptee organisations are attracted to the many benefits associated with the use of cloud computing, they are clearly aware of the data privacy risks associated with cloud computing.

All five adoptee organisations state that the recent controversy regarding the US government and PRISM has increased data privacy concerns and they are being forced to reconsider their adoption and investment strategy in cloud computing. PRISM is a data collection programme run by the National Security Agency (NSA) that gathers information (or metadata) about non-US citizens from large American tech companies including the major cloud service providers (Google, Salesforce, Amazon and Microsoft).

This is a major business risk for four of the five adoptee organisations, who are in the process of building customer-facing services on public IaaS platforms for their large European customer base. They believe that the cloud computing industry is essentially an American-controlled industry and many of their customers are uncomfortable with their data being accessible to the US government without their approval. This is a key reason why four of the adoptee organisations continue to store and process customer specific data on their internal IT assets, as US law enforcement agencies must notify them if these agencies require access to data stored on company-owned assets. The remaining adoptee organisation does not have the same data privacy concerns as the other four adoptee organisations. They will continue to host their company data on US-owned cloud computing services but they are closely watching the situation regarding data protection and safe harbor agreements between the EU and US government.

A key example given by one of the adoptee organisations was their new SaaS-based service offering to their customers. One large Scandinavian banking customer has already warned them that data owned by the bank must not be stored on any American-owned cloud computing-based service for data protection reasons. This feedback from lucrative customers has driven a desire within the participant organisation to find an EU-owned cloud computing service provider to assure their customer base that their data is adequately protected from 'prying eyes'. According to four adoptee organisations, these compliance and data protection issues are key barriers in the growth of cloud computing within their organisations as customer concerns over cloud computing security and privacy will hinder their investment in a cloud computing IT service model. All five adoptee organisations conclude that the compliance and data privacy risks associated with cloud computing affect SMEs more severely because cloud computing levelled the playing field with their larger competitors in winning customer contracts. This matches the findings of the European Commission (2012b), who state that cloud computing is especially important for SMEs trying to diversify into more profitable markets and increase revenue opportunities. This was not achievable for four adoptee organisations on a traditional IT service model as they could not afford the high capital costs associated with enterprise standard infrastructure and network services. This reduces their competitive advantage because larger organisations have the technical capabilities and financial resources to provide these services on internally managed infrastructure. The fifth adoptee organisation does not believe that this puts them at a competitive disadvantage and they have the technical capabilities and financial resources to compete against larger organisations.

Another interesting finding was data privacy concerns by the EU public sector. Two adoptee organisations stated that they cannot sell services hosted on cloud computing platforms to the EU public sector because public sector entities approach cloud computing service models with caution. They believe that the public sector will not adopt any type of cloud computing service model until clearly defined EU data protection legislation surrounding cloud computing is introduced. Both organisations stated that they must choose a different sourcing model to give their public sector customers assurances over security controls, data confidentiality and forensics evidence gathering mechanisms. Both organisations would like to see the EU give more 'direction' on how data privacy issues surrounding cloud computing should be handled and addressed. The other three adoptee organisations did not comment on this subject.

4.5.2 *Service Level Agreements*

Four of the five adoptee organisations were unable to negotiate SLA agreements with cloud service market leaders regarding issues related to data privacy, information security, service availability and performance requirements. These organisations felt they were viewed as ‘too small’ by the large cloud computing service providers to exert influence regarding the negotiation of service level agreements. This is another key reason why these organisations continue to host critical business services on company-owned assets instead of with cloud computing providers. This is in agreement with the assertions of NIST (2011), who state that points of negotiation can significantly perturb and negatively affect the economies of scale that a non-negotiable service agreement brings to public cloud computing.

Four adoptee organisations reported that the level of customer service offered by several cloud computing service market leaders was not satisfactory for hosting critical IT services. All four adoptee organisations used Amazon AWS as an example, whereby it can take 24-48 hours to get technical support from their customer service team regarding a service outage. In their opinion, this is not an acceptable way to run their business as they are mostly relying on technical user forums to resolve critical service outages on Amazon AWS service platforms. The fifth adoptee organisation did not comment on customer support issues with any of the cloud service providers.

As a result, four of the adoptee organisations are reluctant to lose control over critical IT services because they have limited leverage with the large cloud service providers on how service issues and security incidents are handled and resolved. Research by NIST (2012) concurs with this finding. The fifth adoptee organisation was satisfied with how service issues and security incidents are handled and resolved by their cloud service providers.

4.5.3 *Trust*

Trust in the selection of a cloud service provider, according to all six participant organisations, is critical. The non-adoptee organisation stated that they would only trust well-established cloud brands to host their services. The five adoptee organisations chose well-known cloud service providers such as Amazon, Microsoft and Salesforce that were “*too big to fail*” as they could not risk long-term disruption to key business services.

Two adoptee organisations highlighted that trust in your SaaS service providers is critical. A key reason is that the SaaS service provider has the majority of control and access over the service. This means that a SaaS-based service provider controls the entire service

stack, from the virtualisation layer to the application layer. This means that the customer has limited visibility of the underlying security controls and policies beyond the application's core functionality. As a result, two of the adoptee organisations are very selective in their choice of SaaS service provider. A participant from one of these two adoptee organisations was quoted as saying, *"We do depend on the reputation of the cloud vendors as we cannot afford to independently evaluate their security setup. Trusted brands matter with cloud."*

4.5.4 IT Governance

All five adoptee organisations have highlighted that IT governance has become more complicated since the adoption of cloud computing. The management of cloud computing services is significantly different from how traditional IT service models are managed and governed. The main challenge is that the responsibility around IT governance remains within their organisation despite the outsourcing of certain services to cloud service providers. All five adoptee organisations had adopted internal IT governance frameworks. In addition, significant time and effort had been invested within participant organisations to assess and understand different cloud services in terms of compliance, information security, service availability and performance. All five adoptee organisations noted that the need for increased governance puts an additional strain on internal staff resources as careful consideration has to be given to the migration of sensitive company data to an external cloud-based service. The experience of the above organisations is supported by the research by ENISA (2009) and NIST (2011), which demonstrates that additional resources must be invested in IT governance when IT services are being migrated to a cloud computing service model.

Another interesting observation was that only two of the five organisations frequently obtain adequate legal and technical advice to ensure that adequate data security and privacy policies and technical controls were provided by cloud computing service providers for key business. These policies and controls include but are not limited to data ownership, exit rights, data encryption and legal compliance. A key example is the Salesforce CRM SaaS-based service which is used by four of the adoptee organisations. Four adoptee organisations signed non-negotiable service level agreements and contracts, with limited data privacy and security assurances. When asked further about this, two participant organisations reported that needs of the commercial teams for the Salesforce service was prioritised over the security and data privacy concerns raised by IT management.

Another key risk was the use of information security standards within the participant organisations to manage the risks associated with the storage and transmission of confidential information on cloud computing services. Three of the six participant organisations follow a formal Information Security Management System (ISMS) standard such as ISO 27001 to review major changes in their IT service model. The remaining three participant organisations do not follow any structured process for the identification of information security risks, which leaves them more prone to serious security breaches that arise from weak information security controls. This matches the assertions by ENISA (2009) and Park et al (2008), who highlight the need for formal ISMS standards to reduce the risk of serious information security breaches within SMEs.

4.5.5 Identity and Access Management

Four of the adoptee organisations reported that large cloud service providers offered a more powerful range of information security controls when compared with their own internal information security controls. The main reasons for this are the limited financial and technical resources available to implement complex security control systems across their own IT environments. This matches the assertions by ENISA (2009), who found that cloud computing can often improve information security controls within SMEs.

One example given by one of the interview participants was the security controls offered by Salesforce, which is the CRM system most commonly adopted by SMEs worldwide. They reported that the Salesforce security configuration tools allow companies to restrict access to their application data by IP address as well as a twin-factor authentication solution. This twin-factor authentication security control ensures two different methods are used to authenticate the user and deliver a higher level of authentication assurance. This prevents staff in the participant organisation from connecting to highly confidential information on highly insecure networks such as internet cafes and hotel WIFI locations. This greatly reduces the risk of network security breaches as the participant organisation acknowledges that it would be difficult to implement the same level of security controls without major investment. The participant also believed that these types of security controls are rarely implemented on their company-owned assets because of budget, staff and technology restrictions. This matches the assertions made by NIST (2011) that the large cloud service providers can offer a more powerful range of information security controls than the consumer organisation.

The remaining adoptee organisation did not agree that large cloud service providers offered a more powerful range of information security controls when compared with their own internal information security controls. This adoptee organisation had a dedicated team of four information security professionals to deploy information security controls across their organisation. It is important to note that they were the only adoptee organisation involved in the case study to have a dedicated information security team.

4.6 Chapter Summary

4.6.1 Initial Observations

Five of the six participant organisations have adopted some form of cloud computing and the sixth adoptee organisation had no immediate plans to adopt cloud computing services. Software as a Service (SaaS) is the most frequently used cloud service model among the five adoptee organisations.

Four of the five adoptee organisations will potentially invest heavily in public IaaS-based services as their business models continues to evolve. One of the five adoptee organisations uses PaaS-based cloud services and the other four adoptee organisations do not to use PaaS-based services because of the perceived integration challenges with their internal architecture.

Two of the adoptee organisations use a more advanced cloud computing service model because they have deployed a hybrid service model that allows their public IaaS-based services to fully integrate with their internally managed IT services. The other three adoptee organisations are satisfied with investments in cloud computing but system integration with their internally managed IT services is minimal.

4.6.2 Organisational

All five adoptee organisations believe that Cloud Computing allows their IT service model to become more flexible and responsive to rapidly changing business demands. The ability to experiment with cloud computing services on a pay-per-use model allows adoptee organisations to determine what cloud service offering is most suitable for their business needs.

4.6.3 Financial

A key finding is that all five adoptee organisations are currently spending only 5-15% of their IT budget on cloud services. Key barriers associated with data privacy, inadequate service level commitments, interoperability and security risk continue to hinder investment in four of the adoptee organisations, while the remaining adoptee will rapidly increase their investment in cloud computing over the next three years. It is evident that cost reduction is a key driver in the migration of IT services to cloud computing within each of the five adoptee organisations. Four of the five adoptee organisations conclude that it can be sometimes cheaper to manage an IT service internally based on the service type, usage pattern and service complexity.

All five organisations conclude that the total cost of ownership (TCO), increased revenue opportunities and the ability to focus on core competencies are major financial drivers for investment in cloud computing. Technical staffing resources play a key role in TCO in all five adoptee organisations and highlighted the high resource demands on their technical staffing teams. All five adoptee organisations conclude that the fast deployment times associated with public IaaS services makes it easier for them to attract new customers and increase revenue opportunities.

4.6.4 Technical

All five adoptee organisations reported that scalability is a major driver for the adoption of IaaS and SaaS-based services as computing resources could be provisioned with speed and agility to scale rapidly based on consumer demand.

A key finding was that all five adoptee organisations experienced outages and performance slowdowns on the majority of their cloud computing-based services. However, three of the five adoptee organisations note that it was quicker and more efficient to recover from cloud-based service outages compared with the internal IT services.

According to four of the five adoptee organisations, a key technical barrier has been the migration of their existing system architecture to a cloud computing IT service model. Two of the five adoptee organisations are unable to implement key components of their infrastructure architecture on IaaS service platforms. The risk of service disruption is a key driver for hosting many of their customer-facing services on internal company-owned services because current IaaS service offerings are unable to cope with very high volumes of network traffic.

The non-adoptee organisation reported that service disruption on their IT services is common and limited technical staffing resources and poor standards in IT maintenance are the root causes for high service failures rates. They acknowledge that senior management are reluctant to invest in IT and limited research has been done on the benefits of cloud computing.

According to all five adoptee organisations, the IaaS market is dominated by Amazon AWS and the process of migrating Amazon AWS IaaS components to another IaaS service provider is time consuming and complex. They believe this may change in the future with the development of a common IaaS interoperability standard called OpenStack.

4.6.5 Security and Data Privacy

All five adoptee organisations state that the recent controversy regarding the US government and PRISM has increased data privacy concerns and they are being forced to reconsider their adoption and investment strategy in cloud computing. According to four adoptee organisations, these compliance and data protection issues are key barriers in the growth of cloud computing within their organisations as customer concerns over cloud computing security and privacy will hinder their investment in cloud computing. All five adoptee organisations conclude that the compliance and data privacy risks associated with cloud computing affect SMEs more severely because cloud computing levelled the playing field with their larger competitors in new business opportunities.

Three of the six participant organisations follow a formal Information Security Management System (ISMS) standard such as ISO 27001 to review major changes in their IT service model. The remaining three participant organisations do not follow any structured process for the identification of information security risks, which leaves them more prone to serious security breaches that arise from weak information security controls. Four of the adoptee organisations reported that large cloud service providers offered a more powerful range of information security controls when compared with their own internal information security controls.

All five adoptee organisations chose cloud service market leaders such as Amazon, Microsoft and Salesforce because they do not trust smaller cloud service providers. Four of the five adoptee organisations were also unable to negotiate SLA agreements with

cloud service market leaders regarding issues related to data privacy, information security, service availability and performance requirements. This is a key barrier as the four adoptee organisations continue to host many of their critical business services on company-owned assets to avoid any risk to their company brand, revenue or customer relationships.

5. Conclusions and Future Work

This chapter aims to present the conclusions from the research carried out and demonstrate that the research questions have been answered. In addition the chapter includes a discussion of the generalisability of the research results alongside recommendations that may add to the literature in this area. Finally the author will highlight the limitations of this research, advances in the current knowledge and outline possible future directions for research in this area.

5.1 Research Claims

This research determined that Irish SMEs can derive significant value from the adoption of cloud computing. The research study indicates cloud computing allows SMEs to be more cost effective in their investment in information technology and improve competitive advantage through innovation, productivity and business agility. However, the key barriers including data privacy, security risks, service reliability, interoperability and immature cloud service offerings highlighted in the research study continue to prevent faster, more harmonised adoption of cloud computing by Irish SMEs. There is a need for clearly defined standards in the cloud computing industry, not only in regulatory terms but in terms of being competitive, open and secure.

5.2 Demonstration that Research Question has been Answered

The dissertation discusses cloud computing from an organisational, financial, technical, and security and data privacy perspective. It puts them in context by reviewing the existing body of literature on the adoption of cloud computing within Irish SMEs. As highlighted in previous literature, value may be summarised as the ability of IT to enhance the business performance of the organisation (Miller and Porter 1985; Gartner 2006). Therefore, it was essential that the benefits and barriers of cloud computing are identified for SMEs as a cloud computing service model is a fundamental change in the way IT services are delivered to SMEs. This matches the assertions of Brynjolfsson and Jordan (2010) and Marston et al. (2010).

Six SMEs were involved in the case study. In each of the six organisations, employees that strongly influence the IT investment were interviewed. A total of 12 interviews were carried out to gain an understanding of the benefits and barriers related to the adoption of cloud computing services within the SME sector. This case study confirms many of the findings drawn by researchers such as Sultan (2011), ENISA (2009a) and NIST (2012) as to the potential value derived from the adoption of cloud computing. They identified Irish

SMEs can derive value from the adoption of cloud computing in the form of innovation, business agility, total cost of ownership (TCO) and operational efficiency. These benefits were clearly identified as common trends which emerged in the case study findings. Likewise, the risks and concerns over data privacy, inadequate service level commitments, interoperability, immature IaaS architecture and control of critical business services were identified as key barriers in how Irish SMEs can derive value from the adoption of cloud computing.

Key findings from the case study that were not addressed adequately in the literature reviewed were innovation and business transformation benefits associated with cloud computing. A key consideration that has been taken into account for SMEs is the suitability of cloud computing for their organisation. It is hoped that this research will assist SMEs choose an approach most suitable in deriving value based on the organisational, financial, technical and security/data privacy themes associated with cloud computing

5.3 Key Research Recommendations

While there are many ways that SMEs can derive value from the adoption of cloud computing, the suitability of cloud services will vary depending on the business needs of the organisation. Following on from the research findings, this section sets out a series of recommendations which may be used as a framework for Irish SMEs based on the organisational, financial, technical and security/data privacy themes associated with cloud computing. In addition, recommendations for cloud computing service providers and other relevant stakeholders are described.

5.3.1 Organisational

This section outlines a series of organisational recommendations which may be used as a framework for Irish SME considering the adoption of cloud computing.

- **Business Flexibility:** The ability to experiment with cloud computing services on a pay-per-use model allows SMEs to determine what cloud services are most suitable for their business needs. It is recommended that SMEs take advantage of low cost trials offered by cloud service providers to assess the potential benefits delivered to the organisation and their customers.
- **When to Adopt SaaS:** Public Software as a Service (SaaS) service is the most frequently used cloud service model among SMEs. SMEs are attracted to SaaS based services because they can perceive the wide range of readily available

service benefits. The ability to access a wide range of SaaS-based services via mobile computing devices improves staff productivity and provides new opportunities for communication for SMEs. It is recommended that the mobile device access capabilities associated SaaS-based services are particularly suitable for SMEs with limited internal technical resources.

- **When to Adopt PaaS:** The Platform as a Service (PaaS) cloud service model, while providing benefits for custom IT services, has nonetheless been identified as being less mature and still undergoing considerable evolution. It is recommended that SMEs considering PaaS recognise the technical integration challenges which may emerge in adoption of this model.
- **When to Adopt IaaS:** SMEs that provide internet based services to their customer base are more likely to adopt Infrastructure as a Service (IaaS) based services because of faster deployment times and hence the ability to diversify more rapidly into new markets. SMEs requiring such technical agility or scalability should evaluate IaaS opportunities in order to compete against larger competitor organisations.

5.3.2 *Financial*

This section outlines a series of financial related recommendations which may be used as a framework for Irish SMEs considering the adoption of cloud computing.

- **Revenue Opportunities:** In the current economic climate, it is recommended that SMEs consider cloud computing services offerings for new business transformation projects. Cloud computing allows SME to build new services and products on highly scalable, redundant cloud platforms which enables them to compete against larger competitors. This ability to compete in larger markets can in turn increase revenue opportunities.
- **Investment and IT Maturity Levels:** Start-up SMEs are most likely to benefit financially from the adoption of cloud computing with the elimination of capital expenditure on IT infrastructure and software licensing. More consideration is required in reviewing the financial benefits for mature SMEs who have already invested significantly in their internal infrastructure and software services.
- **Cost Reduction Considerations:** Cloud computing is not always cheaper when compared against the costs associated with internal IT services. Cost savings must be assessed on a case-by-case basis when IT services are being assessed for migration to a cloud service model. To achieve real financial benefits, SMEs

must gain a clear understanding of the services provided by their technical teams and the associated costs with delivering those services.

- **Total Cost of Ownership:** The ability to focus on core competencies and increased employee productivity are key benefits in the suitability of cloud computing for Irish SMEs. It is recommended that SMEs use IT service management frameworks to identify all financial and staffing costs associated with the management of each IT service. Without a clear and thorough understanding of the costs associated with each existing IT service, there is no rational way to determine if a cloud computing service model is more economical than a traditional IT service model.

5.3.3 *Technical*

This section outlines a series of technical recommendations which may be used as a framework for Irish SME considering the adoption of cloud computing. In particular cloud service model recommendations are offered among other technical concerns.

- **Interoperability:** While vendor lock-in and interoperability are valid concerns for cloud computing services it is important to note that SMEs can equally be locked into proprietary software applications and license agreements hosted on internally managed platforms. Hence it is recommended that SMEs be focused on such interoperability factors for new initiatives and monitor the emergence of open industry standards such as OpenStack.
- **Improved Resilience:** Hybrid cloud provisioning models will become more popular within the SME sector because it will allow SMEs to host their IT services on their internally managed infrastructure for security reasons and 'burst' into a Microsoft Azure public IaaS cloud when the demand for computing capacity increases substantially. However, SMEs must be aware that advanced technical knowledge is required to deploy a hybrid cloud service model and fully integrate cloud-based services in their internally managed IT service model.

5.3.4 *Security and Data Privacy*

This section outlines a series of security and data privacy recommendations which may be used as a framework for Irish SME considering the adoption of cloud computing.

- **Data Privacy Risk:** It is evident that IT services with stringent data protection requirements are not yet suitable for public cloud service models due to the wide

range of data privacy and compliance risks involved. The recommendation is that SMEs continue to host sensitive data and services on internally managed assets until such risks are adequately addressed, in certain cases via supporting government legislation.

- **Information Security Standards:** There is limited understanding of the negative consequences of information security breaches among SMEs. Therefore, it is recommended that SMEs realise that Information Security Management System (ISMS) standards and risk management frameworks play a key role in protecting company revenue and financial stability. Moreover, these risks may be exacerbated with the adoption of cloud computing.
- **Service Level Agreements:** The default SLA agreements offered by many cloud service providers do not address SME customer requirements over data privacy, information security and service availability for critical business services. Potential SME customers should obtain demonstrations from cloud service providers that their critical business services and reputation will be protected with such demonstrations undertaken by means of a detailed description of their data handling practices, data migration, security controls, and overall industry compliance standards.
- **Other Stakeholders:** Data privacy risks associated with cloud computing continue to hinder the widespread adoption of cloud computing within SMEs. It is essential that the European Commission provide strong leadership by replacing the existing EU/US Safe Harbor data protection directive with a more robust framework to protect EU citizens. This legislation would make it illegal for the US government to invoke the Patriot Act on a cloud service provider, in efforts to acquire data held in the European Union without approval from the relevant Member States' data protection agency.

5.4 Generalisability of Findings

As outlined in chapter 3, a multiple case study approach, using semi-structured interviews was used as the data collection method. It is evident from previous literature (Saunders, Lewis, and Thornhill, 2009) that Interpretivism is a more suitable philosophy for business and management research studies that involve organisational behaviour and the need to capture the rich complexity of social situations.

Due to the complexity of IT management within the SME sector, it was considered appropriate that an interpretivist approach be used to determine the organisational,

financial, technical and security/data privacy factors in how value can be derived by SMEs in the adoption of cloud computing.

A total of 12 participants within six Irish SMEs were selected to participate in the case study. Yin (2003) states that if too few participants are selected in a multi-case study then the findings cannot be generalisable. However, the purpose of the research strategy employed is to gain an understanding of the subject being researched and more than six organisations would have not been possible within the time frame of the case study.

As the theme based analysis shows, some trends emerged across the majority of participant organisations, whilst only one or two participant organisations reported some of the other themes. Based on the number of participant organisations, the strength of the trends offers some measure of how the themes could apply to SMEs not included in the case study. In order to demonstrate that the findings in the research may exist across a large number of SMEs, further research would need to be undertaken using a quantitative methodology among a larger sample size of organisations.

5.5 Limitations

The drawback of a case study approach is that it is difficult for a case study to support or reject a scientific hypothesis due to their reliance on qualitative data. A larger sample size of participants may have been beneficial for data analysis as it would be more representative of the SME industry sector for data population. This would increase the validity of the research findings regarding the potential value that can be derived from the adoption of cloud computing.

A mixed-method approach, incorporating case study and survey would increase the validity of the case study findings by examining the same phenomenon in different ways, which minimises the weaknesses in any single approach. It promotes greater understanding of the case study findings as quantitative data would also provide an overall statistical view of the subject within each participant organisation.

It must be noted that this case study was a cross-sectional study and it only observed the adoption of cloud computing with these participant organisations at one specific point in time. While cross-sectional studies are very useful in identifying associations and trends, a case study over 12-24 months would allow for a more rigorous comparison analysis to

'measure' the business value delivered by adoption of cloud computing within each participant organisation.

Unfortunately this was not possible due to time constraints and a more comprehensive study would rectify these limitations.

5.6 Advancing the Current Knowledge

The dissertation determines how SMEs can derive value in the adoption of cloud computing from an organisational, financial, technical, and security and data privacy perspective. It puts them in context by reviewing the existing body of literature on the adoption of cloud computing for SMEs. However there is currently a dearth of information within the literature as to how Irish SMEs can derive value from cloud computing using qualitative research methods.

Most importantly, the research demonstrates that Irish SMEs can derive value from cloud computing through innovation, productivity and business agility. This case study confirms much of the findings from Chen and Lin (2010), Sultan (2011), ENISA (2009a), NIST (2011) and Kloch, Peterson and Madsen (2011) as to the potential value derived from the adoption of cloud computing for SMEs. The dissertation advances knowledge on the SME sector as it confirms that the barriers facing Irish SMEs in adopting cloud computing are similar to those experienced by SMEs in other countries. The research confirms findings from other authors on the benefits that Irish organisations can derive from cloud computing.

The research improves our understanding of the barriers to the Irish SME sector adopting cloud computing including issues related to data privacy, inadequate service level commitments, security risks, service reliability, interoperability and immature cloud service offerings.

Key findings from the case study that build on the previous literature were innovation and business transformation benefits associated with cloud computing described by the participants from the Irish SME sector. Finally the research advances knowledge in the factors that SMEs should consider when assessing the suitability of cloud computing for their organisation. Moreover the findings from the research will support the decision making of senior management when planning how they can derive value from adopting the cloud computing from an organisational, financial, technical and security/data privacy perspective.

5.7 Areas for Further Research

Cloud computing as an IT service model has existed for a short number of years and there is a broad range of areas for future work and research.

As highlighted in section 5.5, there is a need for more rigorous comparison analysis of how value is to be derived by cloud computing within Irish SMEs over a longer period of time. One interesting area of research would be a detailed analysis on SMEs in the adoption of cloud computing process over the next two years. This type of case study would explain how the wide scale adoption of cloud computing within SMEs can be delivered successfully.

A key finding from the research was that IT management teams within SMEs are under increasing pressure to measure the value of technology investments. An interesting area of research would be the development of a measurement framework to assess the suitability of cloud computing for Irish SMEs. There has been a wide range of literature on complex return on investment (ROI) models but SMEs regularly conclude that they do not yield an accurate result. SMEs would benefit from a flexible measurement framework that assists them in selecting the most suitable IT service model for their business needs.

A key finding from the research was the limited adoption of information security standards within the participant organisations. A future area of research would be the detailed analysis of information security standards within Irish SMEs. This would explore the common information practices and standards regarding disaster recovery, business continuity, risk management, security controls, identity management and the protection of customer-owned data. This could assist SMEs in the successful establishment and maintenance of information security standards within their business environment.

A key area of research would also be the evaluation of the environmental benefits of providing IT services on a cloud computing service model. This would include an assessment of the suitability of cloud computing in assisting the Irish Government in the reduction of energy consumption and carbon emissions.

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Appendices

Appendix 1: Informed Consent Form

TRINITY COLLEGE DUBLIN
School of Computer Science and Statistics
Informed Consent Form

Project Title: How Irish SME organisations can realise value in their adoption of Cloud Computing

Principal Investigator: Robert Kenny

School/discipline: School of Computer Science and Statistics, M.Sc. Management of Information Systems

Academic Supervisor: Noel Faughnan

I am invited to participate in this research study which is being carried out by Robert Kenny. My participation is voluntary. Even if I agree to participate now, I can withdraw at any time without any consequences of any kind.

The study is designed to investigate how Irish SME organisations can realise value in the adoption of Cloud Computing.

If I agree to participate, this will involve me answering a list of questions on your organisation's background and the adoption of Cloud Computing within your organisation. These interviews will be conducted at my office and one visit will be required for this interview. Each interview will last approximately 60-90 minutes.

I have been advised that several participants in this research study are work colleagues of the principal investigator and I am aware that the principal investigator is taking advantage of his existing professional working relationships in order to make progress in this research study. I believe there are no known risks associated with this research study but a possible inconvenience may be the time it takes to complete the study.

I will not directly benefit from this research study in any way but my participation may help Irish SME organisations derive value from their adoption of Cloud Computing services.

Any information or data which is obtained from me during this research which can be identified with me will be treated confidentially. The principal investigator will keep all study records, including any codes to my data, in a locked filing cabinet only accessible to the primary investigator. Research records will be labelled with a code. A master key that links names and codes will be maintained in a separate and secure physical location. The master key and audiotapes will be destroyed after 3 years after the close of the study. All electronic files including but not limited to databases, audio recordings and word document containing identifiable information will be stored on password protected encrypted storage devices. Any computer hosting such files will also have password protection to prevent access by unauthorized users. The principal investigator will have access to the passwords only. At the conclusion of this study, I am aware that the principal investigator may publish his findings.

Information will be presented in summary format and I will not be identified in any publications or presentations.

As part of this research study, an audio recording will be made during my participation in this research project. Audio recordings will be used to verify that all information obtained from me is accurate. This is completely voluntary and I may request to stop the recording at any time or to erase any portion of your recording. I have been advised that no audio recordings will be made available to anyone other than the principal investigator and academic supervisor, nor will any such recordings be replayed in any public forum or research presentation. The recordings will be kept in a password protected encrypted storage devices only accessible to the principal investigator.

If I have any questions about this research I can contact Robert Kenny. I am also free, however, to contact any of the other people involved in the research to seek further clarification and information.

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Appendix 2: Intended Interview Questions for Approval

Overview:

The primary focus of the interview questions are to identify the characteristics that influence the adoption of Cloud Computing within the respondent's organisation and develop an understanding of how these organisations can derive value in use of Cloud Computing. This will involve semi-structured interviews and the data collected from the interviews will undergo qualitative analysis. This will pull the common threads of the interviews together to formulate key research findings and recommendations.

Section 1: Organisational Profile

This section will build of profile of the respondent's organisation and identify the characteristics that influence the adoption of IT services within the respondent's organisation.

1. What is the size of company in terms of revenue and workforce?
2. What are the main products or services provided by your organisation?
3. How has the economic recession affected your business?
4. How many people work for the IT department?
5. What percentage of the annual IT budget is spent on Cloud Computing services?
6. Is there an organisation-wide policy for evaluating and assessing technologies that could substantially improve efficiency in your business processes?
7. What information security assessments are performed within your organisation to ensure core business systems meet specific information security standards?
8. What is the decision making process for investment in information technology (IT)?
9. Does your organisation use Return on Investment (ROI) frameworks in the performance measurement and evaluation of IT services?
10. Does your organisation use IT service delivery frameworks for the implementation of new IT services for your organisation?
11. What are the main technical challenges facing your organisation? Are there specific IT services that could be enhanced or replaced within your organisation to improve business operations?
12. What are your current business continuity and disaster recovery capabilities for your core business systems?

Section 2: Cloud Computing Adoption Practices

This section will explore the adoption practices of Cloud Computing within the respondent's organisation.

1. How would you express your current understanding of cloud computing?
2. Do you have an organisation's cloud computing strategy? If so, can you explain the strategy in more detail?
3. What are the main drivers for the adoption of Cloud Computing Services within your organisation?
4. What are the main barriers for your organisation in the adoption of Cloud Computing?
5. Which Cloud Computing Service Model is your organisation most likely to adopt and why?(Public, Private, Community or Hybrid Cloud)
6. Which Cloud Service model would your organisation be most likely to approach and why? (SaaS, PaaS, IaaS)
7. Which IT services supporting business processes are most likely to be migrated to a Cloud Computing based service?
8. What percentage of IT services that support business processes are currently provided by a Cloud Computing Service provider? Examples would be application hosting, data storage, email and messaging, CRM, server and infrastructure capacity, application development, financial management, ERP, DBMS, BI, project management and customer collaboration tools.
9. What IT services that support business processes would not be migrated to Cloud Computing Provider?
10. Are there industry regulation, business continuity, data privacy or security reasons that determine this approach?
11. Has the adoption of Cloud Computing delivered the expected financial benefits to your organisations?
12. Was there a noticeable reduction in capital and operational expenditure regarding IT asset management (hardware, software, service support)?
13. Did you incur unplanned costs in the migration of 'in-house' IT services to a Cloud Computing service provider? If so, please explain what these costs were?
14. Do you currently have any mechanisms in place to measure ROI for your investment in Cloud Computing?
15. If so, what ROI metrics are used to measure the value of your adoption of Cloud Computing? Examples would be cost, reduction in TCO and quality of service delivered.

16. How satisfied are you with the level of available educational resources and professional training to staff on Cloud Computing?
17. Has there been a change in roles and responsibilities for IT staff with the migration of business systems to Cloud Computing service provider?
18. Has Cloud Computing provided a flexible response to business change within your organisation?
19. Has the adoption of Cloud Computing Services significantly improved business performance? If so, please explain how this was achieved?
20. Has Cloud based services given your organisation access to business productivity tools that allow your organization to diversify into new products and markets quicker and more effectively? Examples of business productivity tools would be email, messaging, CRM, financial management, ERP and customer collaboration tools.
21. Has the adoption of Cloud Computing removed economic/technical barriers in the optimization of business processes within your organisation? If so, please explain how this has been achieved?
22. Has the flexibility and scalability capabilities associated with Cloud based IT resources optimize the use of IT services within your organisation? If so, please explain how this has been achieved?
23. What is your experience of business continuity and disaster recovery capabilities on Cloud based IT services?
24. Has there been a noticeable improvement in the availability and resilience of critical business systems migrated to a Cloud Computing service provider?
25. How does your organisation address concerns about interoperability, data security and privacy surrounding Cloud Computing?
26. What security and data privacy controls are provided by your Cloud Computing providers to ensure your confidential information is secure and protected?
27. How does your organisation evaluate the security and data privacy guarantees offered by Cloud Computing service providers?
28. How did you develop service level agreements (SLAs) with Cloud Computing service providers? What service guarantees do you expect from your provider in terms of service quality, service availability, incident management and IT Governance?
29. What plans does your organisation have for the future adoption of Cloud Computing?
30. What has been your overall experience in the adoption of Cloud Computing?
31. What lessons have you learnt in the adoption of Cloud Computing?

DECLARATION:

- I am 18 years or older and am competent to provide consent.
- I have read, or had read to me, a document providing information about this research and this consent form.
- I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.
- I agree that my data is used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
- I understand that if I make illicit activities known, these will be reported to appropriate authorities.
- I understand that I may stop electronic recordings at any time, and that I may at any time, even subsequent to my participation have such recordings destroyed (except in situations such as above).
- I understand that, subject to the constraints above, no recordings will be replayed in any public forum or made available to any audience other than the current researchers/research team.
- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.
- I have been given a copy of the Participant Information Leaflet and a copy of this consent form to keep.

RESEARCH PARTICIPANT'S NAME:

Signature of research participant:

Signature of participant

Date

Statement of principal investigator's responsibility: I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

Signature of principal investigator

Date