University of Tasmania

Cloud Computing in Australian Organisations: Acceptance and Evolution of Uptake between 2012 and 2013

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Acronyms

ABS	Australian Bureau of Statistics
ACS	Australian Computer Society
ACT	Australian Capital Territory
AGIMO	Australian Government Information Management Office
API	Application Programming Interface
APP	Australian Privacy Principle
ASP	Application Service Provider
ATM	Automated Teller Machine
AWS	Amazon Web Services
BSA	Business Software Alliance
CAPEX	Capital Expense
CC	Cloud Computing
CEO	Chief Executive Officer
CI	Confidence Interval
CIO	Chief Information Officer
CPU	Central Processing Unit
CRM	Customer Relationship Management
CSA	Cloud Security Alliance
CSP	Cloud Service Provider
CSS	Cascading Style Sheet
DDOS	Distributed Denial of Service
ERP	Enterprise Resource Planning
FBI	Federal Bureau of Investigation
FMA	Financial Management and Accountability
FTP	File Transfer Protocol
HaaS	Hardware as a Service
HPC	High Performance Computation
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol

IaaS	Infrastructure as a Service
ICT	Information and Communications Technology
IDC	International Data Corporation
IP	Internet Protocol
IS	Information Systems
ISP	Internet Service Provider
IT	Information Technology
LEA	Law Enforcement Agency
LNP	Liberal National Party
LTE	Long-Term Evolution
NBN	National Broadband Network
NIST	National Institute of Standards and Technology
NSW	New South Wales
NT	North Territory
OAIC	Office of the Australian Information Commissioner
OPEX	Operational Expense
OR	Odds Ratio
OS	Operating Systems
PaaS	Platform as a Service
PDA	Personal Digital Assistant
PC	Personal Computer
QLD	Queensland
QoS	Quality of Service
R & D	Research and Development
RSS	Rich Site Summary
SA	South Australia
SaaS	Software as a Service
SAP	Systems, Applications & Products
SD	Standard Deviation
SLA	Service Level Agreement
SOA	Service Oriented Architecture

SRIA	Strategic Research & Innovation Agenda
SRQ	Subsidiary Research Question
TAS	Tasmania
TCP	Transport Control Protocol
URL	Uniform Resource Locator
VIC	Victoria
VLAN	Virtual Local Area Network
VM	Virtual Machine
VMM	Virtual Machine Monitor
VPN	Virtual Private Network
WA	Western Australia
XHTML	Extensible Hypertext Markup Language
XML	Extensible Markup Language

Abstract

The dream that Computing could become a fifth utility (in addition to Water, Gas, Electricity and Telephony) has been addressed by means of a variety of computing paradigms, including Grid Computing and Utility Computing and, most recently, Cloud Computing (CC). This phenomenon is defined in a number of ways, but the most comprehensive and widely-accepted definition was produced by the National Institute of Standards and Technology (NIST), which identifies CC as: "*a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*".

CC has rapidly developed and grown in popularity since 2007, to become a very fashionable topic. It has had a significant impact on the IT industry over the past 7 years causing fundamental changes to the way in which IT resources are utilised and has led to the creation of a wide variety of new business models, while garnering interest from both public and private sectors in Australia and in other countries.

According to industrial surveys conducted between 2010 and 2013, Australian organisations have been leaders in the adoption of CC in the Asia-Pacific region. Full access to the findings of these surveys is very expensive, although summary results can be found in IT industry literature. The figures for CC adoption in Australia vary across a number of these surveys, making it difficult to ascertain the level of CC uptake with any confidence – thereby suggesting a need for a soundly-based academic investigation of Australian CC adoption. In addition, none of these industry surveys makes use of any theoretical underpinning or of any models of CC, adding further to the demand for a sound, theoretically-based and unbiased study of the acceptance and use of the CC innovation, as well as its evolution within and across Australian organisations. Moreover, knowledge of the nature and progress of this innovation would add to the understanding of both its opportunities, as well as of the challenges and issues surrounding CC. While widespread adoption of CC seems to be a foregone conclusion, its diffusion rate and adoption methods by the wide variety of organisations around the globe which are looking to CC for solutions to a host of problems are not yet fully understood. This research project, therefore, aims to build a broad picture of the existing state of CC in Australian organisations by investigating the nature, role and diffusion of CC innovation and the changes which have occurred over time.

The project takes the form of a longitudinal study, composed of two ‘snapshots’ of Australia’s CC usage and using an online questionnaire in each of 2012 and 2013 (i.e. 16 months apart) based on the extant academic and industry literature. The target group for both surveys was the CIO’s of Australian organisations or their equivalents (i.e. IT Manager, Technical Support Manager and Network Manager) as these respondents were expected to be most capable of providing accurate responses and conversant of the current status of CC adoption in their organisations.

This study classified respondents into categories according to their status and attitude to adopting CC (past, current, future and non-adopters). Respondents were then analysed on the basis of company location, size and industry sector to enable a richer understanding of the decision to adopt (or not to adopt) CC. Changes over time were then analysed on two dimensions: firstly *within each category* of respondents and then *within each survey* to enable a fuller understanding of how CC adoption was progressing over time. The findings were also compared against Rogers’ Diffusion of Innovation Theory and Moore’s Crossing the Chasm Theory, which provided an opportunity to compare the diffusion of the CC innovation in Australia against archetypal diffusion theory. These theories highlighted *the acceptance* (adoption or rejection) and *the use* of the CC innovation, as well as its *evolution* across and within Australian organisations.

This study observed a smooth transition between the Early and Late Majority stages of CC adoption in Australia. Over the 16 month period of the study, there was 10% growth in CC adoption to the end of 2013: from 47.9% to 57.9%. Findings suggest that CC uptake will continue to grow as indicated by the Future Adopters who formed 15.2% of the respondents in 2013. Although the adoption pattern of CC in Australia is following the classic Diffusion of Innovation Theory, adoption will never reach 100%, not just because of resistors (Definite Non-Adopters) but also due to those organisations which adopted CC but later rejected it (Past Adopters). In Future Work, a number of additional projects are suggested to complement this study and extend its reach.

Declaration of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

Date: 2nd November, 2015

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This thesis is not to be made available for loan or copying for three years following the date this statement was signed. Following that time the thesis may be made available for loan and limited copying and communication in accordance with the Copyright Act 1968.

Date: 2nd November, 2015

Statement of Ethical Conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University.

Date: 2nd November, 2015

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[1] Translated statement of Prophet Muhammad (Peace and Blessings of Allaah be Upon him).

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Dedication

This thesis is dedicated to my parents (Abdullah and Moneerah), wife (Dareen - the hidden soldier) and children (Jenan, Hoor and Abdullah) who have being with me throughout my studies. You have been of tremendous motivation and inspiration to me. I ask Allaah to reward you abundantly.

Chapter 1
Introduction

1. Introduction

1.1 Background

The dream of providing Computing as a fifth utility (in addition to Water, Gas, Electricity and Telephony) has been addressed via a variety of different computing paradigms, including Grid Computing and Utility Computing and, most recently, in Cloud Computing (Armbrust et al., 2009, Buyya et al., 2009, Keshavarzi et al., 2013). Cloud Computing (CC) is also regarded as the 5th computing generation after Mainframe, Personal Computer (PC), Client-Server and Web (Fasihuddin et al., 2012, Rajan and Jairath, 2011, Padhy and Patra, 2012).

CC is a means of readily sharing and utilising Information Technology (IT) resources (Linthicum, 2010a, Hooper et al., 2013, Murah, 2012, Padhy and Patra, 2012) and is considered by many authors (see, for example: Durkee, 2010, Mullender, 2012, Cusumano, 2010, Elham et al., 2012) to be an extension of the concept known in the 1970's as "time-sharing". However, CC's features for accessing resources remotely and having the ability to make use of multiple on-demand services from a variety of providers offer a genuine difference over earlier forms of shared storage and processing (Linthicum, 2010a, Srinivasan and Getov, 2011, Motta et al., 2012, Baghdadi, 2013). CC also differs from earlier equivalents by building on techniques such as grid computing, distributed systems and parallel programming (O'Driscoll et al., 2013, Padhy and Patra, 2012, Mikkilineni and Sarathy, 2009).

CC is considered a new phenomenon and is certainly one of the most widely-discussed topics in IT at present (Litchfield and Althouse, 2014, Wattal and Kumar, 2014, Cowan, 2015a, ExpertON, 2015), although an early attempt to formulate CC was made by Chellappa in 1997 (Mei et al., 2008) some ten years before the term 'Cloud Computing' was coined in 2007 (Google Trends, 2011, Motta et al., 2012, Wang et al., 2008). CC has developed and grown in popularity rapidly (Motta et al., 2012, Google Trends, 2011, Xiaoqi, 2012, Avram, 2014) to become a very fashionable topic since 2007 (Google Trends, 2011, Motta et al., 2012, Wang et al., 2008). Figure 1.1 shows that the term CC first appeared in the media in the first quarter of 2007. By the third quarter of that year the term had started to gain wide interest, with the volume of news and, particularly, searches for the term increasing rapidly (Google Trends, 2011).

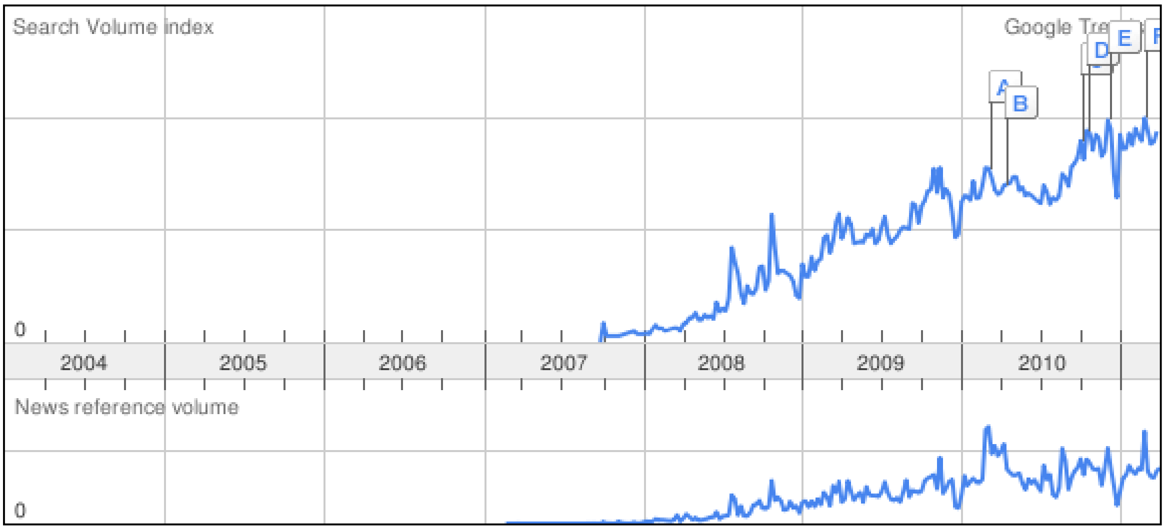


Figure 1.1: The origin of the term CC (Google Trends, 2011)

According to a recent International Data Corporation (IDC) survey, "*global first-quarter sales of cloud-related hardware rose 25.1 percent year on year*" (Hornyak, 2015). News Corp CIO Tom Quinn indicated that 76% of his company's systems are now in the cloud (Crozier, 2015). According to Quinn, this move led to a dramatically different operational model which, in turn, caused a loss of IT staff, since only about half the existing staff were ready and capable for this strategic change (Crozier, 2015).

CC has also gained wide interest from both public and private sectors in Australia, as well as from overseas. A major milestone in the implementation of Australian Government CC Policy occurred in February 2015, when the federal Department of

Finance released a list of 49 Cloud Service Providers (CSPs) forming the ‘cloud panel’ from which government agencies must select their preferred CSP (Cowan, 2015b, Tomlinson, 2015).

According to multiple industry surveys conducted in 2010, 2011, 2012 and 2013 Australian organisations have constantly been at the forefront of CC adoption in the Asia-Pacific region (Banks, 2011, Huang, 2013, VMware, 2012, Budmar, 2013), although the proportions of CC adoption in Australia vary among these surveys. For example, IDC found that 71% of Australian organisations had adopted CC by 2012 (Barwick, 2013a), while VMware found only 54% had adopted it by that same year (VMware, 2012).

It is important that possible issues associated with CC, such as the potential impact of CSP downtime (or failure), be taken into account before the decision to adopt CC is made. Fujitsu’s Perth data centre, for example, suffered a power outage after fierce thunderstorms in Feb 2015 (Coyne, 2015) which affected their major clients such as WA Health Department and BankWest. BankWest, in fact, lost its Automated Teller Machine (ATM) network for 12 hours (Coyne, 2015), showing just how risky CC can be for firms which have not fully protected themselves against loss of service. Like many other high-tech innovations, CC has both opportunity and risk for adopting organisations – but how well understood is Australian acceptance and usage of CC?

1.2 Significance and Application of the Research

CC offers a significant and important new approach to obtaining business value from IT investments. Knowledge of the nature and progress of this innovation would add to the understanding of both its opportunities, as well as of the challenges and issues surrounding CC. While widespread adoption of CC seems to be a foregone conclusion, its diffusion rate and adoption methods by the wide variety of organisations around the globe which are looking to CC for solutions to a host of problems are not yet fully understood.

There are, of course, a number of surveys concerning CC uptake and usage which have been conducted since its emergence by a range of commercial consultants – not infrequently undertaken to highlight some aspect of CC associated with their own product or service offering, which can limit their general usefulness. Even allowing for the limited applicability of these industry surveys, access to their results is usually extremely costly, though summaries of the findings from these surveys are generally announced publicly, or can be found in the commercial literature, as shown in Table 1.1.

Redshift Research (2011) conducted 1513 interviews with organisations having more than 100 employees in both the public and private sectors in the United States, Asia (China, India and Singapore) and Europe (UK, France and Germany). Although Australia and other countries were not involved in that study, the results of that survey showed that 37% of organisations globally were deploying cloud solutions with only 3% rejecting the move to the cloud (Redshift Research, 2011). This survey indicated that smaller organisations with fewer than 500 employees were adopting CC to a greater extent than bigger organisations – perhaps because these firms were not able to afford licences to purchase significant enterprise-wide software solutions such as SAP (Systems, Applications & Products), but could afford to rent access to them via Software as a Service (SaaS). This assumption is consistent with the additional finding that private sector respondents were using CC more enthusiastically than those from the public sector, for whom software solution costs might well have been less relevant. From a strategic point of view, 46% of respondents to the Redshift survey indicated that adopting CC formed a strategic direction in IT policy for the business, while 35% considered it a tactical move to solve a particular need and a further 19% saw CC as a necessity to reduce costs (Redshift Research, 2011).

Table 1.1: CC surveys announced publicly prior to this study

Date	Title	Conducted by	Number of Participants	Target Group	Scope
Apr 2010	2010 ISACA IT Risk/Reward Barometer – Latin America Edition	ISACA	433	Business and IT professionals in Latin America who are members of ISACA	IT Risk Management and CC (ISACA, 2010)
Nov 2010	2011 Cloud Computing Survey	CIO magazine	451	CIO's audience who influenced the cloud computing purchase process	Scale the adoption level, prioritise the benefits of CC (CIO magazine, 2010)
Nov 2010	The Arrival of "Cloud Thinking"	Lee Black, Jack Mandelbaum, Indira Grover, Yousuf Marvi Management Insight Technologies	434	IT professionals in North America and Europe	Understand their perceptions and plans for cloud computing (Black et al., 2010)
Apr 2011	Discrete Manufacturing Cloud Computing Survey 2011	Microsoft	152	IT and business decision makers in automotive, high-tech & electronics / industrial machinery manufacturers and related companies in USA, France and Germany.	Current stage of adoption of CC (Microsoft, 2011)
Apr 2011	A Pulse on Virtualization & Cloud Computing	For Quest Software by Norwich University School of Graduate and Continuing Studies	646	Government and higher education IT management professionals in US	Gauge perceptions of virtualization and CC among federal, state and local govt, and higher education (Norwich University, 2011)

Jun 2011	2011 Cloud Computing Outlook	BITNAMI, Cloud.com & Zenoss	521	Sponsors' communities who are users of enterprise IT software	CC usage trends (Bitnami et al., 2011)
Jun 2011	Adoption, Approaches & Attitudes The Future of Cloud Computing in the Public and Private Sectors	Redshift Research Sponsored by AMD	1513 interviews	Organisations with 100+ employees in public/private sectors in USA, Asia and Europe	Evaluate the percentage deploying cloud solutions, business value achieved and applications most suited for cloud environments (Redshift Research, 2011)
Jan 2012	2012 Cloud Computing Key Trends and Future Effects	IDG Enterprise	1682	Audience of CIO, Computer World, CSO, Network World, Info World and IT World websites	Measure CC trends and effects (IDG Enterprise, 2012)
Feb 2012	LogLogic Big Data and Cloud Survey	Loglogic and Echelon One	207	Directors or above across multiple industries	Management of Log data and deployment of CC (Echelon One and Loglogic, 2012)
Feb 2012	2012 State of Cloud Computing	Information Week	511	Qualified InformationWeek subscribers (IT professionals) at organisations with 50 or more employees in North America	State of CC (Information Week, 2012)

Other industry surveys undertaken at around the same time turned up some interesting findings: SaaS was the top CC investment priority in the cloud ahead of all other services for 62% of respondents to a CIO magazine survey (CIO magazine, 2010); private clouds were preferred by 51% of North American and European organisations, while 34% of respondents to the same Management Insight Technologies survey preferred public cloud access (Black et al., 2010). In terms of government cloud policy, the Redshift survey indicated that 32% of government policies worldwide were accelerating CC adoption – while 12% were slowing it down (Redshift Research, 2011)! And a rather troubling finding from a survey undertaken by Norwich University for Quest Software in 2011 was that approximately half of all Cloud Adopters at that time had no 'exit strategy' from CC (2011). CC, it seemed from this disparate set of announced findings, was in something of a state of flux at the start of 2012!

In terms of its specific issues, security was seen as the major challenge preventing organisations from implementing CC, according to a range of industry surveys (IDG Enterprise, 2012, Black et al., 2010, Bitnami et al., 2011, Information Week, 2012). On the other side of the equation, the most significant benefit from CC was seen as reducing the cost of optimising infrastructure, followed by efficient collaboration across countries (Microsoft, 2011), though calculating the anticipated long-term savings from CC was still seen as a challenge (IDG Enterprise, 2012). As with overall views of CC, specific strengths and weaknesses of the cloud did not seem to be fully understood at the end of 2011 – though it is possible that the somewhat narrow focus of many of these surveys may have given a misleading picture of overall corporate understanding of the cloud phenomenon.

Just as this thesis was being finalised, the first government survey of Australian CC usage was released on 16th July 2015 (Cowan, 2015a, Chanthadavong, 2015). According to this Australian Bureau of Statistics (2015a) (ABS) survey, 19% of 6640 Australian organisations adopted CC for the first time in the 2013-14 financial year (the Australian tax year runs from 1 July to 30 June). This wide-ranging survey showed that the media and telecommunications sectors were the most active adopters during this period.

Somewhat unexpectedly – but very encouragingly – 59% of respondents indicated “no factors” limited or prevented their use of CC. Although insufficient knowledge was the common CC concern factor identified (22%-24%) by organisations of all sizes, security breach was the top concern for 30%, of organisations having more than 200 employees. High cost of CC services and uncertainty regarding data location were the next two most cited concerns, with 20% and 19% respectively. On the plus side, simplicity of CC was the most tangible benefit, followed by increase in productivity, then cost reduction and flexibility. This survey also indicated that SaaS was the most widely-used CC service delivery model for all organisation sizes. The ABS survey has provided considerable additional information concerning Australian organisations’ adoption of CC, but this first investigation is (not surprisingly) somewhat limited. It will, however, provide a very useful benchmark for all future studies of Australian CC uptake.

The present study was designed to fill a gap in the understanding of the adoption and acceptance of CC by organisations of all types, sizes and from all sectors. The time and financial constraints of a PhD project necessitated a focus on a single country and against the background that Australia is considered the leading country in the Asia-Pacific region in terms of CC adoption (Banks, 2011, Huang, 2013, VMware, 2012, Budmar, 2013, Barwick, 2013a), the decision to study the diffusion of the CC innovation in Australia seemed a logical one.

The industry surveys already cited and summarised above, indicated widely varying levels of CC acceptance by organisations in both Australia and overseas. None of these surveys, however, are academic in that, none has studied the phenomenon in depth, none of them made use of any theoretical underpinning and none of them made use of a model of CC – as the present study did. It is therefore important that the acceptance and use of CC innovation, as well as its evolution within and across Australian organisations, be investigated. More than 500 variables were analysed in this thesis and, while this huge variable number was a significant challenge, it was crucial to ensure this first academic investigation of CC would be both broadly-based and wide-ranging.

1.3 Research Questions

The overall research objective of this project was to build a broad picture of the existing state of CC in Australian organisations and study changes in uptake and usage overtime. Specific aims were focused on an investigation of the nature, role and diffusion of CC ideas and realities within Australian organisations between 2012 and 2013. The project explored the current situation of CC in Australian organisations, comparing and contrasting this with the same position 16 months later.

1.3.1 Overarching Research Question

What is the nature and character of CC use and diffusion within Australian organisations: (a longitudinal analysis 2012-2013)?

1.3.2 Subsidiary Research Questions (SRQs)

SRQ1: What is the overall understanding of the role and nature of CC?

SRQ2: What is the current view of the pattern of diffusion of CC by organisations and market sectors?

SRQ3: What is the role and nature of CC in contemporary Australian organisations?

SRQ4: What is the nature and character of the diffusion of CC in contemporary Australia?

a) Across organisations (i.e. from one organisation to another)

b) Within organisations

SRQ5: How have Australian organisations' views on the role and nature of CC changed over the period of the study?

SRQ6: How has the nature and character of the diffusion of CC in Australian organisations changed over the period of the study?

1.4 Research Methodology

The research aimed to provide an accurate and contemporary description of CC in Australia. Thus, generalisability was needed to measure and explore the diffusion of CC around Australia. Consequently, a quantitative approach was selected for this study to enhance the understanding of the acceptance and evolution of CC within and across Australian organisations.

The research design of this research, as a longitudinal study, included two 'snapshots' of the situation of CC in Australia using two surveys – one in 2012 and one in 2013 (16 months apart). Both surveys were conducted online and made use of a questionnaire as the data gathering technique. A comparison was then made between the two snapshots to investigate the changes occurring over the given time interval. Descriptive statistics and repeated measures regression analysis were used as the data analysis techniques to provide an overview and articulate statistically significant differences within and between the two surveys of this study.

Rogers' theory of diffusion of innovations was applied to the study in conjunction with Moore's 'Crossing the Chasm' theory to highlight *the acceptance* (adoption or rejection) and *the use* of CC innovation as well as its *evolution* across and within Australian organisations.

1.5 Outline of the Thesis

This thesis consists of six chapters as described below:

- *Chapter 1* provides an overview for this research project including, background, significance and application of the research and provides a list of all research questions.

- *Chapter 2* reviews the existing literature of CC including: enabling technologies, advantages, disadvantages, service delivery models, deployment models, adoption in Australia, actions of Australian Government; and CSPs and their impacts.

- *Chapter 3* explains and justifies the research methodology, the underpinning theories, data gathering technique, data analysis techniques, research design and survey questions.

- *Chapter 4* provides a comparison between the two surveys and highlights the changes that have occurred for each category of participants.

- *Chapter 5* explores and discusses the differences between the respondent categories for each survey, before applying Diffusion of Innovation Theory and Crossing the Chasm Theory to the findings of both surveys.

- *Chapter 6* summarises the findings, provides an explicit summarised answer to each of the subsidiary research questions, highlights the contributions and limitations of this study; and proposes future research work.

Chapter 2
Literature Review

2. Literature Review

2.1. Introduction

CC has had a significant impact on the IT industry over the past 7 years (Padhy and Patra, 2012, Mikkilineni and Sarathy, 2009, Baghdadi, 2013) causing fundamental changes to the way in which IT resources are utilised (Motta et al., 2012, InfoWorld, 2009, Guptill and McNee, 2008, Creeger, 2009) and creating a variety of new business models (Abah and Francisca, 2012, Baghdadi, 2013, Motta et al., 2012, Rimal et al., 2011). This represents a substantial transformation in the provision of IT services and includes, for example: multi-device access, on-demand self-service, multi-tenancy, pay per use and scalability of services (Srinivasan and Getov, 2011, Abah and Francisca, 2012, Hunter, 2009, Creeger, 2009).

The changes brought about by CC are sweeping in their significance, since demand for space and capacity – the "thirst for information" – continues to grow at almost frightening speed (Padhy and Patra, 2012, Mikkilineni and Sarathy, 2009, Baghdadi, 2013, Foo, 2010a). Incredibly, the volume of data generated in the past two years now accounts for almost 90% of the world's data and 90% of this total is unstructured, raw data (Gang-Hoon et al., 2014). Floridi (cited in Portmess and Tower, 2014) claims that the explosion of data is growing by around five trillion bits per second! This massive amount of structured or unstructured digital data, collected from a wide variety of sources, is known as Big Data (Gang-Hoon et al., 2014, Portmess and Tower, 2014) – a term whose origin is obscure but which can perhaps most realistically be linked with John Mashey, chief scientist of Silicon Graphics during the 1990s (Lohr, 2013). The relationship between CC and Big Data will be described in Section 2.2.1.

The primary objective of CC is to provide fast and secure on-demand services or applications over the Internet to support large numbers of users and services / applications (Linthicum, 2010a, Hayes, 2008, Motta et al., 2012, MacVittie, 2008). Such services include the provision of computer storage, computing processing power, network bandwidth, security, testing, software development environments and the availability of applications, ranging from simple utilities like e-mail through to integrated enterprise-wide systems and other services which are provided dynamically via the Internet (Banerjee et al., 2012, Avram, 2014). Initial offerings and implementations began with large high-tech corporations, which were already making significant use of data storage such as Amazon, Google, IBM and Microsoft (among others) announcing CC initiatives (Guha and Al-Dabass, 2010, Taylor, 2010, Amazon Web Services Inc., 2012, Zhang et al., 2012a).

Economics and simplicity of software operation and delivery are generally believed to be the main drivers of CC (Erdogmu, 2009). The idea is that subscribers to such services do not have to purchase and manage IT infrastructure and software; and only pay for what they use. Such offers of IT services should be particularly relevant to organisations which have difficulty building IT infrastructure or which lack internal IT expertise (Jain and Gupta, 2012, Sultan and van de Bunt-Kokhuis, 2012). Organisations can exploit the substantial IT infrastructure of CC vendors without implementing and administering this themselves, saving both money and time (Linthicum, 2010a, Wattal and Kumar, 2014, Banerjee et al., 2012, Schadt et al., 2010). Where organisations find themselves lacking in high-quality contemporary IT infrastructure and in IT expertise, it might well make sense to consider sourcing these resources over the Internet – for any organisation needing additional or updated IT resources, it may be both easier and more efficient to use the CC option (Linthicum, 2010a, Greengard, 2010, Foo, 2010b). Therefore, CC can be considered a tool which enables an organisation to be more productive and cost effective (Linthicum, 2010a, Foo, 2010b).

Despite all these potential CC benefits and other advantages (which will be discussed in Section 2.4), there are a number of concerns associated with CC, including lack of trust with CSPs (Rimal et al., 2011, Damshenas et al., 2012), performance problems

(Linthicum, 2010a, Sarathy et al., 2010, Motta et al., 2012, Erdogmu, 2009), development problems (Čapek, 2012, O'Driscoll et al., 2013, Rimal et al., 2011, Linthicum, 2010a), immaturity of technology (Motta et al., 2012, Damshenas et al., 2012, Rimal et al., 2011, Dearne, 2011), legal problems (Motta et al., 2012, Srinivasan and Getov, 2011, Hooper et al., 2013, Xiaoqi, 2012); as well as organisational and cultural problems (Sultan and van de Bunt-Kokhuis, 2012, Metzler et al., 2011, Harding and Open Group, 2011). All of these disadvantages will be discussed in Section 2.5.

In addition to the advantages and disadvantages of CC, this chapter will be looking at other details of literature relating to CC such as big data, enabling technologies and techniques, infrastructure properties, service delivery models, deployment models, cloud systems, security and privacy issues, adoption of CC in Australia and CC activities of Australian Government and CSPs while the theoretical underpinning and empirical work will be covered in the next chapter (Research Methodology).

2.2. Path to the Cloud

Linthicum (2010b) suspected that the next model of the Internet bubble would be: "*you start, you build, and you sell*" driven by interest in CC. Kepes (2011) believed CC to be a rapid IT revolution which would become the standard means for IT delivery. This kind of IT delivery was enabled by a variety of technologies and techniques and relies on specific infrastructure properties which will be discussed in the following sub-sections, following a review of the emergence of Big Data and its relationship with CC.

2.2.1. Big Data

The most commonly accepted definition of Big Data is that identified by Gartner: *"…high-<u>volume</u>, high-<u>velocity</u> and/or high-<u>variety</u> information assets that demand cost-effective, innovative forms of information processing for enhanced insight, decision making, and process optimization"* (Australian Government Information Management Office, 2013a). This is known as the "three Vs", although the 'veracity' and 'volatility' (reliability and sensitivity) of the data are often added to form the 'five Vs' of Big Data (Australian Government Information Management Office, 2013a).

As already noted, the volume of digital data is increasing exponentially (Munne, 2013). For example, the data stored in Amazon Web Services' S3 cloud increased from 262 billion objects to 1 trillion objects between 2010 and mid-2012 alone (Aspera, 2014), while the Australian Government stored 93,000 terabytes of data between 2008 and 2012 (Australian Government Information Management Office, 2013a). Organisations have moved beyond merely storing Big Data to addressing ways of deriving meaningful interpretations from this mountain of information that could benefit their activities (Gang-Hoon et al., 2014, Intel IT Center, 2013).

Many industry sectors are making use of Big Data including: finance, health care, media, telecommunications, manufacturing – and the public sector (Munne, 2013), where the concept is so critical that the Big Data Research and Development Initiative was announced by the U.S. government in 2012 (Portmess and Tower, 2014), while the European Commission's Strategic Research & Innovation Agenda (SRIA) on Big Data Value for Europe will provide input to the Public/Private Partnership on Big Data (European Data Forum, 2014, DG Connect, 2014).

Closer to home, the Australian Government Information Management Office (AGIMO), a part of the federal government Department of Finance, formulated a Big Data Strategy in 2013 and considers data belonging to Australian Government agencies a national government asset (Australian Government Information Management Office, 2013a). Many national governments, including South Korea, Japan, Singapore, the U.K., Australia, the U.S. and a significant number of European nations are currently involved in initiatives to build Big Data applications (Gang-Hoon et al., 2014).

Big Data applications have the potential to greatly enhance productivity by improving computer processing performance (Munne, 2013). Innovation gains and substantial productivity improvements are anticipated benefits of Big Data analytics which provide evidence and "real-time" insights to make better decisions for management, optimisation of operations, development of new business models and mitigations of financial and other risks that lead to increased innovation and productivity (Australian Government Information Management Office, 2013a).

More applications, however, lead to more data which, in turn, leads to a need for more storage and computation (Zhang, 2012). Although Big Data technologies have been developed to assist in solving this problem the apparently endless spiral of data creation remains. Scalability and cost effective data storage, then, is the major benefit CC offers to Big Data (O'Driscoll et al., 2013, Zhang, 2012). In addition to its ability to manage data storage, CC also supports advanced analytic applications such as data mining, statistical analysis and machine learning processes for Big Data (O'Driscoll et al., 2013, Intel IT Center, 2013). A survey conducted recently by GigaSpaces shows that 80% of IT executives who indicated processing of Big Data was important are considering the use of one or more cloud delivery models for Big Data analytics (Intel IT Center, 2013).

Big Data applications are dependent on speed of processing and analysis if reliable conclusions are to be obtained (O'Driscoll et al., 2013). Yet transmitting Big Data over the Internet is a significant challenge, since the transfer of large quantities of data (and the quantities involved in Big Data can be very large indeed!) into and out of the cloud is becoming a significant limitation on CC's ability to support Big Data applications – indeed, some organisations are now actually sending disks manually to their CSPs (O'Driscoll et al., 2013, Schadt et al., 2010), which is a somewhat retrograde step. This bottleneck is already leading to attempts to invent new high-speed transmission solutions (Aspera, 2014, Wallace and Kambouris, 2014). For example, some CSPs are trying to overcome this issue by designing a new layer over the Transport Control Protocol (TCP) so as to increase the transmission speed of traditional Hypertext Transfer Protocol (HTTP) / File Transfer Protocol (FTP) by 10 to 100 times (O'Driscoll et al., 2013).

Other challenges of combining Big Data with CC include: security, privacy, complexity, (Gang-Hoon et al., 2014, Australian Government Information Management Office, 2013a, Miller, 2013) data quality, data integration and vendor risk (Miller, 2013). Litchfield and Althouse (2014) sum the situation up neatly: *"Cloud computing challenges have various meanings* [but] *... the fundamental challenges consistently focus on the data theme. Regardless of the application domain, inter-dependencies between big data challenges arise, for example there are relationships between specific* *research domains and the collection of large data sets, the engineering requirements to process and store large volumes of data, and performance and stability issues when managing large numbers of transactions"* (p.17).

It is, therefore, the technological solutions offered by CC which enable the continued evolution of Big Data.

2.2.2. Enabling Technologies and Techniques

CC builds on the foundation of a number of earlier technologies and techniques, such as Grid Computing, Web 2.0, Virtualisation and Service Oriented Architecture (SOA) (Abah and Francisca, 2012, O'Driscoll et al., 2013, Srinivasan and Getov, 2011, Mikkilineni and Sarathy, 2009). The popularity of these enabling technologies as stand-alone tools has decreased since the advent of CC (see Figure 2.1) (Google Trends, 2014b), though their use continues as partner technologies for CC.

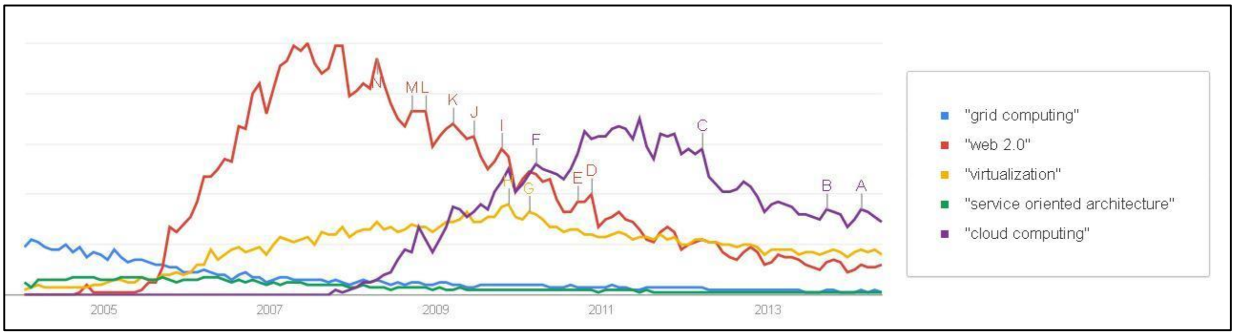


Figure 2.1: CC and its Enabling Technologies (Google Trends, 2014b)

Discussing these technologies and techniques (without going into technical detail) will be helpful to understand the issues surrounding the CC environment, as many of these enabling technologies and techniques are required to adopt CC successfully. This is particularly important if some parts of the cloud need to be implemented inside the organisation of a CC customer, as in on-site Private Cloud (Section 2.3.2.2).

2.2.2.1. Grid Computing

The term Grid was coined in the mid-1990s, to explain the technologies that allow users to acquire computing power on request (Abah and Francisca, 2012, Foster et al., 2008, Rajan and Jairath, 2011). Foster et al wrote the most cited definition of Grid Computing: "*A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities*" (Abah and Francisca, 2012, Keshavarzi et al., 2013). Grid Computing combines distributed and heterogeneous computing resources into a single powerful 'virtual computer' to obtain significant processing power (Keshavarzi et al., 2013). Therefore, Grid Computing, together with a number of other technologies, provides a foundation for CC (Rimal and Choi, 2012, Foster et al., 2008, Abah and Francisca, 2012, Sultan, 2014). Constantly monitoring IT infrastructure and detecting non-responsive components so as to balance the workload among all responsive components is one of the Grid Computing features used in CC (Rimal and Choi, 2012).

2.2.2.2. Web 2.0

The fundamental concept of Web 2.0 is to provide a basis for interactivity and interconnectivity of Web applications (Padhy and Patra, 2012). O'Reilly and Musser, who are credited with promoting the term *Web 2.0* most widely, defined it as *"a set of economic, social, and technology trends that collectively form the basis for the next generation of the Internet – a more mature, distinctive medium characterised by user participation, openness, and network effect"* (Davidson and Keup, 2014). Web 2.0 is, thus, an emerging technology which incorporates a wide variety of technological features, including: CSS (Cascading Style Sheet), Semantic Web, Folksonomies, HTML (Hypertext Markup Language), XML (Extensible Markup Language), XHTML (Extensible Hypertext Markup Language), RSS (Rich Site Summary) and other features to enable information sharing, creativity, Web functionality and collaboration (Wang et al., 2008, Padhy and Patra, 2012, Wang et al., 2010, Ouf et al., 2010).

The authorisation control and management features of Web 2.0 are regarded as critical for CC (Rimal et al., 2011), as Web 2.0 can play an important role in how users interact with CC (Foster et al., 2008) by facilitating subscription, access, compilation; and reuse of micro content, propagation and interactive information sharing (Ouf et al., 2010). Thus, Web 2.0 enables CC users to access the web more easily and efficiently (Wang et al., 2008, Padhy and Patra, 2012, Rimal and Choi, 2012, Wang et al., 2010).

2.2.2.3. Virtualisation

Virtualisation involves partitioning computer hardware to provide a scalable and flexible computing platform (Padhy and Patra, 2012)[2]. It also connects the physical resources dynamically to the various applications which are running on a variety of Operating Systems (OSs) (Guha and Al-Dabass, 2010). Thus, virtualisation insulates computer users from the complexities of IT infrastructure operation (Erdogmu, 2009). With a virtualisation approach to managing IT infrastructure, Virtual Machine (VM) applications such as Xen and VMware can: enable many physical servers to be addressed as one virtual server; distribute the loads between the physical servers; and offer them on demand (Wang et al., 2008, Linthicum, 2010a, Waters, 2009, Padhy and Patra, 2012).

The transition from traditional computing to virtualisation allows multiple OSs to run on a single physical machine (see Figure 2.2) (O'Driscoll et al., 2013, Guha and Al-Dabass, 2010, Padhy and Patra, 2012, Waters, 2009). For example, multiple VMs can be hosted by a single physical machine shared by multiple users to maximise hardware utilisation (O'Driscoll et al., 2013, Guha and Al-Dabass, 2010, Padhy and Patra, 2012). Every VM, which has its own OS and applications, is managed by a virtual layer called the "Hypervisor" or Virtual Machine Monitor (VMM) to control physical hardware resources such as hard disk, memory, Central Processing Unit (CPU) and network connectivity (Banerjee et al., 2012, O'Driscoll et al., 2013).

[2] In fact, there are many types of virtualisation including: network virtualisation which splits available bandwidth into channels; storage virtualisation which pools multiple storage devices into an apparently unique storage device; server virtualisation (discussed above); desktop virtualisation which allows any desktop computer to become a user's own, personalised PC; and application virtualisation, which transforms software applications into centrally-managed services BANAFA, A. 2014. *What is Virtualization* [Online]. LinkedIn. Available: http://www.linkedin.com/today/post/article/20140401073258-246665791-cloud-computing-is-an-evolution-of-virtualization..

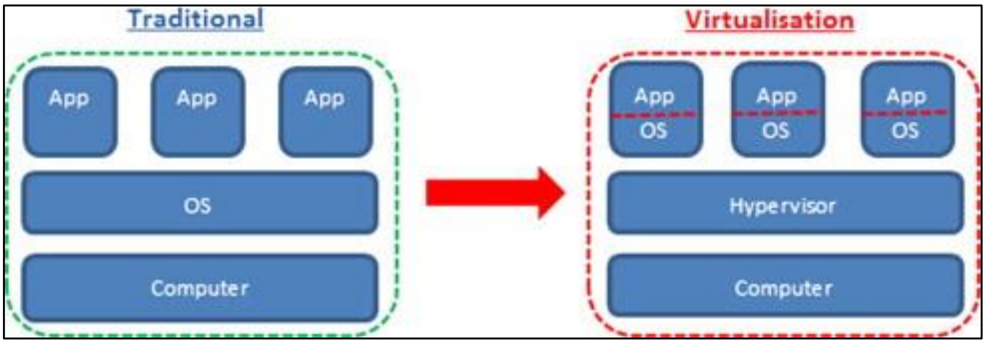


Figure 2.2: Transition from traditional computation to virtualisation (O'Driscoll et al., 2013)

VM techniques provide virtualised IT infrastructure on-demand while advances in virtual networking such as Virtual Private Network (VPN) deliver customisation for network platforms to access external cloud resources safely and effectively (Padhy and Patra, 2012). When VM is used to create and manage flexible Grid systems, performance may be degraded compared with direct use of physical resources – endeavours to improve performance in this situation is a 'hot' research topic (Mancini et al., 2009). Despite possible loss of speed and responsiveness, the complex and stable Grid infrastructure is nonetheless frequently used as a foundation for cloud platforms enabling Grid e-services to manage VMs (Mancini et al., 2009).

Virtualisation supports CC's possibly most well-known feature, multi-tenancy (Abah and Francisca, 2012), by controlling access to the physical resources transparently and enabling users to configure them and act as administrators (Mancini et al., 2009). In addition, virtualisation allows multiple VMs to run their own OS within a single physical server (Hooper et al., 2013). Consequently, virtualisation technology is a primary enabler for CC (Celesti et al., 2010, O'Driscoll et al., 2013, Wang et al., 2008, Padhy and Patra, 2012) because it facilitates and enhances the scalability and flexibility of hardware services on-demand (Padhy and Patra, 2012, Guha and Al-Dabass, 2010, Wang et al., 2008).

2.2.2.4. Service Oriented Architecture

Linthicum (2010a) explains that a process is a sequence of events, each of which leverages one or more services, typically related to the automation of a business process such as preparing and sending an invoice. In identifying which processes are suitable for cloud placement, a model is required to show how processes make use of services, because data and services can usually exist only on a single platform, but processes can bind together services and data between cloud-based and in-house systems. In addition, processes themselves can be inter-platform (both cloud-based and in-house) and can span companies, countries and multiple cloud platforms. Potentially, many services, data and processes can be bound together across many internal systems within many companies and many cloud platforms – using a single process which may be hosted anywhere.

According to Galorath (2009) *"SOA provides methods for systems development and integration where systems group functionality around business processes and package these as interoperable services".* SOA allows data to be transferred between different applications in business processes (Galorath, 2009). In addition, the combination of internal and external services for an organisation creates SOA as a basis for CC (Banerjee et al., 2012, Murah, 2012).

As Linthicum (2014) notes: *"those who leverage cloud computing within the context of an architecture will succeed, while those who just toss things into the clouds will fail … the trick is to determine which services information and processes are good candidates to reside in the clouds, as well as which cloud services should be abstracted within the existing or emerging SOA"*.

Moreover, McKendrick (2011) warned about the absence of service orientation. He stated that "*Not having full-blown SOA isn't necessarily risky in itself when moving to cloud, but the inability to move processes from current interfaces and underlying applications to more agile cloud services could really make a mess of things – and ultimately make cloud more expensive than leaving things as is*".

2.2.3. Infrastructure Properties

Since the primary objective of CC is to provide on-demand services or applications such services must be delivered quickly and securely and must be available at all times to enable them to support a huge number of users and services / applications (Linthicum, 2010a, Baghdadi, 2013, MacVittie, 2008, Murah, 2012). There are thus four key properties needed to build an effective CC infrastructure:

1) Transparency

The complexities of actual IT infrastructure use in application systems operations are hidden from the computer user (MacVittie, 2008). Computing resources must also be arranged so that providers can, again without users being aware, add more computer resources to the cloud without interrupting the provision of services (Mikkilineni and Sarathy, 2009, MacVittie, 2008, Pandey et al., 2010, Rimal and Choi, 2012).

2) Scalability

Since CC delivers on-demand services / applications, it needs real-time scaling in order to manage the infrastructure resources efficiently (Fasihuddin et al., 2012, MacVittie, 2008, Mikkilineni and Sarathy, 2009, Jain and Gupta, 2012). These resources have to be integrated and virtualised so as to be provisioned / de-provisioned easily, quickly and automatically (Celesti et al., 2010, Ouf et al., 2010, MacVittie, 2008).

3) Monitoring

CC services management requires, among other things, an intelligent monitoring system. Such a system needs to know when a particular infrastructure, service or application is out of order or performing poorly (Motta et al., 2012, MacVittie, 2008, Rimal and Choi, 2012, Banerjee et al., 2012). In addition, this system has to be able to take action to achieve required transparency and scalability by balancing the load among responsive components (MacVittie, 2008, Rimal and Choi, 2012).

4) Security

The security of all services, applications and infrastructure must be highly prioritised at the design stage, because if any of these are potentially compromised all associated data will be at risk (MacVittie, 2008). Therefore, all components must be protected by securing the protocol, network, application and transport layers to avoid any threats and increase trust with clients (Mikkilineni and Sarathy, 2009, MacVittie, 2008, Rimal and Choi, 2012).

2.3. Analysis of Cloud Computing

CC is, thus, a way of adding capability or increasing a firm's capacity without purchasing new infrastructure, licensing additional software, or training new employees (Knorr and Gruman, 2010, Linthicum, 2010a). CC utilises a pay-per-use service which is a quite different approach to charging from the 'traditional' approach of purchasing hardware or software in advance (Knorr and Gruman, 2010, Linthicum, 2010a). It involves outsourcing IT work by transferring computing tasks to cloud computers which return results (Gozzi, 2010).

A search for characterisation of the CC phenomenon turned up more than 40 separate definitions of CC, of which the most comprehensive and widely-accepted definition and adopted by Australian Government is that produced by the National Institute of Standards and Technology (NIST) (Fasihuddin et al., 2012, Linthicum, 2010a, O'Driscoll et al., 2013, Department of Finance, 2014b).

NIST defines CC as "*a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*". According to this definition, CC has the following five characteristics:

1) **On-demand self-service:** users are able to register and receive automatically and immediately services that were not available through conventional IT (Jain and Gupta, 2012, Celar et al., 2011, Abah and Francisca, 2012, Ferreira and Moreira, 2012).

2) **Broad network access / Multi-device access:** users are able to access the chosen service via a wide variety of internet-connected devices including: desktop, laptop, tablet, smartphone or other devices (Motta et al., 2012, Divakarla and Kumari, 2010, JB, 2009, Orfano, 2009).

3) **Resource pooling / Multi-tenancy:** multiple clients can share the same virtual and physical resources without awareness of one another's presence (Kepes, 2011, Fasihuddin et al., 2012, Abah and Francisca, 2012, Motta et al., 2012).

4) **Rapid elasticity / Scalability:** users are able to scale the scope of their required service up or down, using more or less of the service/s available, according to their need, automatically and immediately (Jain and Gupta, 2012, Celar et al., 2011, Ferreira and Moreira, 2012, Divakarla and Kumari, 2010).

5) **Measured Service / Pay-per-Use:** bills can be issued according to usage of resources, measured and delivered as a utility service, since CC can optimise and control the provisioned resources automatically (Fasihuddin et al., 2012, Abah and Francisca, 2012, Jain and Gupta, 2012, Motta et al., 2012). CC is thus an Operational Expense (OPEX), rather than a Capital Expense (CAPEX) (Kepes, 2011).

2.3.1. Service Delivery Models

CC makes use of three fundamental, widely-accepted service delivery models: SaaS; Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Kepes, 2011, Damshenas et al., 2012, Xiaoqi, 2012). These service delivery models are offered at different resource layers which mimic the functions of physical hardware, OSs or applications (Padhy and Patra, 2012).

In addition to these fundamental service models, many CSPs are also expanding the service delivery models they offer (Srinivasan and Getov, 2011). Additional models include (among a number of others): Monitoring as a Service (MaaS), Communication as a Service (CaaS), Desktop as a Service (DaaS) and Security as a Service (SECaaS) (Xiaoqi, 2012, Tripathi, 2013). Figure 2.3 illustrates the CC service architecture and how these models are related to one another.

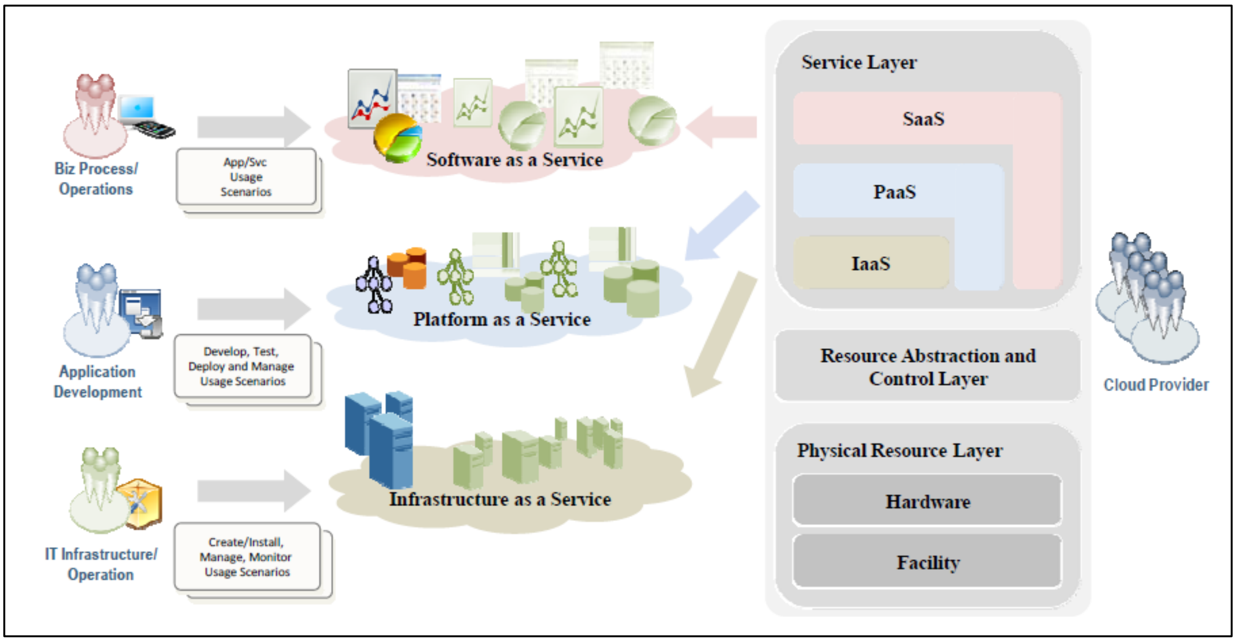


Figure 2.3: Service Orchestration (Hogan et al., 2011)

On the right hand side of Figure 2.3, which is the CSP side, there are three layers. The bottom layer is the Physical Resource Layer which involves hardware such as servers, routers, switches and firewalls; and facility that is the physical plant of datacentre (Hogan et al., 2011, Banerjee et al., 2012). The middle layer is Resource Abstraction and Control Layer such as hypervisor which enables virtualisation and control the physical hardware resources (i.e. hard disk, memory, CPU and network connectivity) (Hogan et al., 2011, Banerjee et al., 2012, O'Driscoll et al., 2013). The top layer, which is the service layer, involves the following three main service delivery models:

2.3.1.1. Infrastructure as a Service

IaaS or Hardware as a Service (HaaS) is really datacentre-as-a-service, or the ability to access hardware and systems software computing resources remotely. IaaS involves all the hardware and software that power the servers, networks, OSs and storage (see Figure 2.3) (Kepes, 2011). Thus, IaaS enable organisations to create their VM and determine OS and, in some cases, their required applications (Padhy and Patra, 2012, O'Driscoll et al., 2013). Additionally, IaaS users can directly access and configure bandwidth, storage space processing and other computing resources which enable clients to run their systems on the cloud infrastructure (Xiaoqi, 2012, Padhy and Patra, 2012, Hooper et al., 2013). The primary advantage of IaaS is to enable an organisation to access very expensive data centre resources, which are managed by the CC provider through a rental arrangement, thus preserving capital for the client's business.

IaaS is recommended when: demand for infrastructure fluctuates significantly; the potential client organisation is new and has not invested significantly in infrastructure; scaling infrastructure is problematic because of rapid growth in the potential client organisation; there is a pressure in the potential client organisation to move to operating expenses and reduce CAPEXs; or when temporary infrastructure is needed by the potential client organisation (Kepes, 2011).

Although IaaS customers can have control over the underlying infrastructure (Xiaoqi, 2012), IaaS is not recommend when an organisation's regulations regarding storing and processing data offshore are difficult, or when maximum performance is needed and on-premise infrastructure is able to deliver the business requirements (Kepes, 2011). See also my discussion of the recent changes to Australia's federal Privacy Act (Section 2.8) and its implications for CC.

2.3.1.2. Platform as a Service

PaaS involves the provision of a complete system development platform for systems development professionals within an organisation or, possibly, across organisations (Xiaoqi, 2012, Hooper et al., 2013, Padhy and Patra, 2012, Linthicum, 2010a). The facilities and services provided include OS/s, application development, database development, interface development, testing and storage. These are delivered to subscribers (developers) via a remotely hosted platform to enable them to develop and code efficiently and quickly (see Figure 2.3) (O'Driscoll et al., 2013, Padhy and Patra, 2012, Kepes, 2011, Linthicum, 2010a).

PaaS merges the power of IaaS and the simplicity of SaaS (Kepes, 2011), allowing developers to focus on software development, with the infrastructure being provided and maintained by the CSPs (Murah, 2012). PaaS is recommended when (a group of) developers work on a development project which interacts with external parties, or when they prefer to automate the testing and deployment of services (Kepes, 2011).

Although PaaS users have control over software design, they do not have control over the underlying infrastructure (Xiaoqi, 2012, Padhy and Patra, 2012). PaaS is therefore not the ideal option when: the underlying software and hardware need to be customised; hosting location is very important; development process is impacted by proprietary approaches or languages; or when a proprietary language might be an obstacle for a client desiring to move to another vendor (Kepes, 2011).

2.3.1.3. Software as a Service

SaaS existed a long time before CC (Motta et al., 2012) – though its providers were originally known as Application Service Providers (ASPs) (Vaughan-Nichols, 2014). This was followed by PaaS and IaaS (Srinivasan and Getov, 2011) (see Figure 2.4) (Google Trends, 2014a). SaaS, therefore, can be regarded as the primary idea behind the cloud (Motta et al., 2012).

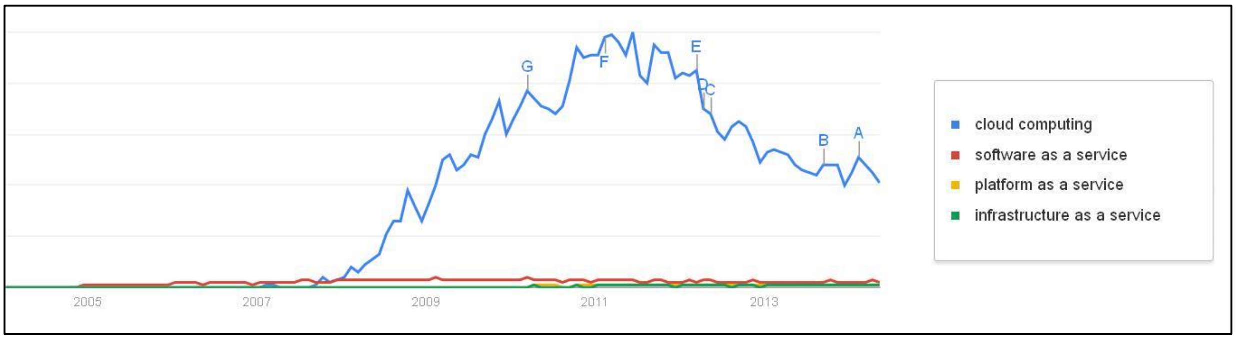


Figure 2.4: CC and its service delivery models (Google Trends, 2014a)

SaaS, also known as application-as-a-service, is a model of computing service delivery which provides ready-made applications running on a remote cloud infrastructure (see Figure 2.3) (Kepes, 2011, Linthicum, 2010a, O'Driscoll et al., 2013, Padhy and Patra, 2012). Thus, SaaS enables clients to utilise the provider's cloud-based applications (Hooper et al., 2013, Xiaoqi, 2012). Users merely need an Internet connection to access their rented applications – typically, but not necessarily – via a web browser rather than installing them on their local servers or PCs (Kepes, 2011, Linthicum, 2010a, O'Driscoll et al., 2013, Padhy and Patra, 2012).

SaaS thus provides the perfect solution for those who do not have an advanced level of technical expertise because SaaS software is already installed and configured (O'Driscoll et al., 2013).SaaS is therefore recommended when: a cloud system such as email is needed and does not give competitive advantage by itself; when there is significant interaction with the outside world; or when mobile access is extensively needed in the short term or needed at a specific time each year such as for tax or billing applications (Kepes, 2011).

SaaS users do not have control over either the software or the underlying infrastructure – apart from minor configuration or customisation (Padhy and Patra, 2012, Xiaoqi, 2012). It is thus not the best option when: real-time data is required; when data cannot be hosted externally (for practical or legal reasons); or when existing on-premise applications meet business needs (Kepes, 2011).

2.3.2. Deployment models

CC can be deployed in four different ways: via a Public Cloud, Private Cloud (out-sourced & on-site), Community Cloud (out-sourced & on-site), or Hybrid Cloud.

2.3.2.1. Public Cloud

Public (or external) cloud refers to sharing resources (applications, infrastructure and platforms) with an industry group or the general public on a self-service basis dynamically over the Internet from an off-site third-party provider (see Figure 2.5) (Padhy and Patra, 2012, O'Driscoll et al., 2013, Johnston, 2009, Linthicum, 2010a). It might be owned, managed and operated by a government, academic or business organisation (Padhy and Patra, 2012).

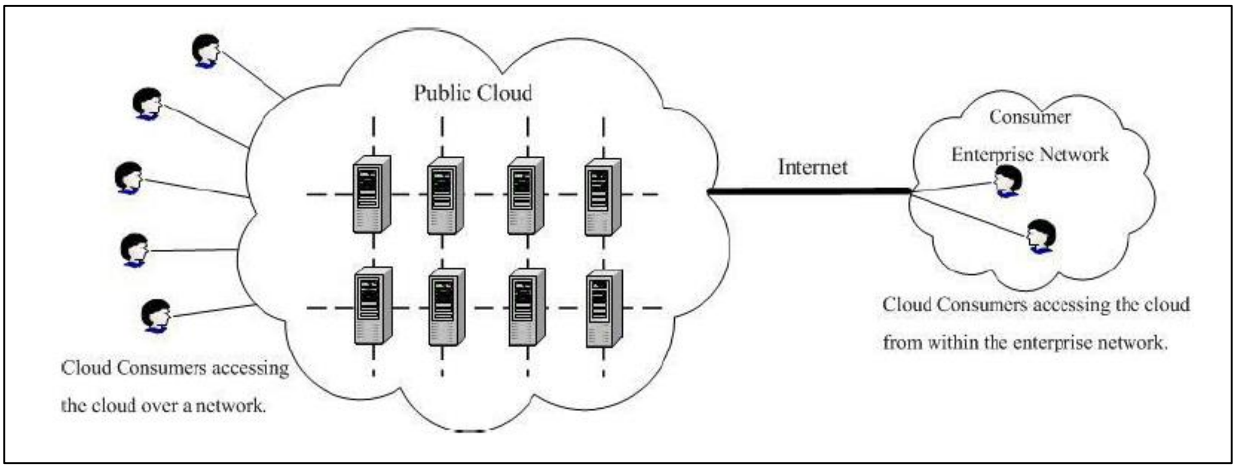


Figure 2.5: Public Cloud (Bohn et al., 2011)

2.3.2.2. Private Cloud

Private Cloud consists of virtualised hardware and software resources (i.e. cloud infrastructure) on a private network that exists within an organisation's own firewall (On-site Private Cloud – see Figure 2.6) (Bohn et al., 2011, Hogan et al., 2011) or outside its firewall but dedicated to its sole use (Out-sourced Private Cloud - see Figure 2.7) (O'Driscoll et al., 2013, Bohn et al., 2011, Hogan et al., 2011, Linthicum, 2010a). The Private Cloud might be owned, operated and managed by the organisation, a third party or some blending of both (Padhy and Patra, 2012).

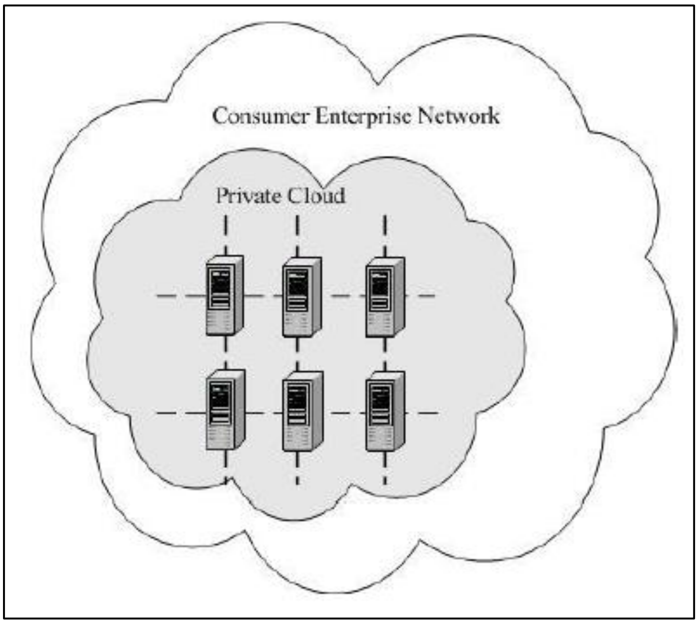


Figure 2.6: On-site Private Cloud (Bohn et al., 2011)

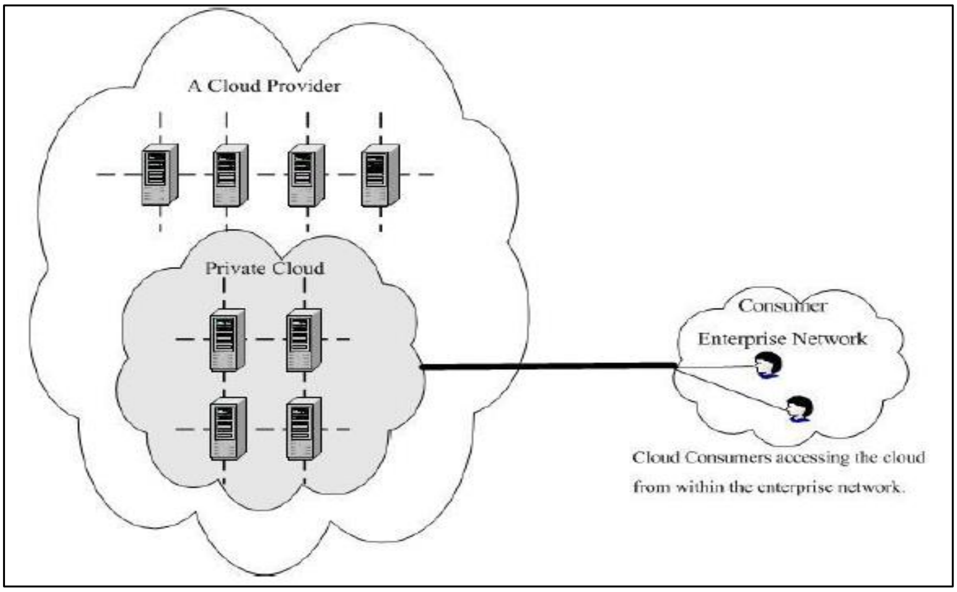


Figure 2.7: Out-sourced Private Cloud (Bohn et al., 2011)

2.3.2.3. Community Cloud

A Community Cloud (either On-site – see Figure 2.8 – or Out-sourced – see Figure 2.9) is shared by a group of organisations having the same concerns, e.g. policy, mission, compliance considerations and security requirements (Linthicum, 2010a, Padhy and

Patra, 2012, Kepes, 2011, Johnston, 2009). Community Clouds can be operated, owned and managed by one or more of the user organisations, a third party, or some blending of both (O'Driscoll et al., 2013, Kepes, 2011, Hogan et al., 2011, Linthicum, 2010a).The simplest way to understand Community Cloud is to think about Government agencies sharing the same cloud.

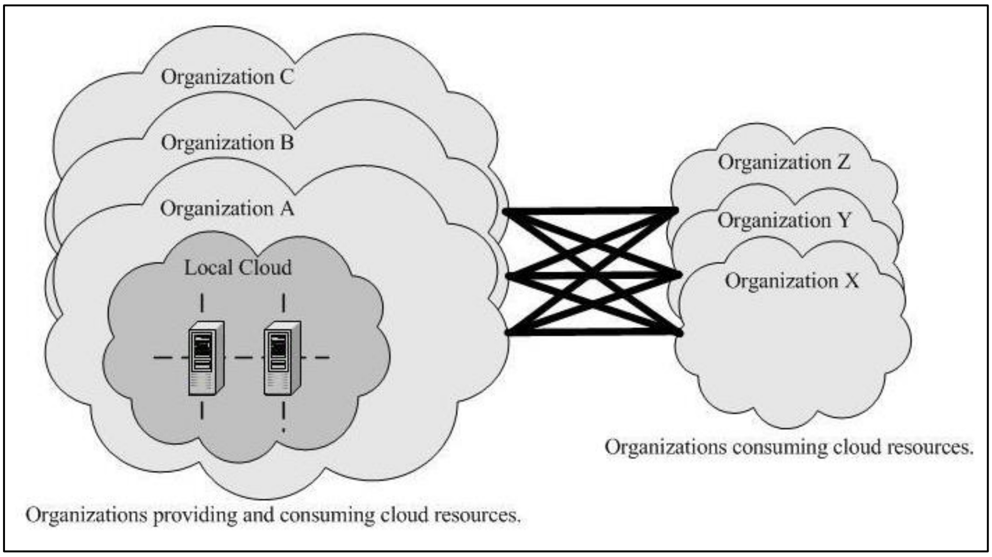


Figure 2.8: On-site Community Cloud (Bohn et al., 2011)

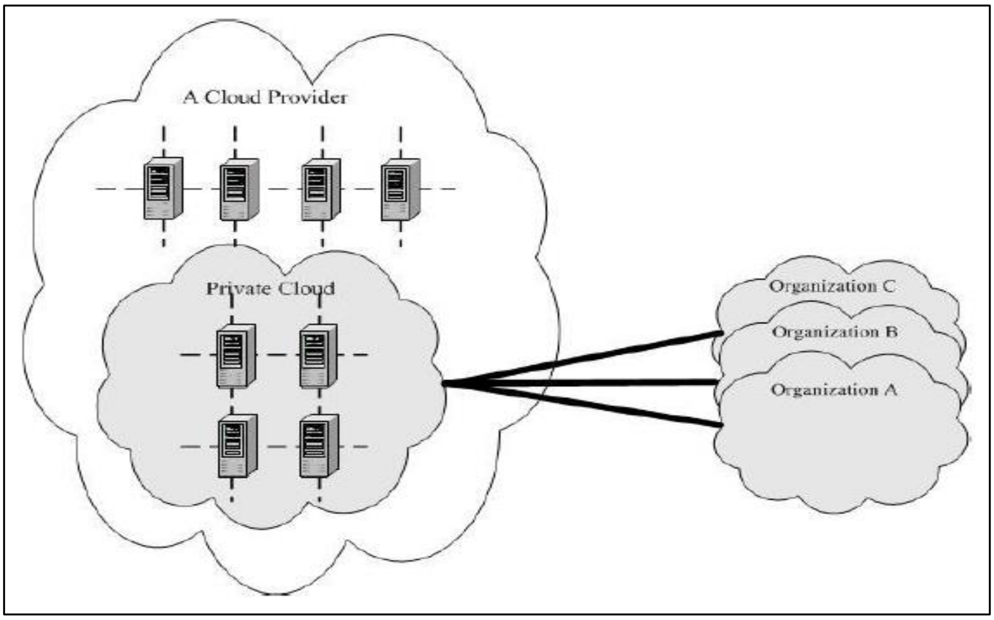


Figure 2.9: Out-sourced Community Cloud (Bohn et al., 2011)

2.3.2.4. Hybrid Cloud

A Hybrid Cloud combines two or more types of cloud connected via VPN so as to be scalable and fault-tolerant (see Figure 2.10) (Padhy and Patra, 2012, Bohn et al., 2011, Linthicum, 2010a, Mell and Grance, 2010). Although Hybrid Cloud is a combination of two or more deployment models (Public, Private or Community), it is regarded as an entity in its own right (Padhy and Patra, 2012).

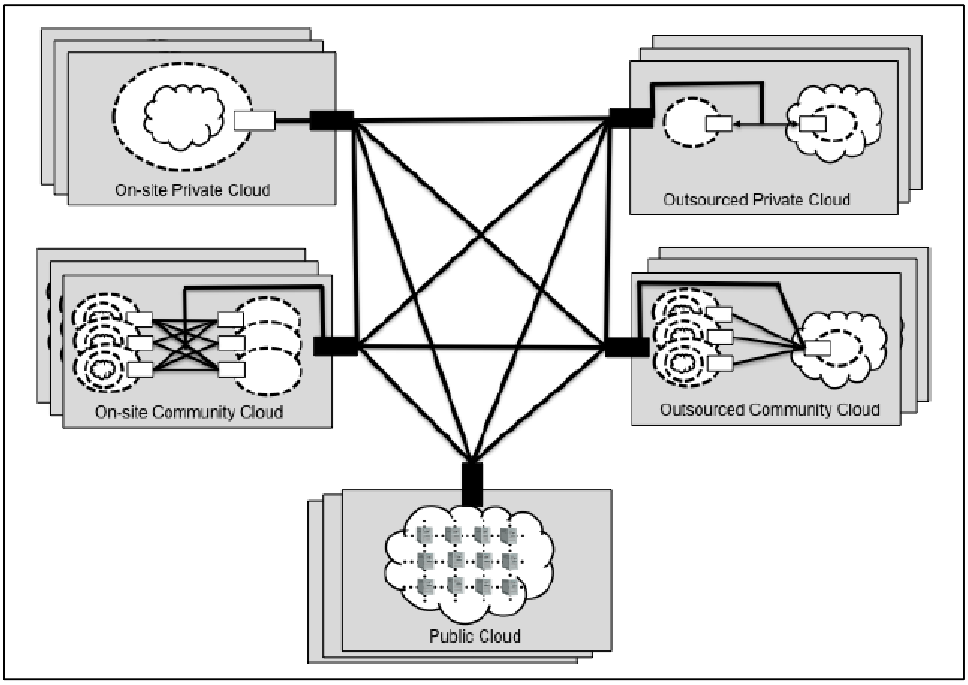


Figure 2.10: Hybrid Cloud (Bohn et al., 2011)

Figure 2.11 ties all these components of CC together, providing a visual model of CC and summarising infrastructure properties, essential characteristics, delivery models and deployment models.

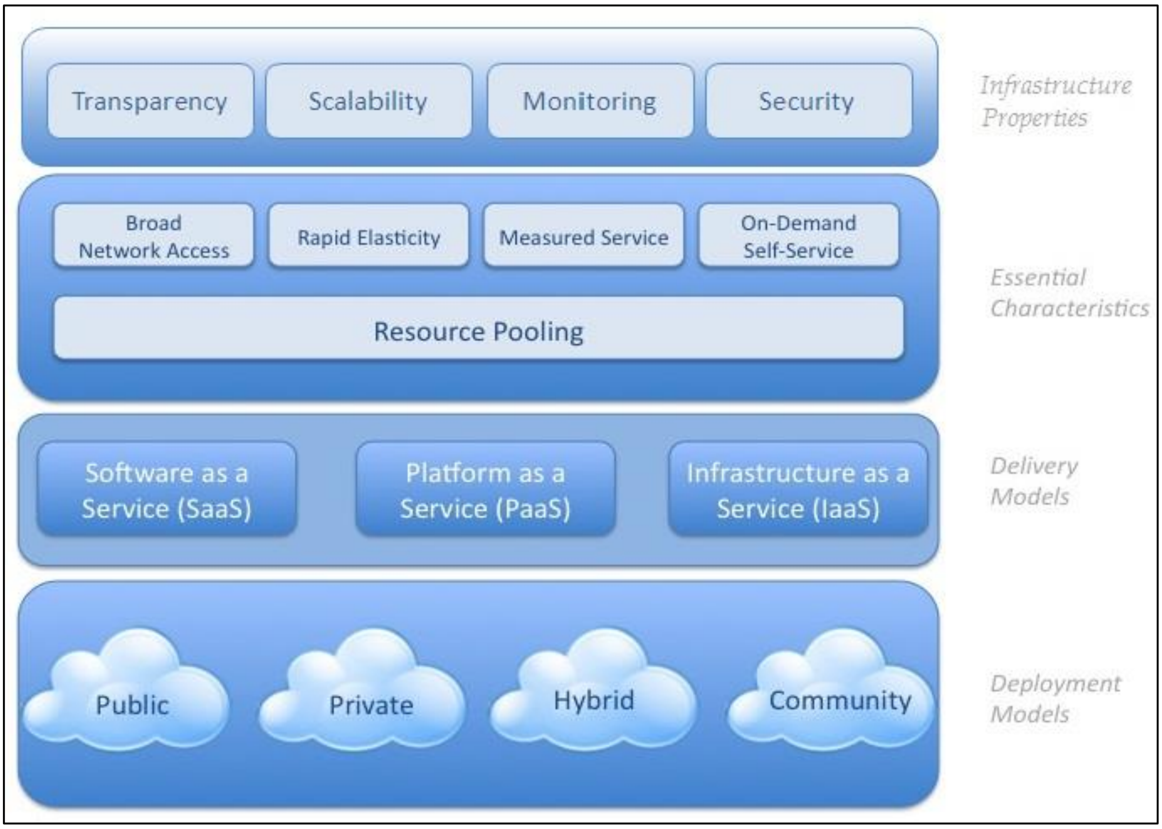


Figure 2.11: Visual Model of CC - adapted from (Jeffreys, 2011)

2.3.3. Cloud System Examples

A CC environment can support the operation of many different types of system. Table 2.1 illustrates the best-known of these, categorised by service delivery model.

Table 2.1: Cloud systems and their service delivery models

Service Delivery Model	Cloud System
IaaS	Storage / Archiving (Baghdadi, 2013, Padhy and Patra, 2012, Murah, 2012)
	Backup (IaaS) (Padhy and Patra, 2012)
	Processing (IaaS) (Padhy and Patra, 2012, Murah, 2012, Baghdadi, 2013)

PaaS	Database (PaaS) (Padhy and Patra, 2012)
	Test and development (PaaS) (Baghdadi, 2013, Padhy and Patra, 2012, Murah, 2012, Srinivasan and Getov, 2011)
	Collaboration (PaaS) (Srinivasan and Getov, 2011, Padhy and Patra, 2012)
	Web Hosting (PaaS) (Padhy and Patra, 2012)
SaaS	Financial and Accounting (SaaS) (Murah, 2012, Padhy and Patra, 2012)
	Marketing and sales e.g. Customer Relationship Management (CRM) (SaaS) (Padhy and Patra, 2012, Baghdadi, 2013)
	Human resource management (SaaS) (Padhy and Patra, 2012)
	Email (SaaS) (Padhy and Patra, 2012, Srinivasan and Getov, 2011, Baghdadi, 2013)
	Project Management (SaaS) (Murah, 2012)
	Phone System (SaaS) (Padhy and Patra, 2012, Baghdadi, 2013)

2.4. Advantages of Cloud Computing

CC offers its users many potential benefits but, as with all technology, it also has a number of disadvantages. This Section of the Thesis summarises and discusses CC's strengths, while Section 2.5 discusses the disadvantages of the CC phenomenon. Many authors have provided lists of advantages and disadvantages of CC as listed in Appendix A, and this Section and the following one combine most of these into a list which is intended to be both comprehensive and succinct. Security and privacy are discussed separately in Section 2.6 because they are both strengths and weaknesses where CC is concerned.

The number of CC's advantages and disadvantages makes it difficult to follow these easily, so Table 2.2 has been included to provide a high-level summary:

Table 2.2: CC Strengths and Weaknesses

Advantages	Disadvantages
1) Assists in reducing costs 2) Helps to maintain systems more effectively 3) Provides support for improving business performance 4) Enables simpler introduction of new systems 5) Allows the addition or removal of services as needed 6) Facilitates internal communication 7) Provides support for enhancing productivity 8) Faster implementation and less IT administration 9) Enables accessibility via any internet-connected device	1) Lack of trust with CSPs 2) Performance problems, including: availability, internet outages and bandwidth problems 3) Development problems, including: integration problems and loss of control 4) Immaturity of the technology, including: recovery problems and quality problems 5) Creates a wide variety of legal problems, including: unsatisfactory SLAs, data sovereignty and cross-border problems 6) Organisational and cultural problems

1) Assists in reducing costs

CC provides almost immediate access to computing resources without upfront capital investments on IT infrastructure and with reduced OPEXs compared to many in-house software solutions (Baghdadi, 2013, Avram, 2014, Linthicum, 2010a, Sultan, 2014). This is largely because CC's multi-tenancy feature, facilitated by virtualisation, supports the sharing of resources – enabling CSPs to offer what is essentially the same system solution to multiple clients, simultaneously, at little additional cost (Hooper et al., 2013, Motta et al., 2012). Moreover, the services of CC are measurable and similar to a utility service in that the customer pays only for what is used (Murah, 2012, Schadt et al., 2010, Knorr and Gruman, 2010, Dearne, 2011). Therefore, many authors believe that CC can dramatically lower costs and thus be considered an economical and cost-effective solution (Avram, 2014, Schadt et al., 2010, Keshavarzi et al., 2013, Damshenas et al., 2012).

This apparently lower cost may, however, prove less economical over time than it initially appears. Figure 2.12 compares the total cost of ownership of SaaS vs. 'conventional' licensed software – and suggests that the savings obtained from SaaS may not be as great as many users believe.

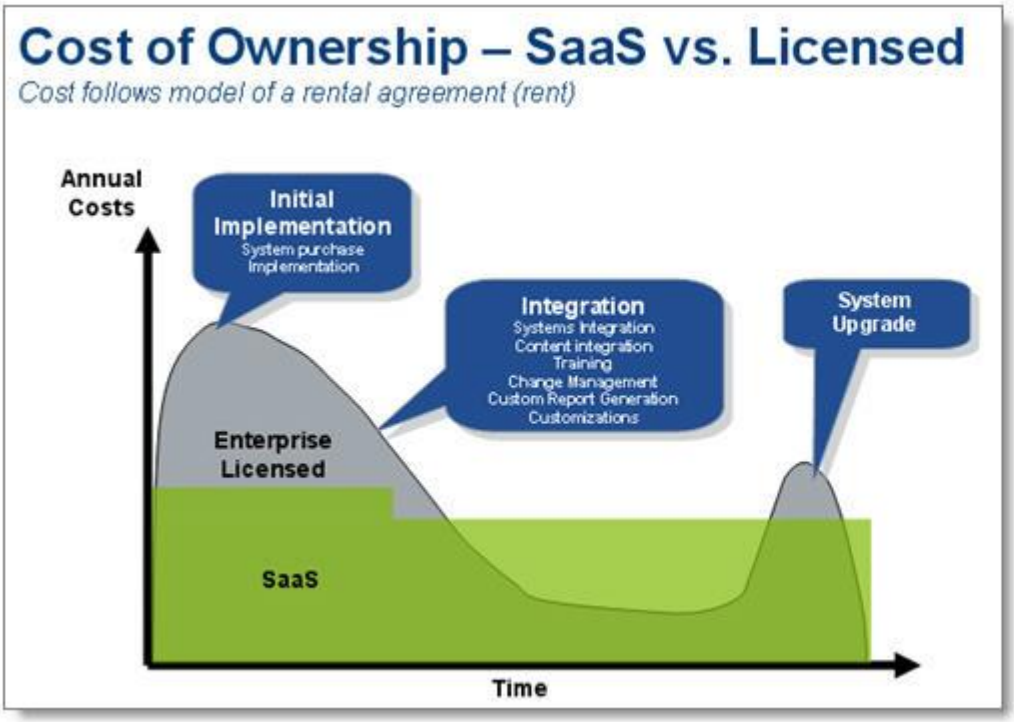


Figure 2.12: TCO: SaaS vs. Licensed Software (Bersin, 2009)

2) Helps to maintain systems more effectively

CSPs, with their teams of IT specialists, are responsible for (and supposed to be capable of) upgrading CC services and maintaining the infrastructure and applications which run in these environments more effectively than would be possible for many small businesses. Indeed, it is the attraction of being able to use sophisticated software without the need for highly-skilled and expensive technical support staff which attracts many SMEs to CC in the first place (Murah, 2012, O'Driscoll et al., 2013, Linthicum, 2010a, Sultan, 2014).

3) Provides support for improving business performance

The ideal CSPs' infrastructure, an up-to-date and effective architecture, provides advanced visualisation, customised hardware and High Performance Computation (HPC) instantaneously (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010). In addition, a cloud customer can in theory make use of multiple CSPs simultaneously to create a combination of services to meet requirements (Murah, 2012). In an ideal world, therefore, CC can enhance the performance of IT solutions (Keshavarzi et al., 2013), integrate business processes efficiently (Baghdadi, 2013) and lower IT barriers to innovation (Avram, 2014) – which may eventually lead to improving business performance significantly (Linthicum, 2010a, Schaffer, 2009), if integration, development, compatibility problems and other issues (explained in the next Section) are avoided.

Respondents to an International Data Corporation (IDC) survey provided support for the view that SaaS was popular with Australian organisations as a means of improving their business performance (Barwick, 2013b).

4) Enables simpler introduction of new systems

CC makes it possible for organisations to use services and contemporary classes of applications which were not previously possible due to lack of technical or human expertise (Linthicum, 2010a, Avram, 2014). REA Group's Head of Delivery, Richard Durnall supports this view: "*The AWS Cloud has enabled us to have more developers working on new products and features concurrently, reducing development time and increasing the speed of technology service delivery for our customers*" (Amazon Web Services Inc., 2012).

5) Allows the addition or removal of services as needed

CC established on distributed computing resources are designed to be simply assigned, de-assigned or re-assigned on a customer's request (Mancini et al., 2009). The on-demand provisioning of CC resources gives CC high flexibility since a customer can choose the type of service needed, such as processing, storage, networking, application – or even a complete platform (Linthicum, 2010a, O'Driscoll et al., 2013, Baghdadi, 2013, Avram, 2014). Simultaneously, CC can adjust the needed infrastructure, such as processing power or storage, automatically to provide the required services on time regardless of the number of users (Murah, 2012). This rapid elasticity and scalability feature of CC should enable the customer to scale the provided services up or down as needed and at very short notice (Hunter, 2009, Schadt et al., 2010, Baghdadi, 2013, Motta et al., 2012).

6) Facilitates internal communication

CC allows employees to communicate within an organisation as though they were all located in one building (JB, 2009). For example, the multinational Rentokil switched from 40 mail systems and 180 different email domains to a single cloud-based email solution which serves 35,000 employees over 50 countries (JB, 2009). CC allows organisations to use more collaborative and integrated tools such as sharing calendar information, translation, live chatting, video and other tools (JB, 2009, Greengard, 2010).

7) Provides support for enhancing productivity

CC allows organisations to focus more on the core activities of their business and to adjust resources to meet unexpected business demand (Wattal and Kumar, 2014, Baghdadi, 2013), rather than needing to spend time and resources on maintaining the software supporting these activities. These organisations may gain competitive advantage by refocusing resources, thus enabling them to build better products, increase market share and promote their mission (Linthicum, 2010a).

One of the largest and oldest CSPs, AWS, cites a number of such success stories, for example:

- the CIO of Commonwealth Bank of Australia, Michael Hart said "*We are now running some of our important customer-facing web properties on AWS, which scales seamlessly to meet all kind of peaks and this has freed up our IT resources to focus on developing more innovative customer offerings*" (Amazon Web Services Inc., 2012)

- the Chief Executive Officer (CEO) of social gaming provider Halfbrick, Shainiel Deo, said "*In the social gaming business, maintaining consistently fast user experience is a critical success factor – and AWS enables us to do exactly that*" (Amazon Web Services Inc., 2012).

CC is, thus, a tool with the potential to enable user organisations to be more productive and cost-effective (Linthicum, 2010a).

8) Faster implementation and less IT administration

Implementing, maintaining and upgrading both software and hardware usually consume a considerable amount of time for IT departments (Wattal and Kumar, 2014). The speed of implementing CC services is one of its advantages since they can be provisioned and deployed rapidly using the CSPs' infrastructure (Baghdadi, 2013, Hunter, 2009, Linthicum, 2010a, Orfano, 2009). This inclines CIOs to CC because they can refocus their limited human and technical resources away from implementation, upgrade and maintenance of IT infrastructure (Wattal and Kumar, 2014).

Organisations can exploit the substantial IT infrastructure of CSPs without implementing and administering it themselves (Linthicum, 2010a, Wattal and Kumar, 2014, Banerjee et al., 2012, Schadt et al., 2010). CC services are frequently provided by a group of data centres typically owned and maintained by a third party (Murah, 2012, Xiaoqi, 2012). Administrative functions such as backup and recovery, as well as implementation, must no longer be provided by the customer since these use the vendor's infrastructure, which would normally be a contemporary and effective architecture (Schadt et al., 2010, Orfano, 2009, Schaffer, 2009).

9) Enables accessibility via any internet-connected device

Broad network access is one of the five characteristics of CC mentioned in Section 2.3 (Motta et al., 2012, Divakarla and Kumari, 2010, JB, 2009, Orfano, 2009). This feature allows customers to request and access CC services via an effectively unlimited variety of internet-connected devices including desktop machines, laptops, Personal Digital Assistants (PDAs) and other mobile devices such as tablets or smartphones, regardless of geographic location (Fasihuddin et al., 2012, Abah and Francisca, 2012, Motta et al., 2012, Baghdadi, 2013).

2.5. Disadvantages of Cloud Computing

Like all technologies, CC has both strengths and weaknesses. Section 2.4 identified and discussed some of the most important of CC's strengths, while this Section highlights and discusses some of CC's more significant disadvantages:

1) Lack of trust with Cloud Service Providers

Customers lack of trust in CSPs can negatively affect adoption of CC (Rimal et al., 2011). For instance, there will be trust concerns if the CSP's customers are not fully aware of the processes used for data governance and billing (Rimal et al., 2011). The level of security and privacy provided by a CSP can also increase or decrease levels of trust between cloud providers and their customers (Rimal et al., 2011). Damshenas et al. (2012) identified a number of methods of improving trust, including: implementing multi-factor authentication to improve security; and utilising the Trusted Platform Module in the hypervisor to resolve some of the most crucial forensic investigation challenges in CC. These authors also suggest that, by applying these solutions, CC will be far more compatible with current forensic investigation practices which, in turn, will increase customer trust.

2) Performance problems

Although CC makes use HPC techniques, performance problems continue to be a matter of concern for customers, due to network latency and limited bandwidth (Linthicum, 2010a, Sarathy et al., 2010, Motta et al., 2012, Erdogmu, 2009) – problems which are, largely, outside the control of the CSPs themselves. These performance issues may occur at the level of the CC customer's Internet Service Provider (ISP), within the CSP itself – or at both levels. Regardless of the causes of latency and limited bandwidth, poor performance will ultimately affect the reliability of CC (Baghdadi, 2013) and, if real-time data is needed, there will be significant delays if the disks on which the data are stored are physically located far from the applications running the data (Linthicum, 2010a), or if Big Data needs to be transferred into and out of the cloud (Aspera, 2014, Schadt et al., 2010). The IDC survey already cited shows that 63.1% of 422 cloud users believed performance was a “very significant” or “significant” challenge in CC (Xiaoqi, 2012). Other problems affecting performance include well-known issues such as availability problems, internet outages and bandwidth problems – discussed below:

a) Availability problems

Availability is a major concern for CC (Sarathy et al., 2010, Rimal et al., 2011, Baghdadi, 2013, Xiaoqi, 2012) and it is important to include this in the Service Level Agreement (SLA) since it affects customer satisfaction and staff morale (Xiaoqi, 2012). CC customers are still suffering from unreliable availability of CC services. For example, Raphael (2014) indicated the worst cloud outages between January and August of 2014 for several cloud services such as Google services, Dropbox, iCloud, Microsoft Exchange, Amazon Web Services (AWS), Facebook and other cloud services; and some of these outages lasted for as many as 2-3 days (Raphael, 2014)! There are a number of causes for limited availability, including DDOS (Distributed Denial of Service) attacks (Xiaoqi, 2012), software failures, data loss, insecure Application Program Interfaces (APIs) and account or service traffic hijacking (Cloud Security Alliance, 2013), but whatever the cause, lack of availability is disastrous for both customers and CSPs alike (though, of course, for different reasons)

b) Internet outages

The frequent outages of Internet services, on which CC relies, are a significant concern for CC customers – particularly if for those depending on offshore CSPs (Linthicum, 2010a, Banks, 2010). Tom Nolle, president of strategic consultancy

CIMI Corporation which specialises in telecommunications and data communications, notes that most CC outages are caused by lack of availability of the Internet (Nolle, 2013). These internet outages could occur at the CC customer's ISP or that of the CSP (or at both of these), but the effects are equally devastating. Although long Internet outages rarely happen, they do occur from time to time, as happened in Egypt and India in 2008 because of the cutting of an undersea telecoms cable (Birman et al., 2011). To mitigate this risk, it is recommended to have a Virtual Local Area Network (VLAN) service or VPN arrangement with at least two ISPs to ensure access to CC services – but to ensure that there are no common failure points between these (Nolle, 2013). In addition, using a CSP with more than one data centre, at least one of which is located physically in your own country will help to minimise risk (Nolle, 2013).

c) Bandwidth problems

As already noted in Section 2.2.1 (Big Data), bandwidth problems are a genuine concern for CC customers (Rimal et al., 2011, Greengard, 2010, Linthicum, 2010a), who frequently need to transfer enormous amounts of data rapidly into and out of the cloud via the Internet. Limited bandwidth can an insurmountable challenge for such customers (Aspera, 2014, Schadt et al., 2010). Subashini et al. in (Xiaoqi, 2012) believe that transaction management is one of the biggest challenges for CC. These problems may well occur due to bandwidth limitations between the ISPs of the CSP and its customers. Theresa Lanowitz, founder of Voke, an independent analyst company, doubts that bandwidth considerations are included in the cloud strategies of many organisations (Gittlen, 2012).

Gittlen (2012) therefore suggests that testing cloud apps, getting the right people involved, optimising the network for data backup; and syncing across data centres are important to minimise the risk of bandwidth problems. The solutions to Internet outages suggested in the previous Section are also applicable here, as the problems are quite similar.

The bandwidth bottleneck is already leading to attempts to invent new high-speed transmission solutions (Aspera, 2014, Wallace and Kambouris, 2014). For instance, some CSPs are trying to solve this issue by creating a new layer over TCP in order to raise the transmission speed of traditional HTTP / FTP by 10 to 100 times (O'Driscoll et al., 2013).

3) Development problems

One of the reasons CC is so attractive to organisations – especially smaller firms – is the possibility of gaining access to sophisticated software solutions, despite a lack of in-house IT expertise (both human and technical) (Linthicum, 2010a, Avram, 2014). The limited IT architecture and platform skills, as well as human expertise, within many CC customer organisations may, however, significantly limit the benefits CC can provide (Linthicum, 2010a).

SaaS customers have very limited ability to customise or configure their software since they are merely renting the service and have no (or, at best, very little) control over the software itself or the underlying infrastructure of their CSP (Padhy and Patra, 2012, Xiaoqi, 2012). Thus software which does not effectively integrate with internal systems cannot readily be modified – and, of course, lack of in-house expertise merely exacerbates this problem. These development problems also include integration problems and loss of control (Čapek, 2012, O'Driscoll et al., 2013, Rimal et al., 2011, Linthicum, 2010a).

This may occur because managers purchase SaaS solutions without consulting the IT department. For example, the IDC survey already cited also showed that 69.6% of respondents indicated CSPs were selected by Business Units while in only 59.8% of respondents had this responsibility been taken by the IT Department (Barwick, 2013b). The Cap Gemini 2012 report “Business Cloud: The State of Play Shifts Rapidly” found that cloud decision were increasingly being made by business (as opposed to IT) managers (Burns, 2012). While this may well be a positive trend in organisations where business and IT are effectively aligned, this is not always the case. Kaplan and Norton (2001), for example, found that only 7% of employees fully understood their company's business strategies and what was needed to assist in achieving corporate goals!

a) Integration problems

Both virtualisation and CC are held up by insufficient integration (Lawson, 2010). Networks, storage, security, backup and management are the five most significant areas of integration challenges (Lawson, 2010). In addition, lack of infrastructure compatibility and interoperability between CC and internal applications, data and service may well lead to prohibitive costs and inconvenience when an organisation decides to move to another CSP or to go back to in-house operations (O'Driscoll et al., 2013, Rimal et al., 2011, Linthicum, 2010a).

b) Loss of control

The control of organisations' IT infrastructure is increasingly in the hands of CSPs, with potential risks inevitable when a customer depends on a service provider it does not control (Linthicum, 2010a, Erdogmu, 2009, Čapek, 2012, Hayes, 2008). Although this problem also occurs in 'classic' outsourcing, it may not be as obvious to CC clients that they are handing over control of their critical IT infrastructure to another company. Is the CSP committed to supporting its clients' on-going business operations? What are the implications of a falling-out between provider and client under these circumstances?

4) Immaturity of the technology

The lack of comprehensive international CC standards can lead to security and privacy problems (Damshenas et al., 2012, Rimal et al., 2011, Hunter, 2009). For example, Venkatraman (2014) indicated "*without any industry-wide cloud standards, suppliers have built proprietary cloud services on software stacks that are not compatible with the stacks used in public clouds, making interoperability difficult*". Moreover, security, legal, economic and contractual issues are not matured yet and require careful consideration (Dearne, 2011, Australian

Government Information Management Office, 2011). CC is still not entirely mature and this concern also involves recovery and quality problems (Motta et al., 2012, Damshenas et al., 2012, Rimal et al., 2011, Dearne, 2011).

a) Recovery problems

The accidental loss of data is a significant potential problem for CC data centres (Gozzi, 2010) and horror stories concerning CC data loss abound – large CSPs being no more immune to the problem than small providers. The 2009 T-Mobile incident, in which an engineering problem at Microsoft's data centre led to the irrecoverable loss of all contacts, call history and other content for an unspecified number of Sidekick mobile phone owners (Consumer Reports, 2009, Felten, 2009), illustrates just how vulnerable data centres can be and how little control CC clients have over their external data (Gozzi, 2010). The dramatic failure of Amazon's EC2 cloud in April 2011 caused enormous recovery problems (Thorsten, 2011, IT PRO India, 2011, Weissberger, 2011) and remains one of the most widely cited examples of CSP failure. More recently, in May 2014, large amounts of academic research data were lost because of a technical failure occurring at 'Dedoose', a cloud software for managing research data (Kolowich, 2014).

b) Quality problems

Quality problems in CC such as data quality and meeting quality-of-service requirements (Srinivasan and Getov, 2011, Linthicum, 2010a, Miller, 2013) are those most commonly mentioned. There are many additional issues associated with data quality, however, which are rarely discussed in CC contexts, including such things as data decay time-related factors, accuracy and completeness; while system reliability, timeliness, volume, criticality, quality of perception and cost are the main dimensions of Quality of Service (QoS) (Pawluk et al., 2011). CC related quality problems also include transparency and business service management issues (Rimal et al., 2011), where there is no *de facto* standard for

CC (Rimal et al., 2011, Damshenas et al., 2012). These quality problems may also affect the reliability of CC more broadly (Baghdadi, 2013).

5) Creates a wide variety of legal problems

There are a number of legal problems associated with CC, of which the most widely mentioned include unsatisfactory SLAs and cross border / data sovereignty problems (Srinivasan and Getov, 2011, Hooper et al., 2013, Xiaoqi, 2012, Wang et al., 2008).

a) Unsatisfactory Service Level Agreements

Schaffer (2009) points out that CC is essentially a different kind of outsourcing, a fact which is often overlooked or ignored because it brings back bad memories of poorly-handled outsourcing projects. He goes on to explain that all the existing (and well-known) problems of outsourcing thus apply equally to CC initiatives – in particular, that of poorly-specified contracts with the provider. Because software provision in the cloud is a contract for service, rather than a contract for product – since the client is renting the software instead of buying it – CC contracts are SLAs rather than contracts for purchase (Hooper et al., 2013). And because SaaS software is based on multi-tenancy – a one-to-many relationship between the CSP and the multiple clients who are renting that particular software application – the relationship between vendor and client is much more like a retail relationship (Business-to-Consumer, or B2C) than it is like a more conventional corporate relationship (Business-to-Business, or B2B) (Mullins, 2010).

Amy Wohl, principal consultant of Wohl Associates, emphasises this issue: "*Today, customers complain regularly that SLAs are just another form of vendor boilerplate, to the extent they exist at all, and that it is difficult if not impossible to get much modification. They also point out that they want the SLA because it will cause the provider to put some skin in the game, not because the penalties would solve their problems in the case of outages or other situations covered by the SLA. That doesn't mean we don't need SLA's; we do. It's important we make* *it clear what is going on now versus what we would like to see/influence for the future and when we are hoping that future will occur*" (Cloud Standards Customer Council, 2013).

The unsatisfactory nature of SLAs is regarded as one of the major concerns for CC customers (Rimal et al., 2011, Schaffer, 2009, Xiaoqi, 2012, Wang et al., 2008). These documents are often written by employees of the Purchasing Department who do not build in provisions that confirm the levels and types of service IT professionals need because they do not understand the computing industry (Schaffer, 2009).

The contract may cover which country's law will be applied, QoS supported, levels of availability, performance, service ability, operation, penalties on violation of SLA or other attributes (Wang et al., 2008, Xiaoqi, 2012). In addition, SLA obligations may include procedures for data seizure in cybercrime investigations which might affect privacy, intellectual property rights and service delivery (Hooper et al., 2013).

b) Data sovereignty and cross-border problems

Data in the cloud can often be considered "resident" in another country because it will be stored on the CSPs' servers which might well be located in a number of different countries (Bates, 2014). For example CC deployment models such as Public Cloud which also includes saving cloud data in a variety of locations, involve political issues due to global boundaries (Avram, 2014, Rimal et al., 2011, O'Driscoll et al., 2013) and this cross-jurisdiction nature of CC can make contractual agreements very difficult (Banks, 2010).

The dynamic and virtual nature of CC may also mean that customers can have difficulties establishing sovereignty of their data, since they cannot identify where their information – which is probably stored across many servers – is physically located (Irion, 2012). This concern also affects data ownership, data governance and intellectual property rights (O'Driscoll et al., 2013, Hooper et al., 2013, Rimal et al., 2011).

Furthermore, the data collection method for physical electronic evidence in forensic investigations may be more complicated because the data in question may be stored outside the physical jurisdiction of the Law Enforcement Agency (LEA) undertaking the investigation (Hooper et al., 2013, Damshenas et al., 2012).

6) Organisational and cultural problems

Organisational and cultural problems are also potential concerns in CC (Harding and Open Group, 2011). Indeed, CSPs and their customers have little choice but to deal with cultural issues because CC is shifting traditional methods of delivering IT services (Sultan and van de Bunt-Kokhuis, 2012, Metzler et al., 2011). The sorts of issues which may arise include, for example, changes in viewing IT infrastructure and resources which can be problematic in terms of corporate culture; and in conducting businesses need to be implemented by CC customers (Sultan and van de Bunt-Kokhuis, 2012). However, Bailey (2010) indicated a lack of appetite for this change within organisations which considering the adoption of CC.

2.6. Security and Privacy issues

The security systems of an organisation can be developed significantly by adopting CC because sensitive data is stored away from head office, and yet is readily accessible through the organisation's IT procedures (Computer Edge, 2010). Vendor supercomputers hosting the organisation's applications are seen as an advantage for both security and storage issues (Orfano, 2009). In addition, the security capabilities of CC providers are generally considered to be better than those of ordinary organisations (Shagin, 2012). However, client organisations will need to resolve the normal issues of outsourcing the project because the firm is literally outsourcing its IT (Computer Edge, 2010).

Although some authors have stated that improved security is one of the potential benefits of CC, it is also, somewhat confusingly considered to be one of the main concerns associated with CC – as many authors have noted (see, for example: Baghdadi, 2013, Murah, 2012, Xiaoqi, 2012, Cloud Security Alliance, 2013).

Digital crimes are increasing annually by 35%, according to recent Federal Bureau of Investigation (FBI) research (Damshenas et al., 2012). In addition, the collection of digital data in the cloud is not compatible with current forensic investigations except for those utilising the IaaS model (Damshenas et al., 2012). Since physical security of CC is out of customers' control the lack of knowledge customers have of how security is handled by their CSP can often mean that security becomes a major concern for prospective CC clients and may well be a barrier to adopting CC (Xiaoqi, 2012). According to a survey conducted by IDC, security is the biggest challenge for CC with 74.6% of 422 cloud users believing it is a "very significant" or "significant" challenge (Xiaoqi, 2012).

Security problems are, in fact, one the most important issues for CSPs who are keen to guarantee the continuity of their business. For example, a number of organisations (including Microsoft Corp, VMware, CA Inc., Santa Clara, Novell Inc. and Intel Corp) have formed the non-profit Cloud Security Alliance (CSA) to identify effective solutions to these problems (Lau, 2010).

Cloud Security Alliance (2013) has identified a number of CC security threats, of which the three most significant threats will be discussed here:

- *Data breach* is the greatest threat to cloud security, according to CSA. A research paper shows how a VM could extract private cryptographic keys from other VMs within the same physical server using side-channel timing information (Zhang et al., 2012b). However, malicious hackers do not need to use such technically sophisticated approaches; they can get hold of CC customer data using a single flow in one of their applications if the database of the multi-tenant cloud service is not designed appropriately (Samson, 2013).

- The second threat on the CSA list is *data loss*, which can occur due to attack by a malicious hacker, CSP carelessness, or as the result of a disaster (e.g.

flood, fire or earthquake) (Cloud Security Alliance, 2013). Thus, data loss may not only affect the relationship between a CSP and its customers, but may also affect the compliance with laws relating to the storage of certain data (Samson, 2013).

- The third highest cloud security risk is *account* or *services traffic hijacking*. If a malicious hacker accesses a cloud customer's credentials, s/he can return falsified information, eavesdrop on transactions or activities, manipulate data; and/or redirect the customers to illegal sites (Cloud Security Alliance, 2013). For example, the attackers of Amazon in 2010 hijacked customers' credentials (Samson, 2013). Cloud Security Alliance (2013) recommended that "organisations should look to prohibit the sharing of account credentials between users and services, and they should leverage strong two-factor authentication techniques where possible".

To avoid these significant risks, the security of all CC services, applications and infrastructure must be prioritised at the design stage – once these are compromised, all associated data may be at risk (MacVittie, 2008).

Approaches taken to improve CC security include splitting data into many parts and distributing these across many datacentres, thus making it more difficult for a hacker to access all data (Murah, 2012). The creation of trusted third parties who can be given responsibility for controlling access to data and securing it (Celesti et al., 2010) using a strong encryption algorithm so that data will not be readable by a hacker has also been suggested as a potential barrier to loss of critical data (Murah, 2012).

Privacy is also considered a major concern for CC (Motta et al., 2012, Linthicum, 2010a, Rimal et al., 2011, O'Driscoll et al., 2013) since customer data resides in a CSP's cloud which can exist across many geographic locations (Rimal et al., 2011). In addition, sharing resources with multiple tenants may cause data exposure, although demand pooling is generally considered as an advantage of CC to maximise resource utilisation by increasing the number of tenants in any given data centre.

Chris Hopfensperger, technology policy counsel at the Business Software Alliance (BSA), believes that security and privacy are the major concerns for CC and "*they are really two sides of the same coin*" (Corbin, 2013). They are the top concerns in CC deployment followed by transaction integrity, according to a survey conducted by Saugatuck Technology in July 2010 (Xiaoqi, 2012). As with any shared cloud environment, CSPs and their customers must address backup, privacy, and security issues (Greengard, 2010) since their data might be exposed to other customers without their control or knowledge (Xiaoqi, 2012).

Indeed the lack of transparency for CC customers on why, when, how and where their data is handled goes against the basic principles of data protection (Council of European Professional Informatics Societies, 2014). Technically, many CSPs can analyse their customers' data by apply data mining techniques (Council of European Professional Informatics Societies, 2014, Ryan, 2011); and this is especially likely to occur in social media applications where users share data relating to their personal life such as photographs, videos and private conversations (Council of European Professional Informatics Societies, 2014). For example, a number of cloud privacy information exposures occurred in 2010 across several CSPs, including Twitter, Facebook and Google (Winkler, 2013). Ryan (2011) suggested that CSP should establish explicit policies on how their customers' data will be accessed and enable customers to choose how their data will be stored.

Some efforts have been made to "harmonise" the legal environment of CC, with major CSPs such as Amazon allowing their customers to choose "regions and availability zones" for the storage of their own data (Amazon Elastic Compute Cloud, 2014). Moreover, data privacy and integrity can be increased by cryptography in most cases (Xiaoqi, 2012). It is suggested that CC customers encrypt their data themselves so as to avoid unauthorised access (Ryan, 2011). However, if the encryption key has been lost, the data itself will be irretrievably lost (Cloud Security Alliance, 2013).

2.7. The Adoption of CC in Australia

CC has been the subject of a number of commercial surveys, as one might expect in the case of such a popular and rapidly-growing technical innovation. The objectives, methodology and results of these surveys are not always clear, especially if they were conducted by CSPs. However, full access to the results of these surveys is costly (many costing as much as tens of thousands of dollars!), though it is common to find summaries of the findings publicly available. Thus, any analysis of these commercial surveys can only be based on the limited information accessible.

At the time this research project began, Australian organisations appeared to be leading the adoption of CC in the Asia Pacific region, with a number of commercial surveys indicating almost astonishingly high rates of CC uptake. For example:

- A survey by analyst firm Frost and Sullivan in 2011 showed that 43% of Australian companies were already using CC, with half of these utilising the hybrid model (Banks, 2011)

- In 2012 an annual survey conducted by Forrester Consulting and VMWare between September and October (Dutt, 2012) was responded to by 6500 business decision-makers across the Asia-Pacific region and included 656 respondents from Australia (Dutt, 2012). Its results showed that adoption of CC by Australian organisations had increased from 43% in 2011 to 58% in 2012 (Dutt, 2012)

- Even more surprisingly, a survey of 100 executives undertaken by IDC in 2013 showed that 86% of the group surveyed were using cloud, compared with 71% in 2012 (Barwick, 2013b)

- A survey undertaken by Research and Market (2013) also found that CC was growing rapidly and had been adopted by 80% of Australian businesses and government agencies

- And Gartner forecast in 2013 that the largest IT spending in Australia in 2014 would be on IT services. followed by telecommunication (Salek, 2013).

The wide discrepancies in the findings of these commercial surveys, together with their suggestion of CC uptake levels so high as to be scarcely credible, indicated a need to discover the real status of CC in Australia, using sound academic analytic techniques.

2.8. Australian Government and Cloud Service Providers' Activities

This study also explores the projects and actions that have been taken by Australian Government and CSPs which might affect the adoption of CC in Australia.

In considering Australian Government CC projects, it is important to look at the real value of both the Australian National Broadband Network (NBN), which can be regarded as a huge cloud, as well as 4G Long-Term Evolution (LTE) infrastructure projects (Research and Markets, 2013). Affordability, ubiquity, high speed, low latency and high capacity are features of these projects (Research and Markets, 2013), although government NBN policy has been radically changed since the election of the Liberal National Party (LNP) federal government in 2013, to focus on delivering a cheaper and more efficient version of CC by "*shifting from a fibre-to-the-premises model to a multi-technology mix NBN"* (Department of Communications, 2014b).

The revised federal government plan 'The Coalition NBN' promises to provide an affordable NBN sooner (by the end 2019 instead of 2021) and which will cost $66/month to households instead of $90/month (Liberal Party of Australia, 2013a) as shown in Figure 2.13), though the revised NBN is not without its critics (see, for example: LeMay, 2013, Taylor, 2014, Chirgwin, 2014, Hamann, 2014).

The Facts	The Coalition NBN	Labor NBN
Timetable	2014-2019	Promised: 2009-2021 Likely: 2009-2025
Required funding	$29.5 billion	Promised: $44.1 billion Likely: $94 billion
Download rates	25-100 mbps by end of 2016 50-100 mbps by end of 2019	25-100 mbps by end of 2021
Cost to households*	$66/month	$90/month
Rollout	Priority for regions with poorest service	Prioritised by political considerations

Figure 2.13: The Coalition's Plan for a better NBN (Liberal Party of Australia, 2013b)

The efficiency and effectiveness of managing infrastructure, traffic, environment and society as a whole will be further enabled by NBN and 4G LTE projects (Research and Markets, 2013). Thus, there are opportunities to speed up data transmission in Australia by means of these projects, which can only be beneficial for CC expansion.

The literature review undertaken for this research project has identified wide interest in CC by the Australian Government, on both sides of the political divide. The federal government departments of Defence, Communications and, especially, Finance produced a substantial number of CC documents; the names, objectives and release dates of which are included chronologically in Table 2.3.

These documents indicate that Australian Government knowledge about CC has become more mature over time. For example, in April 2011 the federal government agency then known as the Department of Finance and Deregulation (now the Department of Finance) produced a 'CC Strategic Directions Paper' providing a "*guidance for agencies about what cloud computing is and some of the issues and benefits that agencies need to understand*" (Australian Government Information Management Office, 2011). In Feb 2012 the Department released a 'Cloud Better

Practice Guide' "*to assist agencies subject to the Financial Management and Accountability Act 1997 (FMA Act) better understand how to comply with privacy laws and regulations when choosing cloud based service*" (Australian Government Information Management Office, 2012a). In the same year, documents regarding financial considerations, records management, Community Cloud governance, implementation guide, security considerations, and CSP certification requirements were released to provide agencies with guidance.

In 2013, following the change of government, previously-legislated changes to the Privacy Act which significantly affected CC came into effect. The new government produced a national CC Strategy and a revised Australian CC Policy, an update to the CC strategic direction paper. In May 2014, a panel of CC providers (the Cloud Panel) was established to provide advice to government agencies regarding their requirements for cloud service (Tomlinson, 2014b). In the same year, documents relating to regulatory stock take, cloud procurement, an agreement for a whole-of-government cloud panel, a third version of the Australian Government CC policy, resource management and CC security for tenants (as well as CSPs) were produced, as summarised in Table 2.3. This huge amount of information was not only directed to government agencies but also to individual consumers, small businesses and industry in general.

Table 2.3: Australian Government Documents on CC

Release Date	Document Name	Objectives
Apr 2011	Cloud Computing Strategic Direction Paper	"*To provide a guidance for agencies about what cloud computing is and some of the issues and benefits that agencies need to understand*" (Australian Government Information Management Office, 2011)
2011	Records Management and the Cloud - a Checklist	*"To assist agencies in managing their records in the cloud"* (National Archives of Australia, 2011).
Feb 2012	Cloud Better Practice Guide	"*To assist agencies subject to the Financial Management and Accountability Act 1997 (FMA Act) better understand how to comply with privacy laws and regulations when choosing cloud based service*" (Australian Government Information Management Office, 2012a)

Apr 2012	Financial Considerations for Government Use of Cloud Computing (Better Practice Guide)	*"This guidance advice focuses on the key financial issues that agencies need to address when adopting a cloud solution"* (Australian Government Information Management Office, 2012e).
Apr 2012	Records Management and the Cloud	*"To weighed up gains in cost and efficiency of CC against the risks associated with records management"* (National Archives of Australia, 2012).
Aug 2012	Community Cloud Governance – An Australian Government perspective (Better Practice Guide)	*"To provide agencies with guidance on implementing Community Cloud Governance from an Australian Government perspective based on related frameworks using formal agreements that are managed by well-defined governance structures with clear roles and responsibilities"* (Australian Government Information Management Office, 2012c).
Sep 2012	A Guide to Implementing Cloud Services (Better Practice Guide)	"*To provide an overarching risk-based approach for agencies to develop an organisational cloud strategy and implement cloud services. It is designed as an aid for experienced business strategists, architects, project managers, business analysts and IT staff to realise the benefits of cloud computing technology while managing risks*" (Australian Government Information Management Office, 2012f).
Sep 2012	Cloud Computing Security Considerations	*"To assist agencies to perform a risk assessment to determine the viability of using cloud computing services"* (Cyber Security Operations Centre, 2012).
Dec 2012	Draft Report on Cloud Service Provider Certification Requirements for the Australian Government	*"To research and provide recommendations on possible approaches to certification of CSPs*" (Australian Government Information Management Office, 2012d).
Dec 2012	Cloud Certification Requirements for the Australian Government (draft)	"To *research and provide recommendations on possible approaches to certification of CSPs*" (Australian Government Information Management Office, 2012b).
Feb 2013	Privacy and Cloud Computing for Australian Government Agencies (Better Practice Guide)	*"To assist agencies subject to the Financial Management and Accountability Act 1997 (FMA Act) better understand how to comply with privacy laws and regulations when choosing cloud based services"* (Australian Government Information Management Office, 2013c).
Feb 2013	Negotiating the cloud – legal issues in cloud computing agreements (Better Practice Guide)	*"To assist agencies to navigate typical legal issues in cloud computing agreements"* (Australian Government Information Management Office, 2013b).
May 2013	National Cloud Computing Strategy	"*Sets out a range of actions being undertaken to promote the smart adoption of cloud services"* (Department of Communications, 2014a).
May	Cloud Computing Policy	An update of the CC Strategic Direction Paper

2013	V2	(Archer, 2013).
May 2014	Cloud Computing Regulatory Stock Take	*"To provide consumers with confidence and industry with certainty about the regulatory arrangements that apply to cloud computing. It will also assist government in identifying and addressing issues that may arise with cloud services"* (Department of Communications, 2014a).
Aug 2014	Release of Cloud Procurement Discussion Paper	"*Provide simple access to cloud procurement for agencies; and support a flexible, agile and competitive marketplace for cloud services*" (Department of Finance, 2014c).
Aug 2014	Draft Head Agreement for whole of government Cloud Panel	*"To improve flexibility and reduce burden on industry*" (Tomlinson, 2014a).
Oct 2014	Australian Government Cloud Computing Policy v3 (Smarter ICT Investment)	"*To drive a greater take up of cloud services by federal government agencies by adopting a 'cloud first' approach*" (Department of Finance, 2014a).
Oct 2014	Resource Management Guide No. 406 (Australian Government Cloud Computing Policy)	*"To provide advice on the use of cloud services by non-corporate Commonwealth entities"* (2014d).
Dec 2014	Cloud Computing Security for Tenants	*"To assist a tenant organisation's cyber security team, cloud architects and business representatives to work together to perform a risk assessment and use cloud services securely*" (Cyber Security Operations Centre, 2014b).
Dec 2014	Cloud Computing Security for Cloud Service Providers	*"To assist assessors1 validating a cloud service's security posture to provide tenants with increased assurance, rather than tenants relying solely on assertions or contractual commitments from the Cloud Service Provider. This document can also be used by Cloud Service Providers that want to offer secure cloud services"* (Cyber Security Operations Centre, 2014a).

In 2012, the federal government approved an amendment to its existing cybercrime legislation, which identifies a need to develop appropriate legal and investigatory tools and allows Australia to join the Council of Europe Convention on Cybercrime (Hooper et al., 2013).

Following the change of federal government in September 2013, there has been a significant change in federal government policy towards CC for smart Information and Communications Technology (ICT) investment. The aim of the latest Australian Government cloud computing policy (version 3.0), which was published on October 2014, is "*to reduce the cost of government ICT by eliminating duplication and fragmentation and to lead by example in using cloud services to reduce costs, lift productivity and develop better services*" (Department of Finance, 2014b). Australian Federal Government agreed on the new Commonwealth cloud policy which requests agencies "*must adopt cloud where it is fit for purpose, provides adequate protection of data and delivers value for money*" (Department of Finance, 2014b, Cowan, 2014b). As Cowan (2014b) noted *"The new cloud policy represents the formal dumping of Labor's National Cloud Computing Strategy, issued in May 2013"*. This policy will "*drive a greater take up of cloud services by federal government agencies by adopting a 'cloud first' approach*" (Department of Finance, 2014b). In addition, this policy will be updated continuously by the Departments of Finance and Communications as the elements of ICT Investment Framework are developed (Department of Finance, 2014b).

Further significant legislative changes affecting CC have resulted from the Privacy Amendment (Enhancing Privacy Protection) Act 2012 which amends the federal Privacy Act 1988, legislated by the former Labour government, but which came into force only on 12 March 2014. From that date, both private and federal public sectors must comply with the 13 new Australian Privacy Principles (APPs) which control the gathering, storing, using and disclosing of "personal information" – which is defined in the broadest possible terms since data is the "new oil" (Goldenfein, 2013). These revisions to the Privacy Act were designed to allow individuals to "*be able to participate in, and have a measure of influence over, the processing of data on them by other individuals or organisations*" (Goldenfein, 2013). APPs expand the power of the Privacy Commissioner, who can now check data at will, whereas previously a complaint had to be initiated (Francis, 2014).

Christie (2013) explains that in the context of the Cloud, companies and government agencies which handle personal information must bear the following APPs in mind:

- APP8 (cross-border disclosure of personal information): this regulates the disclosure or transfer of personal information to some other entity offshore (even if this is a parent company!). The Australian organisation is responsible for taking reasonable steps to ensure the offshore recipient will not breach the APPs; and in any case will still remain liable for all that recipient's acts and practices relating to the information, just as if they had performed those acts and practices themselves!

  - APP11.1 (security of personal information): organisations are required to ensure that 'reasonable steps' have been taken in order to protect any personal information they store – a 32-page Office of the Australian Information Commissioner (OAIC) guide is available on what those steps include

Christie (2013) explains that organisations negotiating agreements with CSPs must therefore fully understand the types and sensitivities of the personal information they upload to their CSP, the obligations they have with respect to that information, the CSP's ability to protect and manage the information (including disaster recovery provisions), its reputation and track record; and the locations of all its data centres offshore – so that the implications of foreign laws on Australian personal data can be ascertained.

These revisions to the Australian Privacy Act were designed to establish a balance between police powers and privacy, and to increase harmonisation between the jurisdictions which allow investigations to occur (Hooper et al., 2013). As a result of this new Act, the executives of large Australian organisations such as Commonwealth Bank and Coles will be likely to store the data of their customers onshore (Cowan, 2014a). The complexity of the revisions, together with a lack of clarity in the new provisions may, however, have the unintended effect of limiting Australia's chances of becoming an Asian data-centre hub (North and Thompson, 2013).

The growing demand for CC services in Australia led a group of CSPs (Macquarie Telecom, Infoplex, Fujistu and VMware) to establish a coalition called OzHub in Oct

2011, which they hoped would enhance the chances of creating an Australian regional CC hub (Macquarie Telecom, 2011). OzHub members believed that the immaturity of CC in Australia required the development of an effective self-regulation framework to ***increase trust*** and ***minimise uncertainty*** (Macquarie Telecom, 2011). OzHub was therefore created to take the initiative in understanding consumer needs and developing an effective self-regulating framework and a set of protocols for CC so as to position Australia as a national and regional cloud hosting centre (Macquarie Telecom, 2011). This coalition appeared likely to become a major driver for Australian CC and made public pronouncements on all major CC issues as they emerged. As is often the case with bleeding-edge technology companies and conglomerates, however, OzHub disappeared quite suddenly, without trace, towards the end of 2014 – leaving only the message “account suspended” at its former Uniform Resource Locator (URL).

Despite the apparent demise of OzHub, the widespread adoption and enhancement of CC policies in Australia have made it one of the world leaders in CC policies and the government cyber security centre in Canberra is a part of a new national security plan (Osman, 2013).

BSA evaluated the cloud scorecard account for 24 countries covering 80% of the global ICT market in terms of: security, privacy, intellectual property, cybercrime, promoting free trade, ICT readiness and support for international harmonisation and industry-led standards (Corbin, 2013). As of 2012, Australia ranked as the second friendliest platform for CSPs after Japan (Corbin, 2013, Osman, 2013).

This Australian CC atmosphere has attracted some giant international CSPs. For example, AWS Inc. opened the ninth region of its global CC datacentres in Sydney in 2012, because they had more than 10,000 customers in Australia and New Zealand (Amazon Web Services Inc., 2012). Data is now stored locally in Australia in two totally separated datacentres because their customers concentrate on high availability in multiple zones in order to increase fault-tolerance and minimise the latency which is expected due to the increase in the number of customers in this area (Amazon Web Services Inc., 2012). Ninemsn, one of the largest web sites in Australia, has now moved its data to AWS (Coyne, 2014).

While it is difficult to obtain a complete and up-to-date listing of CSPs operating in Australia, current suppliers include (among others): Area9, BitCloud, BrennanIT, CloudCentral, CSC Australia, Dimension Data, Fujitsu, HP, IBM SoftLayer, iiNet, Macquarie Telecom, Microsoft Australian Azure, Ninefold, Optus, OrionVM, Rackspace, Salesforce, Telstra (in partnership with VMware's vCloud Air) and Ultraserve.

2.9. Summary

This Chapter has explored the current literature and built a broad picture of the existing state of world CC, using both academic and industry sources. Although it is now seven years since the term CC was coined in 2007, this innovation is still growing dramatically.

Australia is not only participating in this trend but is also leading the Asia-Pacific region in terms of adopting CC. The a lack of soundly based academic analysis of the growth and evolution of this important innovation makes it a particularly good time to undertake research into CC and provide appropriate analysis of this phenomenon. Additional research is needed to understand fully the nature and character of CC use and diffusion within Australian organisations – and the present project offers a solid jumping-off point for future research into Australian CC development and evolution.

The literature review offered in this Chapter provides a basis for the quantitative empirical investigation which forms the core of this research project. A discussion of the methodological framework for this project is included in Chapter 3 (Research Methodology). In that Chapter, I will be discussing the relevant academic theories underpinning the empirical work of this research project. Here, the well-accepted theories of Diffusion of Innovation and Crossing the Chasm will be applied together to highlight *the acceptance* (adoption or rejection) and *the use* of CC innovation as well as its *evolution* across and within Australian organisations.

Since the reality of many theoretical aspects stated in the literature still need to be explored, the findings of the empirical investigation, illustrated in Figure 2.14, will identify the real advantages of CC which have attracted Australian organisations to adopt the innovation; and the real disadvantages which have prevented them from doing so. In addition, enabling technologies and techniques which must be applied by CC clients before adopting CC and the impact these have on achieving CC goals will be reviewed. These findings will clarify the current level of adoption of CC in Australia and its usage (i.e. service delivery models, deployment models and cloud systems).

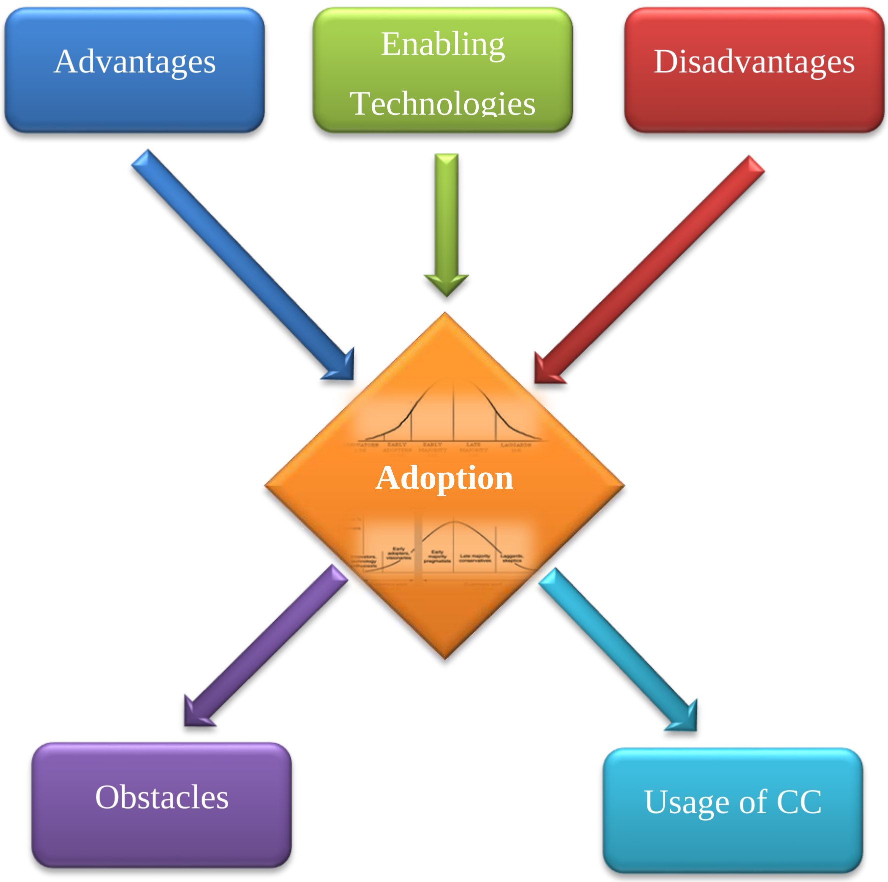


Figure 2.14: Aspects of the empirical work

Chapter 3
Research Methodology

3. Research Methodology

3.1. Research in Information Systems

The Information Systems (IS) discipline is a multidisciplinary field which studies the management and use of IT and its deployment and management (Farhoom and Drury, 2001). Neuman (2006) identifies two primary approaches to research:

1) A positivist approach which is used for gathering facts. This approach is the oldest and the most commonly used.
2) An interpretivist approach which is used by those endeavouring to understand the nature of a problem.

The positivist approach still dominates IS research, according to many researchers, including Chen, Hirschheim, Orlikowski and Baroudi (cited in Recker and Niehaves, 2008). Generalisability, precision and objectivity are the characteristics of the positivist approach (Rubin and Babbie, 2008), which is founded on the belief that objective evidence can be obtained to explain real world phenomena (Neuman, 2006). Neuman explains that positivist research offers the ability to, for example, measure precisely quantitative data gathered from thousands of participants by means of statistical analysis. Positivist research frequently makes use of quantitative data analysis methods (Mukherji and Albon, 2010) and data gathering approaches such as surveys, experiments and statistics which are designed to deal with precise quantitative data in order to test hypotheses (Neuman, 2006). Thus, positivist research is predominantly used for the gathering of information, facts or empirical data that is derived by experiment or observation (Mukherji and Albon, 2010).

Although a positivist approach enables the researcher to identify relationships between two or more phenomena, it cannot provide an understanding of causal mechanisms to the same depth as an interpretivist approach (Lin, 1998). For researchers wishing to understand meaning as well as facts the interpretive approach offers the chance to add flexibility and subjectivity to their understanding of a topic, as well as an individual perception of truth (Rubin and Babbie, 2008). Interpretivist research frequently makes use of techniques such as participant observation which can require many hours in direct personal contact with participants; and the analysis of conversation transcripts (Neuman, 2006). For example, an interpretivist researcher may spend a year with a small group of participants to gather a huge amount of qualitative data which will provide an in-depth understanding of how these people generate meaning in daily life (Neuman, 2006).

Choosing the most appropriate research approach will be influenced by the nature of the research problem itself. Since CC adoption is extremely widespread – both geographically as well as in terms of adopting company size – it would be difficult to fully understand the nature of this adoption without ‘hard’ data, indicating the benefit of taking a positivist approach (Lin, 1998) to this problem. In addition, the positivist approach provides the researcher with significant ability to generalise the data obtained from a sample to the wider population, thus elucidating both the extent of a problem and a sense of the significant variables (Lin, 1998). This ability is particularly relevant to the present research topic, particularly when applying Diffusion of Innovation Theory (Rogers, 2003) to the findings, as described and explained in Section 3.3.

3.2. Quantitative vs. Qualitative Research

In empirical research there are two main methodologies (illustrated in Figure 3.1):

1) Quantitative Research, which can be represented and analysed by numbers (Neuman, 2006). Such research provides descriptive and factual information (de Vaus, 2002). The results of quantitative research are generalisable (Rubin and Babbie, 2008).

2) Qualitative Research, which can be represented and analysed using narrative or text (Neuman, 2006). Such research is focussed on the details of particular cases (Rubin and Babbie, 2008). Thus, it has the potential to provide rich data about situations, which enables understanding of behaviours within the given context (de Vaus, 2002, Neuman, 2006). However, the results of qualitative research are not generalisable (de Vaus, 2002).

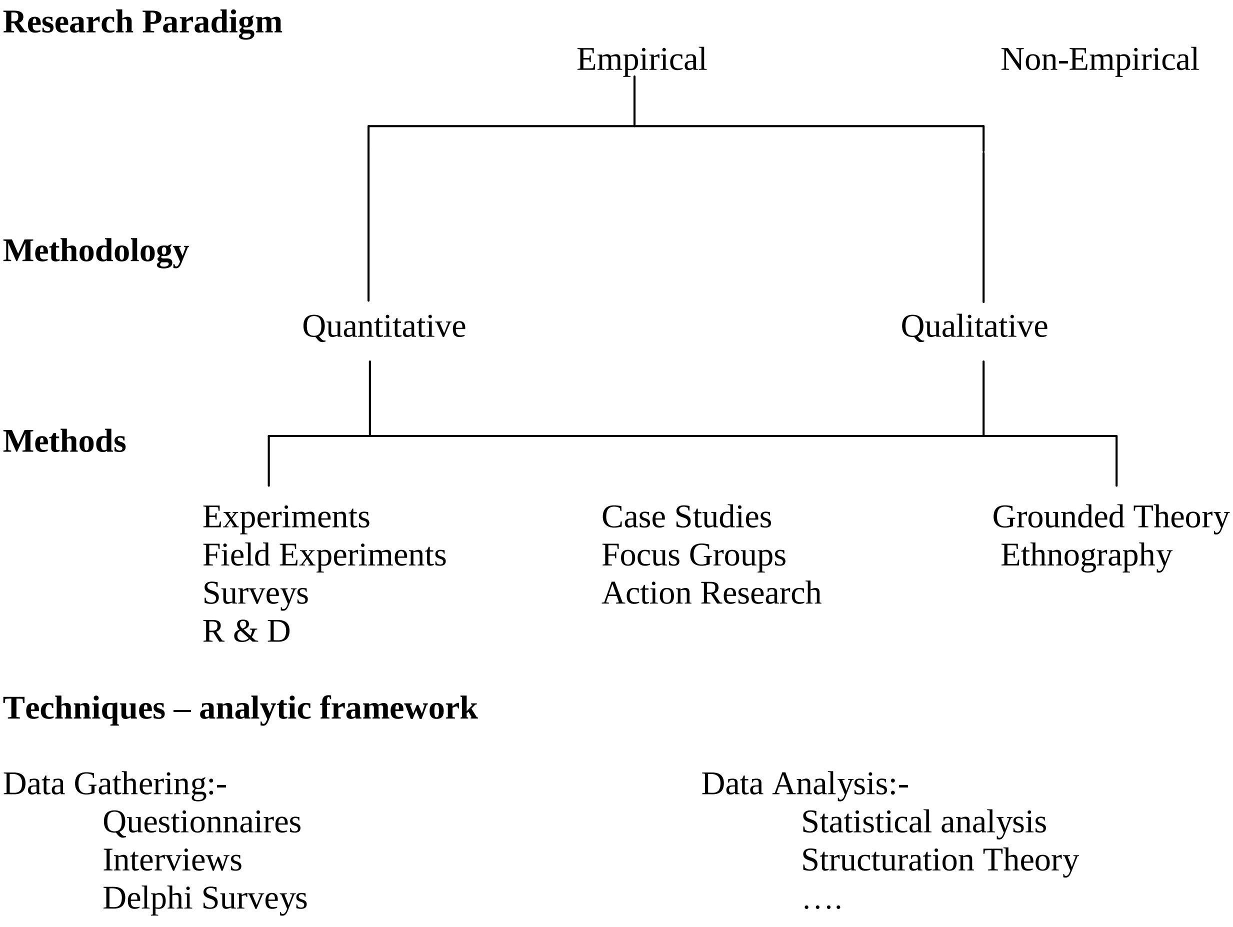


Figure 3.1: A top-down approach to researching (Swatman, 2011)

The present research project aims to provide an accurate and contemporary analysis of CC in Australia. Thus, generalisability is needed to measure and explore the diffusion of CC within Australian organisations. Qualitative research is thus not suitable since it is not generalisable, while quantitative research provides the level of generalizability required by this study. Moreover, quantitative research can provide a broad picture of the current situation of CC in Australian organisations. Consequently, quantitative research was used to understand the acceptance and evolution of CC within and across Australian organisations.

3.3. Theoretical Foundation for this Project: Diffusion of Innovation

Most individuals and almost all organisations will ultimately be affected by technological innovations as sweeping as CC (Dearne, 2011, Hayes, 2008, Greengard, 2010, Linthicum, 2010a). Moreover, success and failure stories of organisations which adopt CC can themselves affect the adoption of CC, leading others either to accept or to reject it. For example, the dramatic failure of Amazon's EC2 in April 2011, at that time possibly the world's largest CSP, appears to have had a significant impact on both the level of CC adoption as well as on diffusion rates of CC (Thorsten, 2011, IT PRO India, 2011, Weissberger, 2011).

Although there are many theoretical approaches to investigating the rates of adoption for technological innovations, Rogers' (1962) theory of diffusion of innovation is the most widely known (Sahin, 2006). In addition, Moore's theory on crossing the adoption 'chasm' in high-tech products between early adopters and the early majority (Moore, 1999) can add significantly greater insight to an analysis of the diffusion of technological innovations such as CC. Both these theories have been used together in many studies of other major IT innovations (see, for example: Agyeman et al., 2009, Cho et al., 2009, Chuang and Hsu, 2010, Constantiou et al., 2009, Egmond et al., 2006, Faiers and Neame, 2006, Greenhalgh et al., 2008, Lehmann and Esteban-Bravo, 2006, Lelarge, 2008, Linton, 2002, Towns, 2010) and they have the potential to enrich this study similarly.

3.3.1. Diffusion of Innovation Theory and Crossing the Chasm Theory

The diffusion of innovation theory was developed by Everett M. Rogers in 1962 to describe and explain the way/s in which innovations are adopted (Rogers, 2003). After studying a number of different innovations in agriculture, education, healthcare and other disciplines, he discovered that the adoption rate for any innovation is a universal process of social change. Rogers identified Relative Advantage, Compatibility, Observability, Trialability and Complexity as the five attributes for an innovation. The innovation characteristics, communication channels, time and social system were assigned in his theory as the main four elements of an innovation. Rogers investigated the adoption life cycle of an innovation and classified adopters into five categories: (1) innovators 2.5%, (2) early adopters13.5%, (3) early majority 34%, (4) late majority 34%; and (5) laggards 16% (see Figure 3.2). He then provided a profile of each category based on personality, socioeconomic and communication behaviour. For example, early adopters spend more years in education and are more knowledgeable about technology. This theory has been widely accepted and is generally regarded as the most significant contribution to identifying the stages of innovation diffusion (although a number of later researchers (e.g. Nelson, 2002, Lissoni and Metcalfe, 1994) have criticised aspects of Rogers' theory and have proposed other, specifically-tailored approaches to deal with specific circumstances.

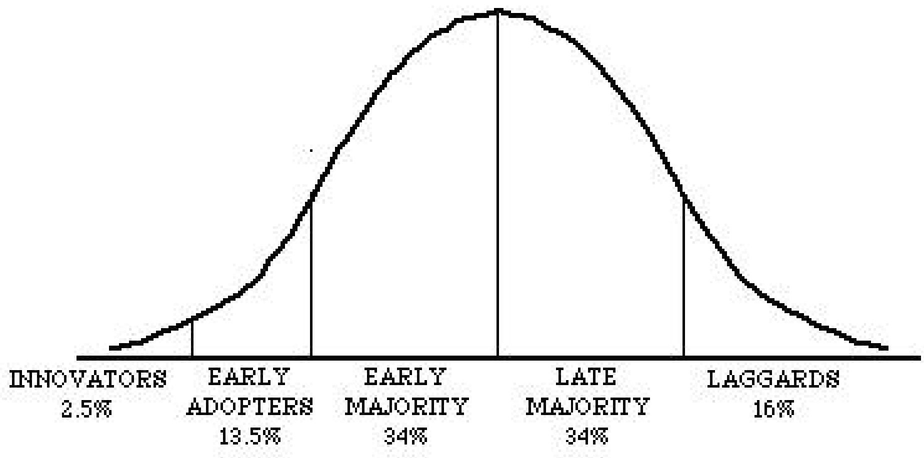


Figure 3.2: Rogers' Innovation Diffusion Bell Curve (Rogers, 2003)

Twenty-nine years later, in 1991, Geoffrey Moore developed the 'crossing the chasm' theory based on Rogers's diffusion of innovation theory (Moore, 1999). Moore focused on high tech innovations and identified a *chasm*, a slowing in the adoption rate, between the early adopters and the early majority categories (see Figure 3.3). Moore found that the early market for an innovative product (innovators and early adopters) is driven by a visionary attitude while the mainstream market (early majority, late majority and laggards) is driven by a pragmatist attitude – and that not all innovations survived as far as majority acceptance. He proposed some techniques to assist organisations cross this chasm, including "finding a pragmatist in pain" and helping him to solve his problems using the innovation so as to influence other pragmatists.

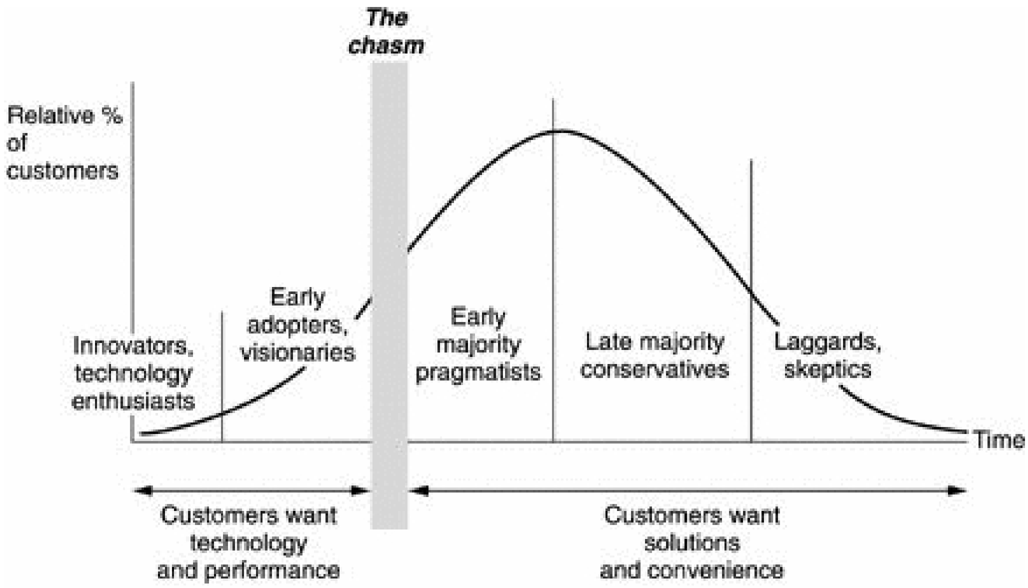


Figure 3.3: The Chasm in the Adoption Curve (Barker, 2011)

3.3.2. Why these theories are applicable and how they will be used

Since the diffusion of innovation theory and the crossing the chasm theory were built on "behaviour of specific segments of target groups" (Egmond et al., 2006) and since adopting CC innovation will cause business behavioural changes in organisations, such as changing business processes, these theories are particularly relevant to this study.

Moreover, both theories are applicable to this research since they will highlight *the acceptance* (adoption or rejection) and *the use* of CC innovation as well as its *evolution* across and within Australian organisations. In other words, both the diffusion as well as the development of CC innovation will be studied.

The adopters' categories of Rogers' theory and Moore's chasm metaphor has been used to identify whether a gap exists between the early adopters and early majority segments, since the largest obstacle for adopting an innovation is to achieve the transition between these segments (Moore, 1999, Agyeman et al., 2009). This study examines the attitudes of all categories toward CC and determines whether the chasm has been crossed, investigating how it was crossed (i.e. what new capabilities, resources and skills have been developed; and what developments have been made in CC to meet the pragmatists' requirements).

This approach also had the potential to analyse a situation where the chasm had not been crossed, investigating why this had occurred (i.e. what challenges might have occurred to slow diffusion and prevent the pragmatists from adopting the CC innovation).

3.4. Appropriate Research Methods for this Project

Figure 3.4 summarises the research methodology for this project which includes research approach, research method, data gathering technique and data analysis technique.

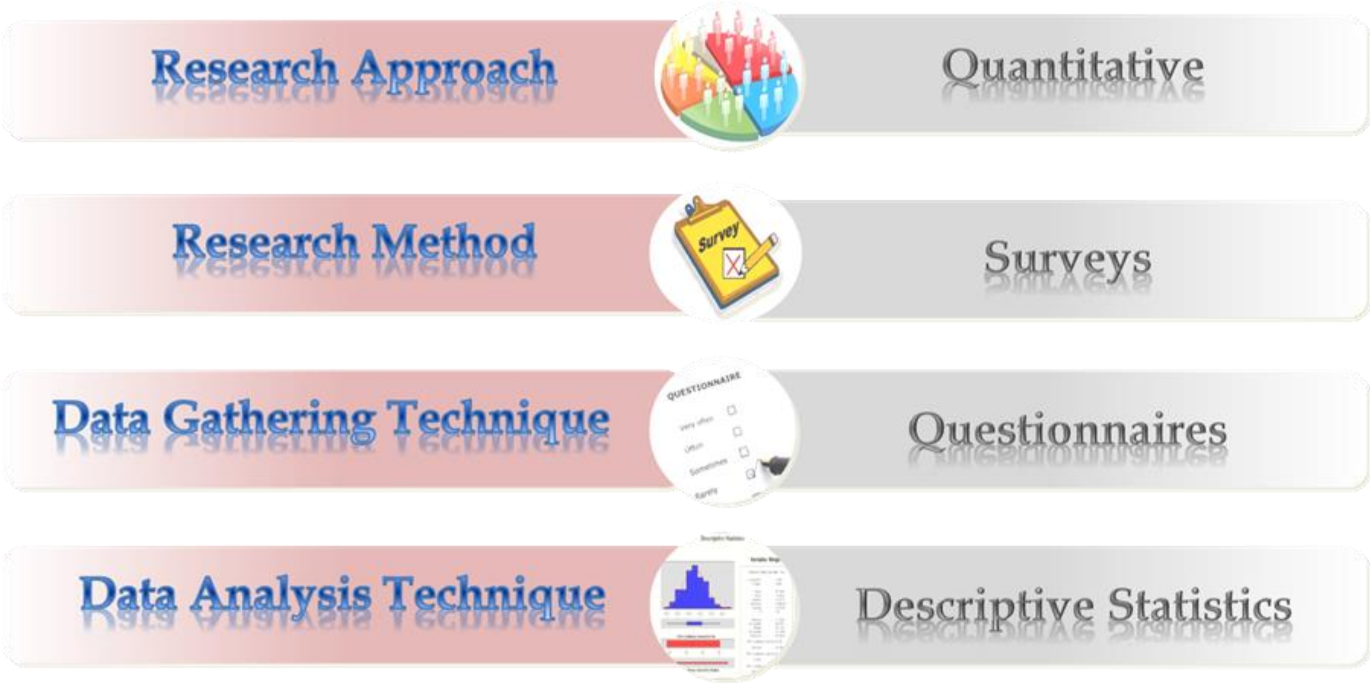


Figure 3.4: Research Methodology

There is a range of research methods which are commonly used in IS research (see Table 3.1) and researchers select the most appropriate approach/es from these options. From this table, surveys has been selected as the most suitable research method of Quantitative approach for this research study, since the researcher cannot use experiment for this type of research and has no control over events of the CC phenomenon in Australia which is being investigated. This study is also a longitudinal investigation which compares two 'snapshots' of the status of CC in Australia using two surveys (16 months apart) as described in Section 3.4.2.

Table 3.1: Traditional Quantitative and Qualitative Approaches (Tashakkori and Teddlie, 2003)

Traditional Quantitative Approaches	Traditional Qualitative Approaches
• Experimental • Quasi-experimental • Casual Comparative • Co-relational • Surveys	• Focus Groups • Case Studies • Ethnographic research • Participatory models of research

3.4.1. Surveys

Surveys are used in exploratory, explanatory and descriptive studies (Babbie, 2001) to provide descriptive and factual information (de Vaus, 2002). They are excellent in measuring attitudes of participants (Babbie, 2001, Tashakkori and Teddlie, 2003). Surveys seek to understand what may cause a phenomenon (de Vaus, 2002).

3.4.2. Longitudinal Research

Babbie (2001) provides a clear and simple explanation of longitudinal research:

A longitudinal study is used to observe a phenomenon over a period of time. A researcher can participate in the activities of this phenomenon or can study its changes over time. Many longitudinal research projects involve direct observation and possibly in-depth interviews. Although the longitudinal study can be more difficult if a quantitative technique is used (i.e. large scale surveys), it is often the best approach to study changes over time.

There are special three types of longitudinal study:

1) *Trend study*: observes changes over time within a population.

2) *Cohort study*: observes changes over time within a specific subpopulation or cohort (i.e. age group).

3) *Panel study*: observes the same group of people each time.

Both trend and cohort studies show net changes, while a panel study provides the most complete picture and the most comprehensive data on changes across a number of different categories. Although giving information which describes processes over time is an advantage of a longitudinal study, it costs both time and money. In addition, observations may have to take place at the time of the occurring phenomenon. Moreover, panel attrition is a major problem facing a panel study. For example, some of the participants of the first wave of the survey might not respond in the next wave.

Thus, results can be distorted and potentially give rise to misleading conclusions, if this problem is not taken into account.

Since this research is investigating the acceptance and evolution of CC in Australian organisations and asking about how the acceptance and use of CC within and across Australian organisations has evolved over the period 2012-2013, a *longitudinal research approach* is very appropriate, since it can observe this evolution and study the changes over time (Babbie, 2001). Moreover, surveys and/or case studies are commonly used in longitudinal studies (Venkatesh and Vitalari, 1991). Furthermore, longitudinal survey research considered a valuable tool to investigate contemporary IS issues (Venkatesh and Vitalari, 1991). It is worth noting in passing that the panel attrition problem could be minimised by surveying a very broad sample of organisations in the first survey which leads to a suitably large number of participants in the second survey. In addition, announcing prizes for randomly selected participants in the second survey may encourage participants and raise their number to be close to the first survey.

3.5. Data Gathering Technique

There is no ideal method for conducting research because each individual method has both strengths and weaknesses. However, since the objective of this research project was to understand the acceptance and evolution of CC in Australian organisations, the research approach taken was positivist and exploratory; and made use of a quantitative methodology. Questionnaires are widely and commonly used in surveys (de Vaus, 2002) and can be used in exploratory, explanatory and descriptive studies (Babbie, 2001) and, in addition, are less expensive to administer than interviews (Tashakkori and Teddlie, 2003). Thus, questionnaire was selected as the main technique for data gathering. Additional data was collected from government policy announcements, industry articles, the limited base of academic articles in this area, news articles and observation of CC events.

The project, as a longitudinal study, involved two surveys some sixteen months apart, with both surveys being conducted online and using a questionnaire as the data gathering technique. It was hoped that the number of participant organisations responding to the survey would be between 200 and 500. The target group was Chief Information Officers (CIOs) or their equivalent (i.e. IT Manager, Technical Support Manager or Network Manager) in each of the organisations invited. In order to maximise the number of participants, an Australian CC service provider was requested to distribute invitations to take both surveys to their clients – although this did not prove successful.

3.6. Data Analysis Technique

Since CC is a new innovation and is evolving over time (Mell and Grance, 2010), it is important to analyse the data by arranging events chronologically so as to understand "what led to what and when" and to state the actors, their actions and the implications.

Descriptive statistics is a way of describing data in manageable structures (Babbie, 2001). It is used as a *quantitative* data analysis technique (Babbie, 2001), summarises the patterns of the cases and provides such information as their averages (de Vaus, 2002). Thus, this technique was used to analyse the data of the first and the second surveys to give an overview for this study.

Dooley (1990) has defined Regression Analysis as "*a procedure for analysing the association of two variables while controlling or statistically adjusting for the effects of one or more other variables*". Along with descriptive statistics, ordinal/ordered logistic regression was used to analyse the ranked/Likert scale data and logistic regression was used to analyse the binary data (Stata version 13, StataCorp, Texas, US). Holms post hoc analysis was used to adjust p values for multiple comparisons. Comparisons were between the two years for the same categories or between categories in a given year. Data was also adjusted for potential confounders including industry sector, State and organisation size. There were very small number of users/respondents for questions on various deployment models and respondents were allowed to choose more than one answer. Hence, to avoid over-interpretation of data for various deployment models, this data was not statistically tested.

3.7. Research Design

The research design for this project includes two 'snapshots' of the situation of CC in Australia using surveys. Since CC is currently a 'bleeding edge' phenomenon (i.e. a new phenomenon that is changing rapidly) it is important to trace developing trends in order to predict the future.

Then, a comparison can be made between the two snapshots to investigate what changes occurred over the given time interval.

This study adopted positivist research to explore the research questions. The two stages of the methodology are shown in Figure 3.5.

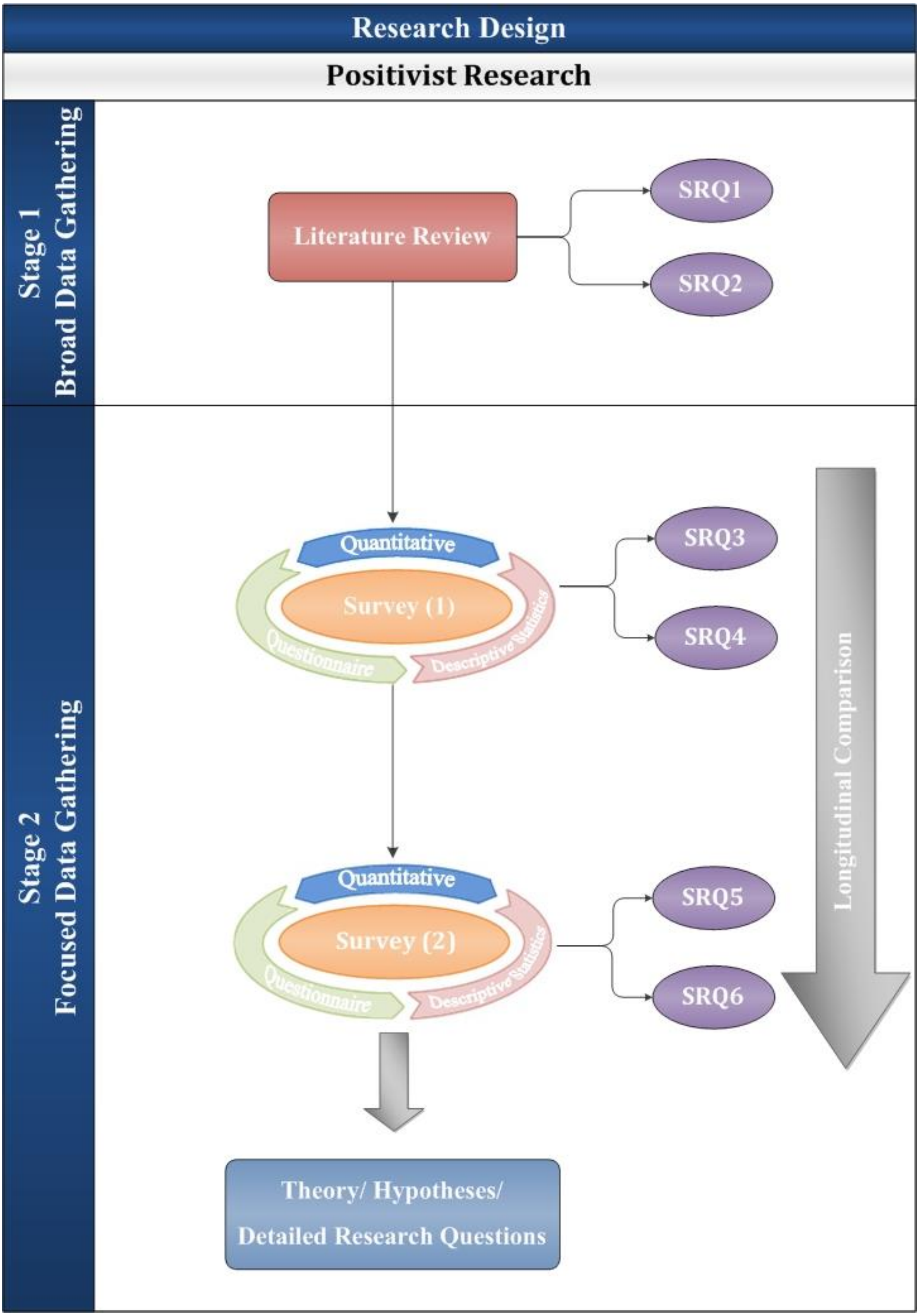


Figure 3.5: Research Design

In the first stage, broad data were gathered by reviewing the current literature about CC so as to gain a broad understanding, and to answer the first two SRQs which were as follows:

SRQ1: What is the overall understanding of the role and nature of CC?

SRQ2: What is the current view of the pattern of diffusion of CC by organisations and market sectors?

In the second stage, the initial web-based survey was conducted in 2012 to explore issues and practices regarding CC in a number of Australian organisations to respond to the following subsidiary questions:

SRQ3: What is the role and nature of CC in contemporary Australian organisations?

SRQ4: What is the nature and character of the diffusion of CC in contemporary Australia?

a) Across organisations.
b) Within organisations.

The knowledge gained was broad and the number of participant organisations was 417 for the first web-based survey in 2012. After 16 months in 2013, a follow up web-based survey (second survey) was conducted to gain a broad understanding of usage of CC in Australian organisations among the same invitees of the first survey, which attracted 176 participants. A longitudinal comparison was then used to answer the last two subsidiary research questions:

SRQ5: How have Australian organisations' views on the role and nature of CC changed over the period of the study?

SRQ6: How has the nature and character of the diffusion of CC in Australian organisations changed over the period of the study?

The Questionnaires provided a rich basis for analysing the facts of CC in Australia

3.8. An unexpected Challenge

Obtaining a mailing list was a LONG process. Unfortunately, the University's library database was unable to provide a mailing list for the target group. Searching for a company that provide a commercial mailing list and investigating sources of funding took approximately 3 months and the commercial solution proved to be very expensive. Coordinating funding for the mailing list between the project sponsor and the University was both administratively complex and time-consuming.

Further issues arose because the mailing list purchased had not been fully qualified by the seller (despite its promises in this regard) and a small number of the companies approached complained they had been spammed. Distribution of the second survey was then held up until conditional approval could be obtained from the University to proceed with a revised contact strategy which included:

- Removing those people who had complained about spamming from the mailing list; and
- Adding the source of the email addresses, together with information about how to contact the mailing list provider and an apology for the inadvertent spam to the invitation for the second survey.

3.9. Survey Questions and Justifications

Questions for a study of this kind must be designed carefully by selecting the most appropriate questions vs. those most likely to still be relevant in 16 months' time for the follow-up survey. This is a challenge, especially when there is a lack of academic literature relating to the topic under investigation. Therefore, the following questions have been designed according to the literature that was available at the beginning of the study. Thus, a justification has been articulated based on the literature prior to each question, including its options.

The logic design for the first survey shows that the first seven questions are common to all groups of respondents, as illustrated in Figure 3.6. It also demonstrates that question

7 will classify the respondents into five categories: Current Adopters, Past Adopters, Future Adopters, Undecided Non-Adopters and Definite Non-Adopters.

All questions past this point, such as questions 9 (a-d), were reformatted according to each category; while the options of these questions remained the same for all categories.

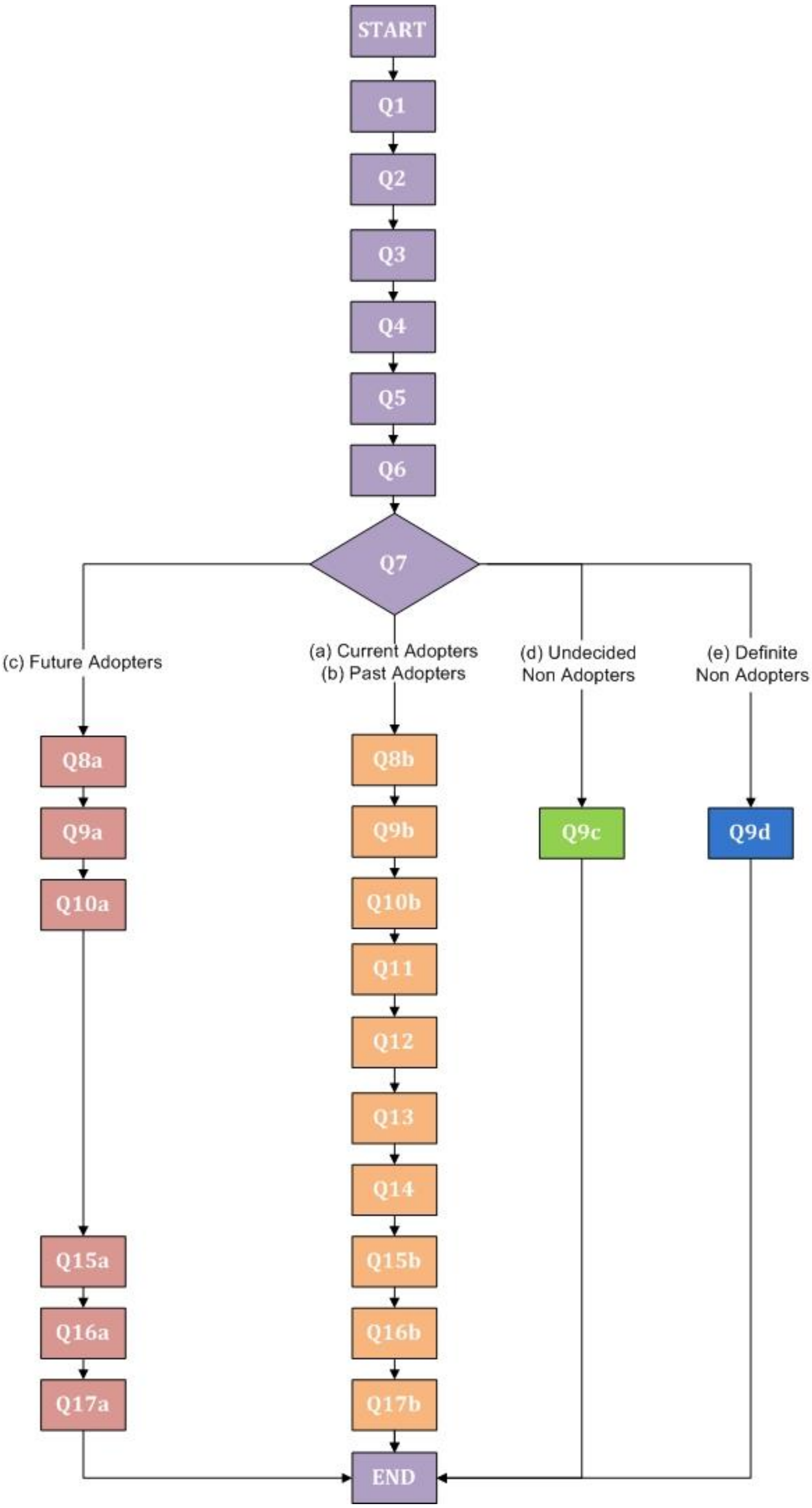


Figure 3.6: Logic design for the first survey (2012)

3.9.1. Demographic Questions

The literature (Foo, 2010b, LeMay, 2010a, LeMay, 2010b, Australian Government Information Management Office, 2011, Taylor, 2010) indicated that Australian Government, Education, Financial and Telecommunication sectors were adopting CC. However, the percentages of each sector's opinions on the role and nature of CC and its adoption in other industry sectors had not been examined by other authors. Thus, question 1 was designed to enable the survey findings to be related to industry sectors so as to classify participant responses by industry sector. Moreover, studying the changes over the period of study (i.e. the difference between the responses to this question in the 1st and 2nd survey) had the potential to enable the researcher to determine the level of variation of opinions on the role and nature of CC, as well as its diffusion within individual industry sectors during the period of the study.

Q1: Please indicate the industry sectors to which your organisation belongs [Mark multiple sectors if relevant]

- Agriculture
- Construction
- Education
- Energy
- Financial
- Fishing
- Government
- Healthcare
- Information Technology
- Manufacturing
- Media
- Mining
- Real Estate
- Retail
- Services
- Telecommunication
- Tourism
- Transportation
- Utilities
- Wholesale distribution
- Other (please specify)

Although Pauli (2010) stated that the then NSW government was enthusiastic about CC, opinions on the role and nature of CC, as well as its diffusion within all States, was unknown. Therefore, question 2 was designed to enable the researcher to relate the survey findings to individual Australian States so as to classify participant responses by State. In addition, studying the changes over the period of study (i.e. the variation between the responses of this question in the 1st and 2nd survey) enabled an examination of difference of opinions concerning the role and nature of CC, as well as its diffusion within Australian States over the period of the study.

Q2: Please select the States in which your organisation and its branches are located [Select more than one if appropriate]

- ACT
- NSW
- NT
- QLD
- SA
- TAS
- VIC
- WA

The literature (LeMay, 2010a, LeMay, 2010b, Taylor, 2010, Foo, 2010b) showed that large Australian organisations were adopting CC. However, opinions on the role and nature of CC, or its adoption by small or medium organisations, had not been studied in depth. Thus, question 3 enabled the given information on CC in the survey to be categorised organisation size (small, medium or large). Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled the researcher to specify the variation of practices and opinions on the role and nature of CC, as well as its diffusion within differing sizes of organisations.

Q3: Approximately how many employees are currently working in your organisation?

- Under 5
- 5-10
- 11-20
- 21-50
- 51-100
- 101-499
- 500- 999
- 1000-4999
- 5000-10000
- More than 10000

It was important to ensure survey participants represented IT management, holding positions such as CIO, IT Manager, Technical Support Manager or Network Manager.

Therefore, question 4 was designed to enable the researcher to identify respondents' job titles.

Q4: Please indicate your job title.

- CIO
- IT Manager
- Technical Support Manager
- Network Manager
- Other (please specify) [ ]

3.9.2. Beliefs about Cloud Computing

The literature (Kotadia, 2010, Macquarie Telecom, 2011) indicated considerable uncertainty and confusion over the concept of CC among Australian CIOs. However, the influences of this uncertainty on the role, nature and adoption of CC were unknown. Thus, question 5 was designed to enable the data gathered on CC in the survey to be related to the level of uncertainty among Australian CIOs. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) had the potential to determine variation of uncertainty between the two surveys.

At the start of this project OzHub, a coalition between four CSPs (Macquarie Telecom, Fujitsu, VMware and Infoplex) which was established in October 2011 to minimise this uncertainty and to increase levels of trust and position Australia as a national and regional cloud hosting centre (Macquarie Telecom, 2011), appeared likely to become a major driver for Australian CC. As is often the case with bleeding-edge technology companies and conglomerates, however, OzHub disappeared quite suddenly, without trace, towards the end of 2014.

This question was also designed to demonstrate the influences of uncertainty on the role and nature of CC as well as its diffusion within Australian organisations.

Q5: How well do you believe you understand the concept of Cloud Computing (CC)?

- Very Well
- Reasonably Well
- Neutral
- Not very well
- I really don’t understand it at all

6 (a) According to Erdogmu (2009), the main drivers of CC adoption are economics and simplicity of software operation and delivery. However, the level of agreement on this statement among Australian CIOs and its effect on the role, nature and adoption of CC has not been examined. Thus, question 6 (a) was designed to enable the data gathered on CC in the survey to be related to the level of agreement with this statement. In addition, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) allowed a determination of the level of agreement with this statement and its effect on the role and nature of CC, as well as its diffusion within Australian organisations.

6 (b) The literature (Linthicum, 2010a, Foo, 2010b) indicated that CC is a tool which enables an organisation to be more productive and cost effective. However, the level of agreement with this statement among Australian CIOs and its effect on the role, nature and adoption of CC has not been studied. Thus, question 5 (b) was designed to enable the given information on CC in the survey to be related to the level of agreement with this statement. In addition, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) allowed verification of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

6 (c) Although Gartner (2010) stated that CC would be one of the top ten strategic technologies for the next 5 years, the level of agreement with this statement

among Australian CIOs and its effect on the role, nature and adoption of CC had not been verified. Thus, question 6 (c) was designed to enable the data gathered on CC in the survey to be related to the level of agreement on this statement. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

6 (d) The literature (Wang et al., 2008, Linthicum, 2010a, Erdogmu, 2009, Hunter, 2009) indicated that virtualisation was required to enable CC. However, the level of agreement on this statement and its effect on the role, nature and adoption of CC had not been studied in depth. Thus, question 6 (d) was designed to enable the given information on CC in the survey to be related to the level of agreement with this statement. In addition, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled verification of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

6 (e) Although the literature (Wang et al., 2008, Linthicum, 2010a) stated that SOA was required to enable CC, the level of agreement on this statement among Australian CIOs and its effect on the role, nature and adoption of CC had not been theorised. Thus, question 6 (e) was designed to enable the data gathered on CC in the survey to be related to the level of agreement with this statement. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

6 (f) The literature (Australian Government Information Management Office, 2011, Dearne, 2011) indicated that CC in Australia is currently immature. However, the level of agreement on this statement and its effect on the role, nature and adoption of CC had not been verified. Thus, question 6 (f) was designed to enable the given information on CC in the survey to be related to the level of agreement on this

statement. In addition, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled verification of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

6 (g) Although the literature (Hunter, 2009, JB, 2009) indicated that CC was likely to prove the future of IT, the level of agreement on this statement among Australian CIOs and its effect on the role, nature and adoption of CC had not been examined. Thus, question 6 (g) was designed to enable the data gathered on CC in the survey to be related to the level of agreement with this statement. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the level of agreement with this statement and its effect on the role and nature of CC as well as its diffusion within Australian organisations.

Q6: To what extent do you agree with the following statements? [Please respond to all items a-g]

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't Know
a) The main drivers of CC adoption are economics and simplicity of software operation and delivery. (Erdogmu, 2009)	○	○	○	○	○	○
b) CC is a tool that enables the organisation to be more productive and cost effective. (Linthicum, 2010a, Foo, 2010b)	○	○	○	○	○	○
c) CC will be one of the top ten strategic technologies for the next 5 years (Gartner, 2010).	○	○	○	○	○	○
d) Virtualisation is required to enable CC (Wang et al., 2008, Linthicum, 2010a, Erdogmu, 2009, Hunter, 2009)	○	○	○	○	○	○
e) Service Oriented Architecture (SOA) is required to enable CC (Wang et al., 2008, Linthicum, 2010a).						

3.9.3. Adoption of Cloud Computing

According to Banks (2011), 43% of Australian organisations had adopted CC at that time. However the percentages of willingness, abandonment or rejection of CC among Australian organisations were not yet known. Thus, question 7 was designed to enable the information given in the survey to be related to the percentage of adoption, abandonment and rejection of CC among Australian organisations. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) provided the ability to determine the percentage of willingness, adoption, abandonment and rejection of CC among Australian organisations.

Question 7 classified respondents into the following five categories:

- *Current Adopters* (organisations which already adopted CC)
- *Past Adopters* (organisations that adopted CC in the past but then they terminated their use of it)
- *Future Adopters* (organisations which expected to adopt CC in the near future)
- *Undecided Non Adopters* (organisations which have not decided whether to adopt CC or not)
- *Definite Non Adopters* (organisations that decided not to adopt CC)

This classification was designed to enrich the gathered data so as to enable a more precise understanding of the acceptance and use of the CC innovation, as well as its evolution across Australian organisations. For easier understanding, the target category for all questions after question 7 is included at the end of the description of each question.

Q7: Has your organisation already adopted Cloud Computing?

a) We have already adopted it
b) We adopted CC in the past but have since then terminated our use of it
c) We expect to adopt it in the near future
d) We have not yet decided whether to adopt CC
e) We will not adopt CC

Although Google Trends (2011) indicated that CC first came to general attention in 2007and has grown in popularity rapidly since then, the real starting time of adopting CC by Australian organisation, as well as the annual adoption rate, was not yet known.

Thus question 8 (a-b) was designed to relate the information given in the survey to the time of first adoption of CC and to identify its annual adoption rate. In addition, studying the changes over the period of study (i.e. the variation between the responses of this question in the 1st and 2nd survey) offered the ability to examine the differences between diffusion rates across Australian organisations.

Q8a: When do you expect your organisation will adopt CC? - *(For Future Adopters)*

- 2012
- 2013
- 2014
- 2015
- 2016
- Other (please specify)

Q8b: When did your organisation adopt Cloud Computing? - *(For Current Adopters and Past Adopters)*

- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- Other (please specify)

3.9.4. Concerns about Cloud Computing

The reviewed literature identified many of the challenges and risks associated with CC that concern organisations. However, the reality of these challenges and risks, as well as their influences on the role, nature and adoption of CC among Australian organisations, had not been examined. Thus, question 9 (a-d) was designed to enable the information given in the survey to be related to the reality of these challenges and risks, as well as to their influences on the role, nature and adoption of CC among Australian organisations. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled verification of the reality of these challenges and risks as well as their influences on the role, nature and adoption of CC among Australian organisations.

Questions 9 (a-d) were reformatted according to the category respondents had indicated their organisation belonged to, although the options offered by each of these questions remained the same for all categories. The target category for each of the following questions was mentioned at the end of the question – and is included here, together with the references justifying its inclusion in the question.

Q9a: Which of the following concerns do you believe are likely to prevent your organisation from adopting CC? [Tick all that apply] - *(For Future Adopters)*

Q9b: Which of the following problems concerned you when your organisation adopted CC? [Tick all that apply] - *(For Current Adopters and Past Adopters)*

Q9c: Which of the following concerns are likely to prevent your organisation from adopting CC? [Tick all that apply] - *(For Undecided Non Adopters)*

Q9d: Which of the following concerns prevented your organisation from adopting CC? [Tick all that apply] - *(For Definite Non Adopters)*

a) Security problems (Lau, 2010, Linthicum, 2010a, Greengard, 2010, Smith, 2011)

b) Privacy problems (Linthicum, 2010a, Hayes, 2008)

c) Availability problems with cloud service providers (Linthicum, 2010a, Banks, 2010)

d) Integration problems (Lawson, 2010, Linthicum, 2010a)

e) Development problems (Harding and Open Group, 2011)

f) Recovery problems (Gozzi, 2010, Harding and Open Group, 2011)

g) Legal problems (Harding and Open Group, 2011, Schaffer, 2009, Australian Government Information Management Office, 2011, Linthicum, 2010a)

h) Unsatisfactory Service Level Agreement (SLA)

i) Quality problems (Harding and Open Group, 2011, Linthicum, 2010a)

j) Organisational and cultural problems (Harding and Open Group, 2011)

k) Loss of control (Linthicum, 2010a, Erdogmu, 2009, Hayes, 2008, Gozzi, 2010)

l) Lack of trust with cloud service Providers (Erdogmu, 2009)

m) Lack of service orientation (McKendrick, 2011)

n) Insufficient skills (Linthicum, 2010a)

o) Immaturity of technology (Australian Government Information Management Office, 2011, Dearne, 2011, Hunter, 2009).

p) Internet Outages (Linthicum, 2010a, Banks, 2010)

q) None

r) Other (please specify)

3.9.5. Importance of Expected Benefits

Although the reviewed literature highlighted the potential benefits of CC, the actual level of importance of these benefits for Australian CIOs had not yet been studied. Thus, question 10 (a-b) was designed to enable the data gathered on CC in the survey to be related to the level of agreement with these benefits, identifying what was attracting Australian CIOs to adopt CC, as well as the influences of the various benefits on the role, nature and adoption of CC among Australian organisations. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) offered the possibility of verifying the level of agreement with these benefits, as well as their influences on the role, nature and adoption of CC among Australian organisations.)

Although there was no difference between question 10a and 10b in terms of the options they provided to respondents, it was necessary to separate these questions so as to associate each question with its target category, as mentioned at the end of each question.

Q10a: Please indicate how important the following EXPECTED benefits were in your decision to adopt Cloud Computing. - *(For Future Adopters)*

Q10b: Please indicate how important the following EXPECTED benefits were in your decision to adopt Cloud Computing. - *(For Current Adopters and Past Adopters)*

		Extremely Important	Very Important	Important	Not Very Important	Not at All Important
a)	To reduce costs (Linthicum, 2010a, Erdogmu, 2009, Hunter, 2009, Dearne, 2011).	○	○	○	○	○
b)	To maintain our systems more effectively (Linthicum, 2010a)	○	○	○	○	○
c)	To improve business performance significantly (Schaffer, 2009)	○	○	○	○	○
d)	To enable us to introduce new systems more easily (Linthicum, 2010a)	○	○	○	○	○
e)	To add or remove services as needed (Linthicum, 2010a, MacVittie, 2008, Erdogmu, 2009, Mell and Grance, 2010, Kepes, 2011)	○	○	○	○	○
f)	To facilitate internal communication (JB, 2009).	○	○	○	○	○
g)	To increase productivity (Linthicum, 2010a, Foo, 2010b).	○	○	○	○	○
h)	To improve security (Computer Edge, 2010, Orfano, 2009)	○	○	○	○	○
i)	It can be implemented quickly (Orfano, 2009, Schaffer, 2009, Linthicum, 2010a)	○	○	○	○	○
j)	To avoid the expense of buying licenses (Gozzi, 2010, Knorr and Gruman, 2010).	○	○	○	○	○
k)	Implementation or administration of IT infrastructure is not needed (Orfano, 2009, Schaffer, 2009).	○	○	○	○	○
l)	It is accessible via any internet-connected device (Orfano, 2009, JB, 2009, Erdogmu, 2009, Linthicum, 2010a)	○	○	○	○	○
m)	It is green IT (Orfano, 2009, Linthicum, 2010a)	○	○	○	○	○
n)	Other (please specify)	○	○	○	○	○

3.9.6. Realised Benefits

The reviewed literature had identified potential benefits of CC (and with considerable enthusiasm!). However, the realities of these potential benefits, as well as their influences on the role, nature and adoption of CC for Australian organisations, had not been examined. Thus, question 11 was designed to enable the given information on CC in the survey to be related to the reality of these potential benefits, as well as their influences on the role, nature and adoption of CC among Australian organisations. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) offered the ability to verify the reality of these potential benefits and the level of improvement that have been occurred during the study as well as their influences on the role, nature and adoption of CC among Australian organisations.)

Q11: Please indicate which of the following benefits were actually REALISED after your adoption of Cloud Computing? [Tick all that apply] **-** *(For Current Adopters and Past Adopters)*

a) It reduced costs

b) It led to more effective systems maintenance

c) It improved our business performance significantly

d) It enabled us to introduce new systems more easily

e) It was easy to add or remove services as needed

f) It facilitated internal communication

g) It increased productivity

h) It improved security

i) It was implemented quickly

j) It avoided the expense of buying licences

k) Implementation or administration of IT infrastructure was not needed in CC

l) It was accessible via any internet-connected device

m) It was green IT

n) None

o) Other (please specify)

3.9.7. Experience after Using Cloud Computing

Although 43% of Australian organisations had adopted CC by 2011, according to Banks (2011), the feasibility of applying CC in reality and the levels of satisfaction among Australian Cloud Adopters had not been studied. Thus, question 12 was designed to enable the survey findings to be related to feasibility of applying CC in reality and the satisfaction level among the Australian organisations. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the maturity level of CC in Australia by measuring the goal achievements and satisfaction levels among the Australian organisations.

Q12: To what extent have your organisational goals for cloud computing adoption been achieved? - *(For Current Adopters and Past Adopters)*

- Fully achieved
- Mostly achieved
- Partially achieved
- Not really achieved
- Not achieved at all

The reviewed literature indicated that service interruptions (unavailability of services) were a significant concern for adopters of CC. However, the average number of service interruptions (unavailability of services) and their influence on the role, nature and adoption of CC among Australian organisations had not yet been studied. Thus, question 13 was designed to enable the information on CC in the survey to be related to unavailability of CC services. In addition, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled verification of this concern and the possibility of measuring the average number of service interruptions, as well as the influences of these interruptions on the role, nature and adoption of CC among Australian organisations.

Q13: How many times per month on average did you find CC services unavailable (i.e. you can't access to CC services)? - *(For Current Adopters and Past Adopters)*

- ○ 0
- ○ 1-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ More than 20

The reviewed literature had identified the characteristics and infrastructure properties of CC. However, these CC characteristics and infrastructure properties had not yet been examined in Australia. Thus, question 14 was designed to enable data gathered on CC in the survey to be related to the real characteristics and infrastructure properties of CC in Australia. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the improvements to IT generally offered by CC's characteristics and infrastructure properties, as well as their influences on the role, nature and adoption of CC among Australian organisations.

Q14: From your experience with CC services which of the following statements do you believe is true? (Tick all that apply) - *(For Current Adopters and Past Adopters)*

- ☐ The provided service is not affected when our cloud service provider adds more computer resources to the cloud (MacVittie, 2008).
- ☐ Our cloud service provider monitors the services that are out of order or performing poorly (MacVittie, 2008, Linthicum, 2010a).
- ☐ Our cloud service provider can measure the provided service in order to issue invoices or bills (Mell and Grance, 2010, Kepes, 2011).
- ☐ The provided service is secure (MacVittie, 2008, Computer Edge, 2010).
- ☐ Our organisation can scale the service up or down immediately on demand (MacVittie, 2008, Kepes, 2011, Linthicum, 2010a).
- ☐ We can register online and receive services immediately (Linthicum, 2010a, Mell and Grance, 2010, Kepes, 2011).
- ☐ We can access the service via any internet-connected devices such as desktop, laptop, smart phone, tablet or other device (Orfano, 2009, JB, 2009, Erdogmu, 2009, Linthicum, 2010a).
- ☐ Our existing systems were virtualised before we moved to the cloud (Wang et al., 2008, Linthicum, 2010a, Erdogmu, 2009).
- ☐ Service Oriented Architecture (SOA) was applied before we moved to the cloud (Wang et al., 2008, Linthicum, 2010a).
- ☐ None

3.9.8. Service Delivery Models and Deployment Models

The reviewed literature had identified three possible CC service delivery models (SaaS, PaaS and IaaS). However, no exploration had yet been undertaken of which of these service delivery models was actually in use within Australia; and the location of CSPs had not been explored. Thus, question 15 (a-b) was designed to enable data gathered on CC in the survey to be related to the service delivery models which were in use in Australia, as well as the location of CSPs. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the evolution of service delivery and the location of CSPs, as well as the influences of this evolution on the role, nature and adoption of CC among Australian organisations.

Question 15 (a-b) were reformatted according to category of respondent, although the options within each of these questions remained the same for all categories. The target category for each question was mentioned at the end of the question itself.

Q15a: Please indicate the service delivery models and the type of cloud service provider that you are looking to use in CC: [Indicate more than one type of cloud service provider and service delivery model if applicable] - *(For Future Adopters)*

Please note that:

- **Software as a Service (SaaS)**, also known as application-as-a-service, is fully provisioned software available for rent.
- **Platform as a Service (PaaS)** is a development environment.
- **Infrastructure as a Service (IaaS)** or Hardware as a Service (HaaS) is really datacentre-as-a-service which rent access to computers, space to store data or a processing facility.

Q15b: Please indicate the service delivery models and the type of cloud service provider that you have used in CC: [Indicate more than one type of cloud service provider and service delivery model if applicable] - *(For Current Adopters and Past Adopters)*

Please note that:

- **Software as a Service (SaaS)**, also known as application-as-a-service, is fully provisioned software available for rent.
- **Platform as a Service (PaaS)** is a development environment.
- **Infrastructure as a Service (IaaS)** or Hardware as a Service (HaaS) is really datacentre-as-a-service which rent access to computers, space to store data or a processing facility.

	International cloud service provider	Australian cloud service provider
SaaS	○	○
PaaS	○	○
IaaS	○	○

The reviewed literature had identified three CC service delivery models (SaaS, PaaS and IaaS) and four CC deployment models (Public cloud, private cloud (on-site & out-sourced), community cloud (on-site & out-sourced); and hybrid cloud). In addition, it had been suggested that large Australian organisations were predominantly interested in Private Cloud (LeMay, 2010b), while Banks (2011) suggested that 50% of Cloud Adopters in Australia were using a hybrid deployment model. No exploration of actual service delivery or deployment model selection within Australia had, however, been undertaken.

Thus, question 16 (a-b) was designed to enable data gathered on CC in the survey to be related to the selection of service delivery and deployment models within Australia. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled determination of the evolution of service delivery and deployment model selection, as well as its influences on the role, nature and adoption of CC among Australian organisations.

Question 16 (a-b) were reformatted according to each category of respondent, while the options of this question remained the same. The target category for each question was mentioned at the end of the question.

Q16a: Please indicate the service delivery models and the deployment models listed below that you are looking to use in CC: [Please indicate more than one deployment model and service delivery model if applicable] - *(For Future Adopters)*

Q16b: Please indicate the service delivery models and the deployment models listed below that you have used in CC: [Please indicate more than one deployment model and service delivery model if applicable] - *(For Current Adopters and Past Adopters)*

	SaaS	**PaaS**	**IaaS**
Public Cloud	○	○	○
On-site Private Cloud (within your organisation network)	○	○	○
Out-sourced Private Cloud (within your Cloud Service Provider's network)	○	○	○
On-site Community Cloud (a group of organisations share their private clouds)	○	○	○
Out-sourced Community Cloud (a group of organisations share a private cloud within their Cloud Service Provider's network)	○	○	○
Hybrid Cloud (a combination of two or more deployment models)	○	○	○

3.9.9. Cloud Systems and Their Deployment Models

Although the reviewed literature shows that demand for CC-based applications such as email, testing and development – as well as storage systems – was increasing rapidly, no actual investigation had yet been undertaken into CC-based application systems in use, not used, abandoned or desired; and no analysis of deployment models among Australian organisations had occurred.

Thus, question 17 (a-b) was designed to enable given information on CC in the survey to be related to those CC-based application systems which have been used, not used, abandoned or desired, as well as to their deployment models. Moreover, studying the changes over the period of study (i.e. the difference between the responses of this question in the 1st and 2nd survey) enabled discovery of the evolution of these systems and their deployment models within (between departments) and across Australian organisations.

In addition, studying these changes over the period of study enabled determination of whether the CC-based application systems desired (i.e. pragmatists' systems) would still be required 16 months later, or whether there would be changes to the requirements (either because these systems were already provided or were no longer needed). In the sense that CSPs already provided these systems, the chasm would have already been crossed and CC would have been taken up by the next category of adopters (i.e. the early majority).

Questions 17 (a-b) were reformatted according to each category of respondents, although the options within these questions remained the same. The target category for each question was mentioned at the end of the question.

Q17a: Please indicate the cloud systems and the deployment models that you are looking to use: [Please indicate more than one system if applicable] - *(For Future Adopters)*

Q17b: Please indicate the cloud systems and the deployment models that you have used in CC: [Indicate more than one system if applicable] - *(For Current Adopters and Past Adopters)*

	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	○	○	○	○	○	○
Manufacturing	○	○	○	○	○	○
Real time	○	○	○	○	○	○
Marketing and sales e.g. CRM	○	○	○	○	○	○
Human resource management	○	○	○	○	○	○
Database	○	○	○	○	○	○
Storage / Archiving	○	○	○	○	○	○
Backup	○	○	○	○	○	○
Email	○	○	○	○	○	○
Critical business systems	○	○	○	○	○	○
Processing	○	○	○	○	○	○
Test and development	○	○	○	○	○	○
Project Management	○	○	○	○	○	○
Other (please specify)	○	○	○	○	○	○

To provide a broad overview of the survey in Appendix B, a summary and justification for all questions in the survey questionnaire is presented in Table 3.2.

Table 3.2: Summary of survey aspects and their rationale

Survey Aspect	Rationale
Demographic Questions (industry sectors, States, organisation size and job of respondents)	To classify participant responses according to industry sector, State and organisation size. The job title question was included to ensure the respondents were employed in IT management (target group).
Beliefs about Cloud Computing	To identify the level of uncertainty about CC among Australian CIOs and ensure understanding of the level of agreement with various arguments and facts found in the literature.
Adoption of Cloud Computing	To measure the percentage of willingness / adoption / abandonment / rejection of CC among Australian organisations and identify the CC annual adoption rate by determining initial date of adoption.
Concerns about Cloud Computing	To ascertain the reality of the challenges and risks of CC adoption, as well as the influences of these factors on the role, nature and adoption of CC in Australia.
Importance of expected benefits	To determine the level of importance of expected benefits so as to identify factors that attract Australian organisations to adopt CC, including the influences of the various benefits on the role, nature and adoption of CC.
Realised benefits	To investigate the reality of the potential benefits and their impact on the role, nature and adoption of CC in Australia.
Experience after using Cloud Computing	To discover the feasibility of applying CC in real situations and the level of satisfaction among Australian user organisations.
Usage of Cloud Computing (service delivery models, type of Cloud Service Providers, deployment models and cloud systems)	To explore the service delivery models, deployment models, types of CSPs and cloud systems that have been used / not used / abandoned / desired by Australian organisations.

3.9.10. Changes to the Second Survey

The second survey invitation, information sheet, introduction, questions and logic design were modified as a result of the experiences with the first survey (see Table 3.3 and Figure 3.7).

The mailing list provider's name and contact email address was included in the invitation. In addition, summary results of the first survey and the opportunity to enter a draw to win an Apple iPad mini were included as both thanks for previous engagement with the survey and as encouragement to participate once again in the second survey. An offer of a set of summary results for the second survey similar to that offered with the first survey provided a further incentive to increase respondent numbers in the second survey.

Some questions in the second survey were changed by adding more options, to avoid the repetitive "Other" option answers received during the first survey as illustrated in Table 3.3.

Table 3.3: Changes in second survey questions

Question	Changes
Throughout the survey	All of the abbreviations of CC were changed to "Cloud Computing"
Q1	Three options were added: • Engineering / Aerospace • Not For Profit • Research / Consulting
Q3	Option 101-499 was split into two options: • 101-200 • 201-499
Q9a, b, c and d	Six options were added: • Bandwidth problems • Cross border problems • Data sovereignty • Government legislations • Performance problems • Usage costs

Q8a	Option 2012 was deleted and 2017 was added
Q8b	Option 2013 was added
Q10a and b	Two options were added: • To mitigate risks • For business continuity
Q11	Two options were added: • It mitigated risks • It enabled business continuity
Q17a and b	Six options were added: • Collaboration • Content Filtering • E-Learning • Library Services • Phone System • Web Hosting

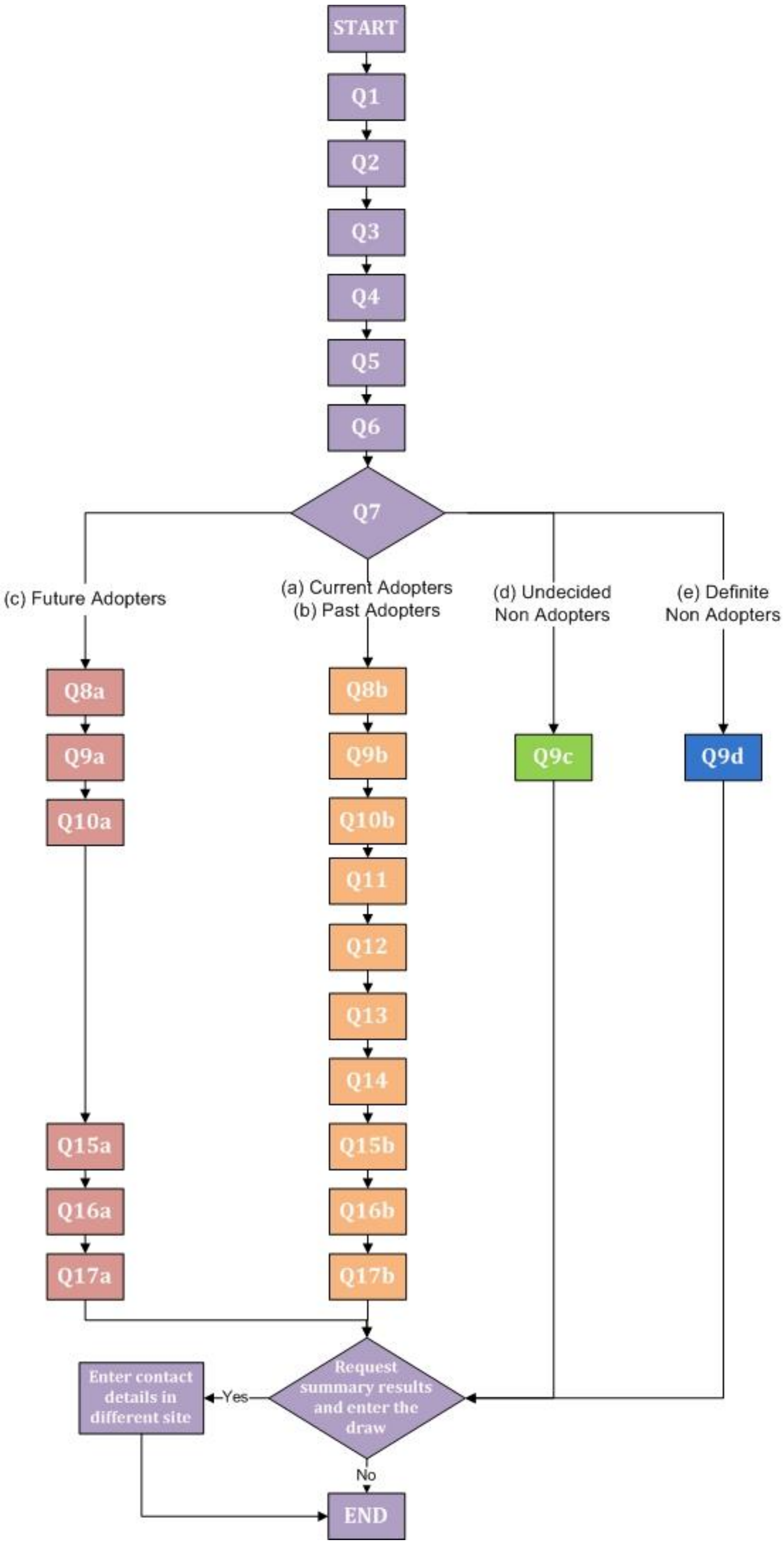


Figure 3.7: Logic design for the second survey (2013)

At the end of the second survey all participants had the option of requesting a brief summary of results and/or the option of entering a draw to win an Apple iPad mini by clicking on a provided link to connect with a site where they could enter their contact details, as shown in Figure 3.7. This approach was taken as an incentive and to ensure all survey responses remained anonymous.

Respondent Request and Details Collection Page:

Please enter your contact details to receive an extended version of the summary results and enter the draw to WIN an Apple iPad mini.

Full Name: [ ]

Organisation: [ ]

Job Title: [ ]

Email Address: [ ]

Office Phone: [ ]

Please select what would you like to have?

- o I would like to receive only an extended version of the summary results.
- o I would like to enter only the draw to WIN an Apple iPad mini.
- o I would like to have both of them.

3.10. Data Collection

The target group for both surveys was CIO's of Australian organisations or their equivalent (i.e. IT Manager, Technical Support Manager or Network Manager). This group was felt to be most capable of providing accurate responses to the survey and to include those people most aware of the current status of their organisations regarding the adoption of CC. In addition, it was expected that this group would be Internet users. Therefore, the easiest, fastest and cheapest way to obtain their responses was by means of an online survey.

Online surveys save money and time, and provide flexibility compared with manual surveys (Evans and Mathur, 2005). In addition, they avoid the errors that may occur due to data entry in manual surveys (Evans and Mathur, 2005). SurveyMonkey was selected as the online survey provider because it provided the needed facilities such as variety of question types, flexibility in applying survey logic design; and the availability of an invitation distribution service at a reasonable price.

The surveys were designed to be anonymous so as to increase number of respondents. Although, in this case, a vital comparison between the status of the same respondents in both surveys would not be available, it was originally felt worth sacrificing the ability to compare respondents across surveys because of the virtues of anonymity (a decision which would probably not be made under these circumstances again); and because it was extremely difficult to ensure respondents to the first survey would return for the second survey 16 months later (a view which appears to have been correct).

3.10.1. Sampling Technique

Various sampling techniques were available – and attempted. However, some of them did not work or were not effective, so that eventually only one technique proved effective. Obtaining a mailing list was a long process: searching for a company that could sell or rent a suitable mailing list and investigating sources of funding took approximately 3 months, as already noted briefly in Section 3.8.

Firstly, attempts were made to use the University library's listing of Australian Organisations. Unfortunately, this list did not include email addresses and would have required either a manual survey or an invitation with an online survey link, both of which would have meant that the mail might reach other people than the target group. Moreover, this technique would be costly and time-consuming. Therefore, this sampling technique was excluded.

Secondly, as a member of Australian Computer Society (ACS), it seemed possible their assistance might be available to forward the survey invitation to the target group registered in their Database. Unfortunately, the ACS was unwilling to provide assistance, replying: "*Unfortunately we are unable to assist with this request. The ACS undertakes its own surveys with its members*".

Thirdly, an attempt was made to approach an Australian CSP, "CloudCentral", for assistance in distributing the survey to their clients – and the CSP agreed to help. Although the responses from this group would not accurately reflect all Australian Cloud Adopters, it could be used to provide data triangulation for the Cloud Adopters in the study. Following CloudCentral's agreement to support the study, a number of changes were made to the survey questionnaire to fit in with their requirements. Sadly, however, no responses were collected from the private link dedicated to this group. Unfortunately, this approach proved to be merely a waste of time and effort.

Finally, the Media M Group was recommended by the University Library and provided an effective (though extremely expensive) mailing list. Renting the maximum available number of email addresses, 5000 email addresses of Australian CIOs / IT Managers or their equivalent in 5000 different Australian Organisations, cost approximately AUD$2700. This was the only sampling technique that worked effectively, though it was costly.

3.10.2. Population and Sample Size

The more relevant the people responding to a survey, the more accurate the results which can be obtained to, in this case, represent Australian organisations. According to the most up-to-date statistics available prior to the first survey, there were 2,132,412 businesses in Australia: 826,389 (38.8%) employing businesses and 1,306,023 (61.2%) non-employing businesses (Australian Bureau of Statistics, 2012).

After distributing the invitation for the first survey to 5000 email addresses of Australian CIOs or their equivalent (the maximum random number available), only 180 responses were collected in the first month. As a result of this poor response rate, a second invitation was sent to the same group and 135 responses were gathered during the next 3 weeks. After that, a third and final invitation was sent and a further 102 responses were collected during the following one month.

In summary, 417 responses were collected over a three month period, after sending the invitation three times. Of these 417 responses who accepted to enter the survey, only 403 answered the questionnaire. Although the response rate for the first survey was approximately 8% of total invitees, the Confidence Interval (margin of error) was +/- 4.88 with a Confidence Level of 95%.

By the time of the second survey, 16 months later, 667 of the original 5000 invitees had opted out of the survey distribution service. Thus, an invitation was sent to only 4333 email addresses of the same group which was rented again for the second online survey.

A decline in number of respondents in the second survey was expected, since the same people were being asked the same questions after a gap of 16 months. Therefore, a set of summary results of the first survey was provided, together with the opportunity to enter a draw to win an Apple iPad mini, as well as an offer to receive a set of summary results of the second survey as incentives to increase respondent numbers. Sadly, however, these techniques proved less successful than hoped.

Only 68 responses were collected in the first month. As a result of this poor response rate, a first reminder was sent to the same group and another 54 responses were gathered in the following 3 weeks. A second reminder was then sent and a further 34 responses were collected in the next two weeks. Subsequently, a third and last reminder was sent and 25 additional responses were gathered over the following two weeks. In summary, 181 responses were collected over an 11 week period after sending the invitation and three reminders. Of the 181 respondents who accepted to enter the survey, only 176 answered the questionnaire. Although the response rate for the second survey was approximately 4.3% of the invitees, the Confidence Interval (margin of error) was +/- 7.39 with a Confidence Level of 95%.

Chapter 4
Survey Data Overview

4. Survey Data Overview

Chapters 4 and 5 comprise the empirical component of this Thesis. Beginning with a brief description of the respondents to both surveys, the two chapters will then take different approaches to analysing the data obtained. This chapter will investigate the differences between both surveys *within each category* between the two years of the respondents as they were classified into five categories according to their status and attitude towards adopting CC. On the other hand, the differences between those categories *within each survey* will be discussed in Chapter 5. It will include also the application of the Diffusion of Innovation Theory and Crossing the Chasm Theory.

The first of the two online surveys was carried out between 22 June 2012 and 25 October 2012. Four hundred and three participants responded after sending an invitation and two reminders to 5000 email addresses of CIOs, IT managers, network managers, or equivalents to these positions, from a variety of Australian organisations. The second online survey was carried out between 8 October 2013 and 23 December 2013. On this occasion only 4333 invitations from the initial list were sent, as 667 list members had withdrawn their availability from the list provider. 176 participants responded to the second survey after sending an invitation and three reminders. The decline in the number of participants was expected because of survey fatigue (Cloud Computing Magazine, 2013) and because the same invitees had been asked the same questions 16 months earlier, even though some incentives to respond were adopted.

Although the response rate for both surveys seemed small (approximately 8% in 2012 and 4% in 2013), it is worth remembering that the number of participants obtained (403 in 2012 and 176 in 2013) is a proportion of Australian organisations rather than individual members of the population.

Moreover, because many of the organisations surveyed have branches or operations in multiple States, the sum of all locations of the Australian organisations represented by the survey responses amounted to 945 in the 2012 survey and 454 in the 2013 survey. This needs a little additional clarification: these figures do not include branches, because the surveys only counted the number of States in which a particular organisation was located, e.g. if Organisation A has branches located in Australian Capital Territory (ACT), New South Wales (NSW), Western Australia (WA) and Tasmania (TAS), it was counted as having four locations, regardless of the number of branches the organisation might have in these States.

Question 7 in both surveys classified the respondents into the following five categories:

1- Current Adopters (organisations which had already adopted CC)
2- Past Adopters (organisations which had adopted CC in the past but had since terminated their use of it)
3- Future Adopters (organisations which expected to adopt CC in the near future)
4- Undecided Non-Adopters (organisations which had not decided whether or not to adopt CC)
5- Definite Non-Adopters (organisations which had decided definitely not to adopt CC)

Thirteen participants from the 2012 survey and five participants from the 2013 survey were removed from the analysis because they stopped filling in the survey before reaching question 7. Hence, a total of 390 (2012) and 171 (2013) questionnaires were analysed. Responses from Past Adopters and Current Adopters were combined under a new category called ‘Cloud Adopters’ due to poor representation of Past Adopters (only 4 participants in each survey). However, the proportions of Past Adopters among the respondents in both surveys will nonetheless be considered during the application of Diffusion of Innovation Theory and Crossing the Chasm Theory in Chapter 5.

The proportions of CC adoption in Figure 4.1 confirm its popularity and rapid growth as noted by a number of industry surveys (Banks, 2011, Dutt, 2012, Barwick, 2013b, Research and Markets, 2013), with an encouraging uptake pattern over the period between the two surveys:

- The 2012 survey indicated that slightly less than half of all responding organisations (47.9%; 187 of 390 respondents) were Cloud Adopters, while 16.4% (64 of 390 respondents) saw themselves as Future Adopters. A further 28.5% (111 of 390 respondents) were Undecided Non-Adopters and 7.2% (28 of 390 respondents) were Definite Non-Adopters;
- The 2013 survey showed a different (and more positive) composition. Cloud Adopters now formed 57.9% of all respondents (99 of 171 respondents) with a further 15.2% (26 of 171 respondents) being Future Adopters. A far smaller percentage (21.6%; 37 of 171 respondents) was Undecided Non-Adopters and Definite Non-Adopters formed only 5.3% (9 of 171 respondents).

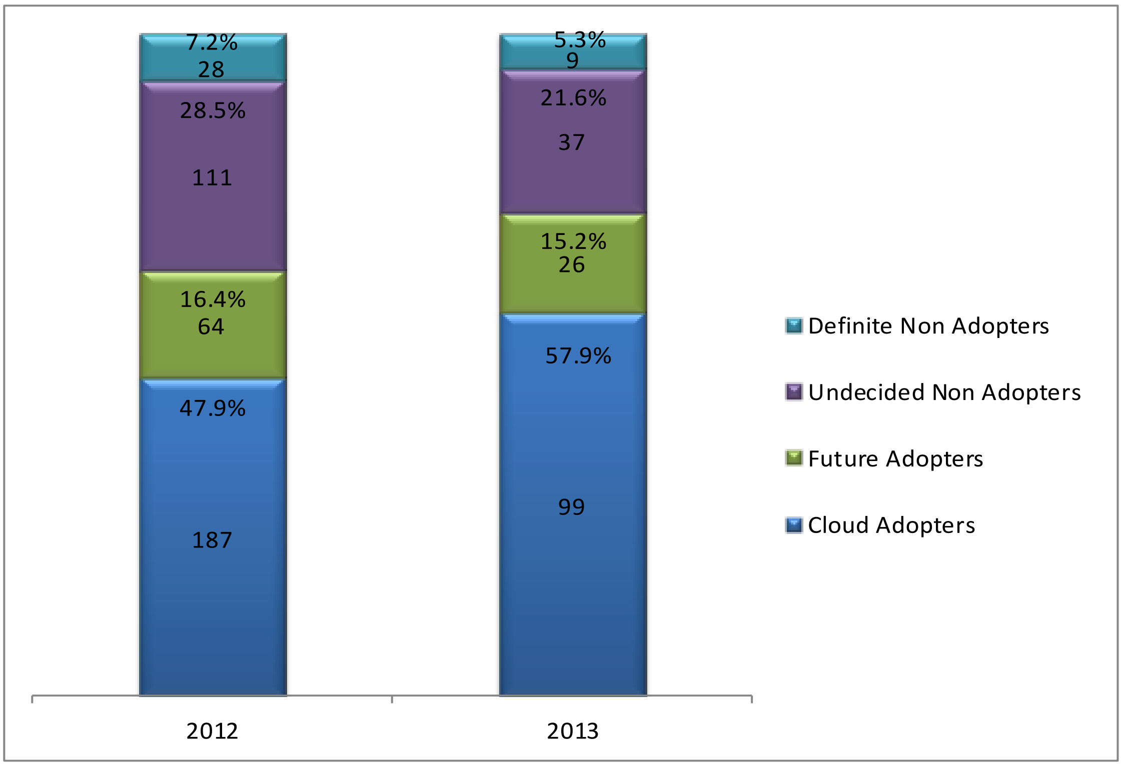


Figure 4.1: Categories of respondents in 2012 and 2013

Like most online survey software, Survey Monkey offers the option of collecting respondents' Internet Protocol (IP) addresses. Given the difficulty of attracting industry survey participants, however, it was decided to make the surveys anonymous in the hope of encouraging participation. However, such an approach has an inherent limitation, as it prevents the researchers from determining whether the same people answered both surveys. Respondents could therefore be: entirely independent groups; a subset of the first group; or overlapping groups – a as shown in Figure 4.2.

This decision is one which must be made by all survey researchers and it is easy to look back and regret the decision to collect only anonymous data. Given the comparatively small respondent number obtained, however, this decision (despite its limitations) seems likely to have been the correct one.

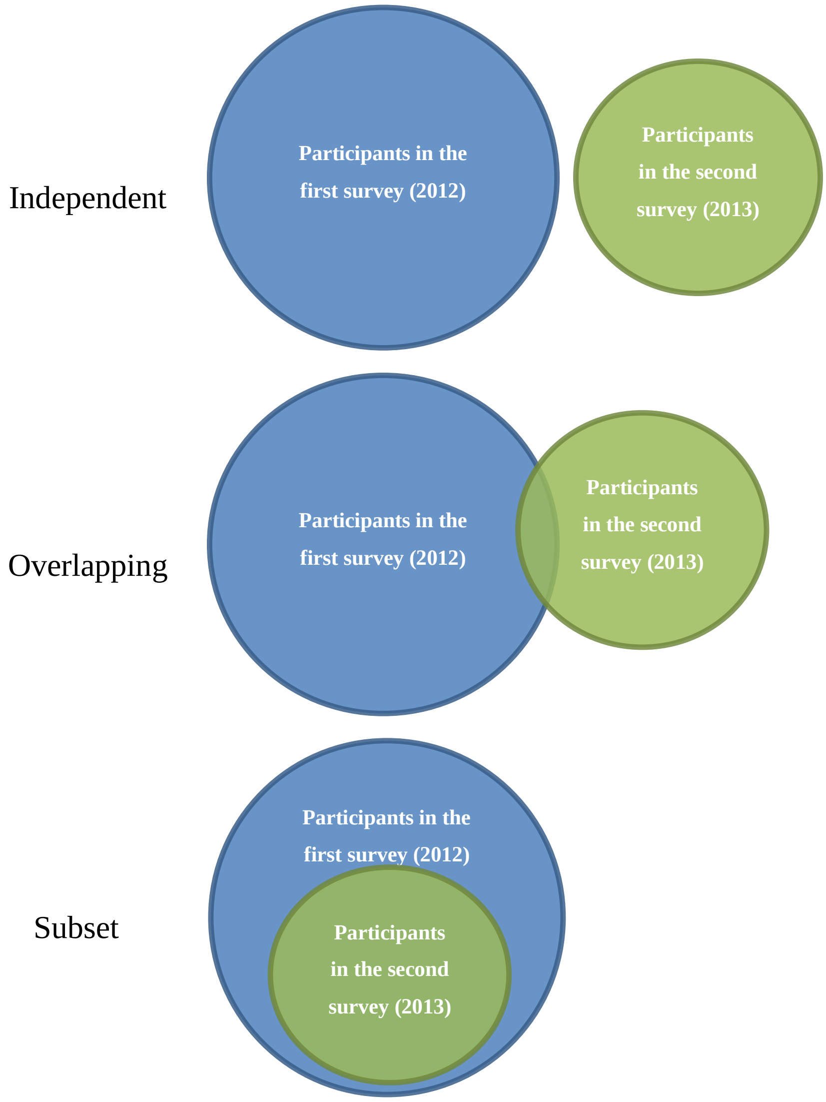


Figure 4.2: Possible cases of the relationship between the participants in 2012 and 2013

The present Chapter compares the results from the two surveys and analyses the changes which occurred within each category, over the period of the study. The seven analytic aspects illustrated in Figure 4.3 will be used in this Chapter, although the differences between all categories for each survey will be explained in Chapter 5.

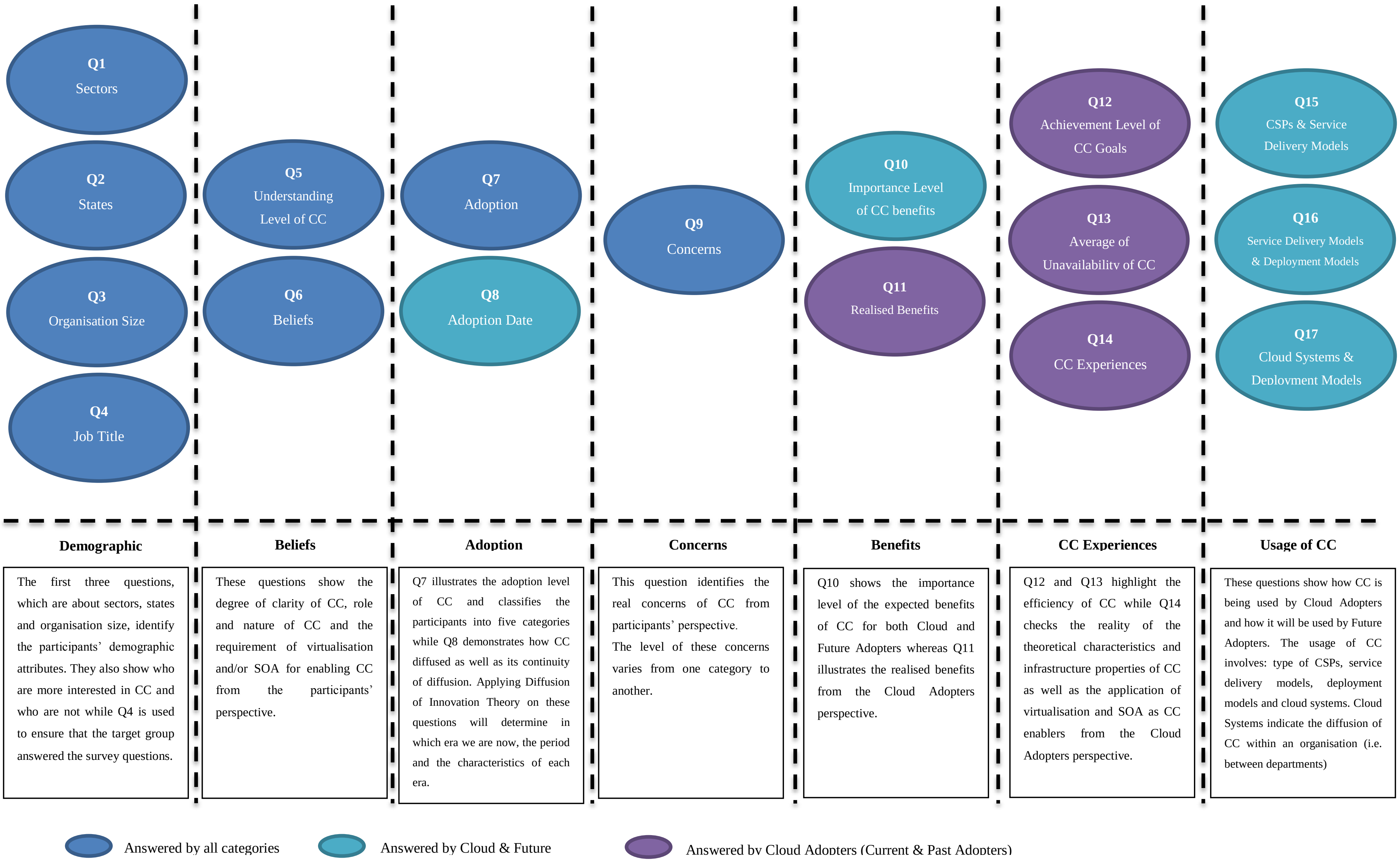


Figure 4.3: Analysis aspects of survey questions

Some manipulation of data occurred to enable effective analysis, as explained in the following six bullet points:

- Demographic profile: this covers the industry sector/s, location/s (states), organisation size and job title for each respondent. The aim of asking about job title was to validate the responses of the participants, because these surveys were intended for those employed in IT management. This included IT Managers, CIOs, Network Managers and Technical Support Managers. People in these positions are not only more likely to use CC but are also able to provide more meaningful responses, as they have a better understanding of the issues covered by these surveys;
- Respondent numbers: the symbol 'N' in all figures in this Chapter represents the number of respondents who selected that option, e.g. the education sector shown in Figure 4.5 was selected by 28 out of 187 (15%) Cloud Adopters in the 2012 survey. In addition, some sectors shared the same rank because they were selected by the same number of respondents but, as already explained, due to the anonymous nature of the surveys this did not necessarily mean that the same respondents had selected all of them. For instance, both the healthcare and manufacturing sectors in Figure 4.5 were selected by 15 out of 187 respondents in the 2012 survey, but not necessarily by the same respondents. Finally, a respondent could select more than a single industry sector or State if these were applicable to his/her organisation. Thus, if all proportions were added, the numbers could exceed 100% in some cases;
- Data grouping – locations and organisation sizes: to enable the application of ordered logistic regression analysis, industry sectors and organisation sizes were combined into a smaller number of groups, as shown in Table 4.1 and Table 4.2. Similarly, States were grouped into single or multi-State organisations, because some individual industry sectors, organisation sizes and States had such small respondent numbers that, without combining them, the effect of these demographic attributes could not be investigated;

Table 4.1: Combined industry sectors

Combined Industry Sector	Individual Industry Sector
Manufacturing & Goods Distribution	Wholesale/Distribution
	Retail
	Manufacturing
Services	Services
	Transportation
	Media
	Tourism
	Research/Consulting
	Utilities
Healthcare & Education	Healthcare
	Education
Finance & ICT	Telecommunication
	Financial
	Information Technology
Government	Government
Resources & Construction	Construction
	Engineering/Aerospace
	Mining
	Energy
Other	Not For Profit
	Real Estate
	Agriculture
	Fishing
	Other

Table 4.2: Combined organisation sizes

Combined Organisation Size	Individual Organisation Size
Less than 101	Under 5
	5-10
	11-20
	21-50
	51-100
101-499	101-200
	201-499
500-999	500-999
1000-4999	1000-4999
More than 4999	5000-10000
	More than 10000

- Data grouping – expected benefits of CC: respondents were asked to list the relative importance of expected benefits at 5 levels. However, due to the small number of responses in some levels, answers consisting of 'extremely important', 'very important' and 'important' were merged into 'important' while answers consisting of 'not very important' and 'not important at all' were merged into 'not important';
- Data grouping – beliefs about CC: as with expected benefits, some categories of responses for beliefs were very poorly populated, so that answers consisting of 'very well' and 'reasonably well' were merged into 'well', while answers consisting of 'not very well' and 'I really don't understand it at all' were merged into 'not well'. In addition, the answers of 'strongly agree' and 'agree' were merged into 'agree' while the answers of 'strongly disagree' and 'disagree' were merged into 'disagree'.

The p values in all Tables in this Chapter test the statistical null hypothesis that there was no statistically significant difference between the two surveys. If p value > 0.05, the statistical null hypothesis must be accepted. Otherwise, if p value ≤ 0.05, the statistical null hypothesis can be rejected, i.e. there is a statistically significant difference between the two surveys.

A further consideration concerns the location and size of respondent organisations. At first sight it seemed intuitively logical that organisations located in a single State would most likely belong to small(er) organisations while multi-State organisations would be larger. Thus, any statistical difference found between single and multi-State organisations might imply that the same difference could also be found between small and larger organisations. However, more detailed inspection of the data collected showed that this logical assumption was incorrect in terms of this study. In fact, during the statistical data analysis, occasionally surprising results appeared.

Table 4.3 shows clearly that organisations located in a single State are not necessarily small in terms of employee numbers – and, in addition, multi-State organisations are not necessarily larger organisations. There is, in fact, no relationship between the number of States in which respondent organisations are located and their size in terms of employee numbers.

Table 4.3: Organisation size and type of their Sates in 2012 and 2013

Year	Type	Org. Size				
		1-100	101-499	500-999	1000-4999	More than 4999
2012	Single State	58	97	20	42	12
	Multi-State	24	52	26	36	23
2013	Single State	25	36	17	12	10
	Multi-State	8	23	11	21	8

4.1. Cloud Adopters

The results of both surveys showed that 47.9% (187 of 390) of Australian organisations had adopted CC by the middle of 2012, increasing to 57.9% (99 of 171) in 2013. The 10% growth in CC adoption within 16 months suggested Australian organisations were still interested in CC and, potentially, that CC uptake was increasing. The following sub-sections discuss the differences between the Cloud Adopters of both surveys in terms of adoption date, demographic profile, importance of expected benefits, realised benefits, beliefs, experiences using CC, usage of the CC innovation and concerns.

4.1.1. Adoption Date

The annual adoption proportions of Cloud Adopters are illustrated in Figure 4.4. A handful of respondents claimed to have adopted CC prior to 2006 though, clearly, as the term CC had not come into existence at that time they must have been referring to some other form of hosted computing to which they now, retrospectively, attached the name.

The difference between the numbers of Cloud Adopters in both surveys claiming to have adopted CC prior to 2006 (see Figure 4.4) and, indeed, the general difference between the two surveys in terms of number of organisations adopting year by year suggests that the participants in the 2013 survey were not a subset of those in the 2012 survey. Hence, the 2012 variation in uptake rates should be ignored, since the 2012 survey was conducted halfway through that year. This would suggest that the participants of both surveys are most likely to be independent or overlapping groups (the first or second options in Figure 4.2).

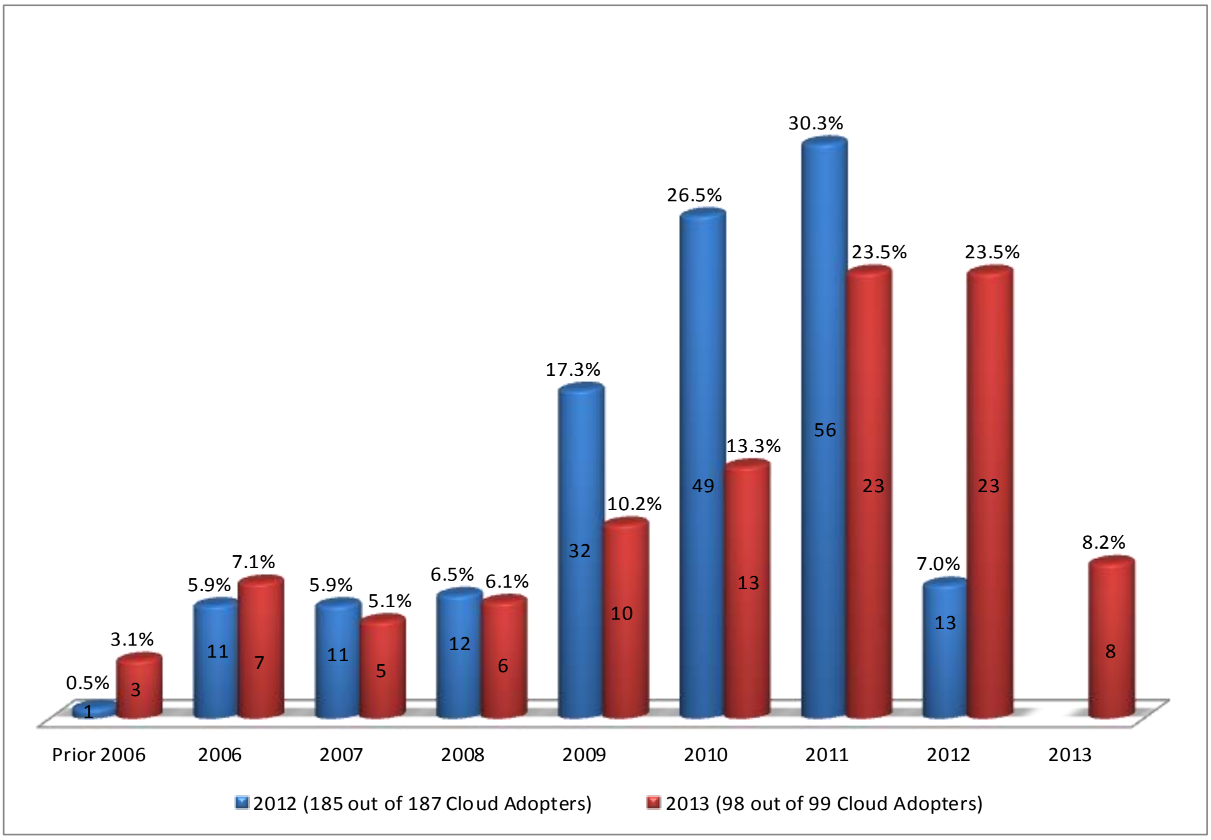


Figure 4.4: Adoption date of Cloud Adopters in 2012 and 2013

4.1.2. Demographic Profile

4.1.2.1. Industry Sectors

Although there was little variation over the two surveys, the government sector provided the largest number of respondents overall. It showed a slight increase between 2012 and 2013, with16.6% (31 of 187) and 17.2% (17 of 99) of Cloud Adopters, respectively. Although CC was adopted by representatives from all industry sectors, the education and information technology sectors had the next highest response rates in the 2012 survey, with 15% (28 of 187) and 14.4% (27 of 187) respectively, while the manufacturing and IT sectors had the next highest response rates in 2013, with 15.2% (13 of 99) and 12.1% (12 of 99) respectively, as shown in Figure 4.5. It was noticeable that in the 2012 survey, education was the biggest group after government whereas in the 2013 survey it had dropped to the fourth place and had replaced by manufacturing. In addition to manufacturing, services, wholesale/distribution, financial, retail and mining sector also achieved higher ranks in terms of response rate in the 2013 survey while education, healthcare, construction and media sector gained lower positions. All other sectors not mentioned in Figure 4.5 as they were below 5% in both surveys.

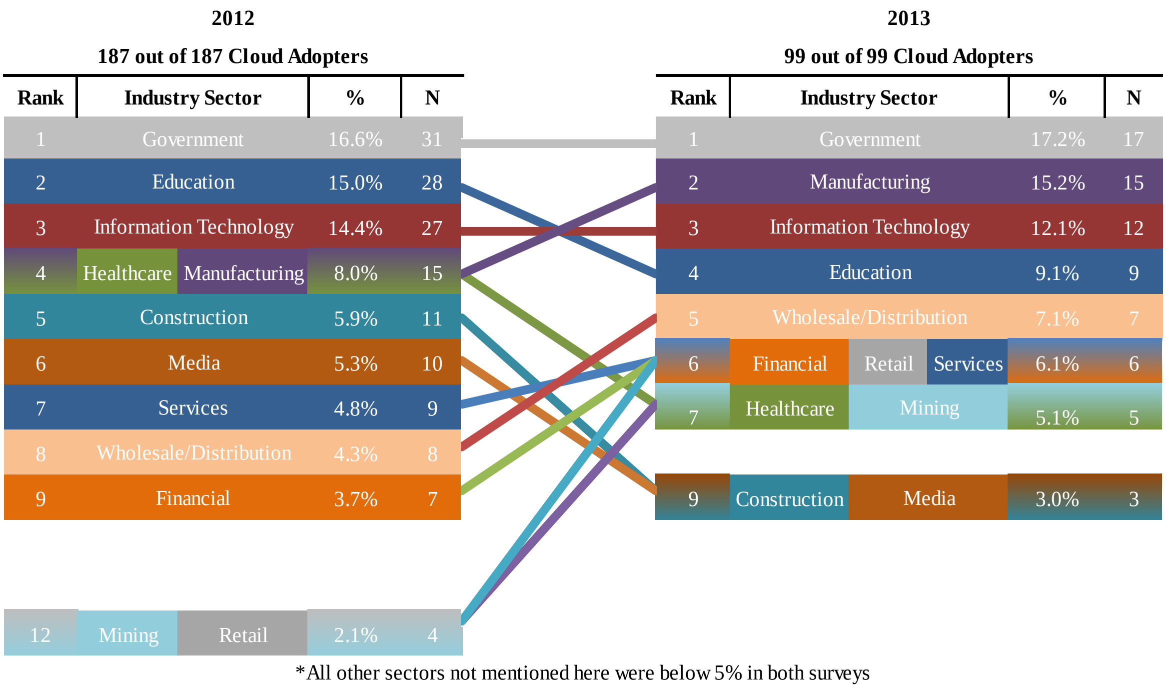


Figure 4.5: Ranking response rate of industry sectors of Cloud Adopters in 2012 and 2013

4.1.2.2. Location of Respondents

More than half the respondents to both surveys in the Cloud Adopters group were based in NSW or Victoria (VIC), as shown in Figure 4.6. In the 2012 survey, the largest number of Cloud Adopters respondents came from NSW, with 59.4% (111 of 187), followed by VIC with 52.9% (99 of 187). However, in the 2013 survey, these two States exchanged positions and VIC took first place, with 55.6% of Cloud Adopters (55 of 99), followed by NSW with 51.5% (51 of 99).

The ranks of the other States remained the same across the two surveys but their proportions fluctuated. In both surveys Queensland (QLD) was the third State followed by WA then South Australia (SA). TAS, ACT and North Territory (NT) respectively provided the fewest responses in terms of adopting CC, as presented in Figure 4.6.

In the 2012 survey, approximately 52% (97 of 187) Cloud Adopters organisations were located in a single State while the rest 48% (90 of 187) were located in multiple States. However, in 2013, 55.6% (55 of 99) of Cloud Adopters were located in a single State, with multi-State organisations making up the remaining 44.4% (44 of 99). This shift towards single State organisation respondents seems counter-intuitive: since the distribution of Australian organisations has not changed significantly over this period (Australian Bureau of Statistics, 2015b) the explanation must lie in the types of organisations responding to the two surveys. A possible explanation is provided by the organisation size data in Section 4.1.2.3 below.

2012
187 out of 187 Cloud Adopters

Rank	State	%	N
1	NSW	59.4%	111
2	VIC	52.9%	99
3	QLD	49.2%	92
4	WA	37.4%	70
5	SA	33.7%	63
6	TAS	26.2%	49
7	ACT	23.0%	43
8	NT	15.5%	29

2013
99 out of 99 Cloud Adopters

Rank	State	%	N
1	VIC	55.6%	55
2	NSW	51.5%	51
3	QLD	43.4%	43
4	WA	40.4%	40
5	SA	30.3%	30
6	TAS	26.3%	26
7	ACT	22.2%	22
8	NT	21.2%	21

Figure 4.6: Ranking response rate of States of Cloud Adopters in 2012 and 2013

4.1.2.3. Size of Responding Organisations

Organisations with 101–499 employees formed the largest group of respondents in both surveys[3], as shown in Table 4.4. These organisations accounted for 39% (73 of 187) of Cloud Adopters in the 2012 survey and 40.4% (40 of 99) in the 2013 survey.

The second largest response group of Cloud Adopters in the 2012 survey was those with 1000-4999 employees, which accounted for 25.1% (47 of 187), followed by organisations with 500-999 employees, which formed 14.4% (27 of 187) of Cloud Adopters. Although these groups kept the same rankings in the 2013 survey, their proportions decreased to 18.2% (18 of 99) for organisations with 1000-4999 employees and increased to 17.2% (17 of 99) for those with 500-999 employees, as illustrated in Table 4.4.

Thus, the ranks of CC Adopting organisations remained similar across both surveys. The major exception was organisations having 5000–10000 employees, which dropped from 5th position in 2012 to 6th position in 2013. At the opposite end of the size scale, organisations with fewer than five employees were last in terms of response rate in both surveys.

Overall, then, responses to the two surveys can be seen to come from what in Australia are considered mid-sized organisations (Australian Bureau of Statistics, 2015b) – and this casts more light on the apparently curious finding in the previous Section that the percentage of CC Adopting organisations based in just one State had increased between 2012 and 2013, as smaller organisations are more likely to be single State organisations. Follow-up studies might well clarify this issue further.

[3] Although this group was later split into two sub-groups (101-200 and 201-499 employees) in the 2013 survey to correct a design error relating to organisation size in the 2012 survey, the two groups were recombined to enable comparison with the 2012 survey in Table 4.4.

Table 4.4: Ranking response rate of organisation sizes of Cloud Adopters in 2012 and 2013

Org. Size	2012 186 out of 187 Cloud Adopters			2013 99 out of 99 Cloud Adopters		
	Rank	%	N	Rank	%	N
More than 10000	6	4.3%	8	5	7.1%	7
5000-10000	5	4.8%	9	6	4.0%	4
1000-4999	2	25.1%	47	2	18.2%	18
500- 999	3	14.4%	27	3	17.2%	17
101-499	1	39.0%	73	1	40.4%	40
51-100	4	5.3%	10	4	8.1%	8
21-50	7	2.7%	5	7	3.0%	3
11-20	8	2.1%	4	8	2.0%	2
5-10	9	1.6%	3	9	0%	0
Under 5	10	0.5%	1	9	0.0%	0

4.1.2.4. Job of Respondents

Individual respondents to the surveys came predominantly from the ranks of what might be described as 'hands-on' IT management, rather than from management generally. Approximately 90% (140 of 187) of the 2012 survey respondents who represented the Cloud Adopters were employed in IT management, as illustrated in Figure 4.7. This percentage later increased slightly to 92% (91 of 99) in the 2013 survey. This was consistent with the sharp increase in proportion of Technical Support Managers of Cloud Adopters from 1.6% (3 of 187) in the 2012 survey to 9.5% (9 of 99) in the 2013 survey.

This is not surprising, as CC is widely considered to be a 'technical' issue in many (if not most) organisations. It is also possible that the survey questionnaires were passed on to the more technically-oriented IT senior staff.

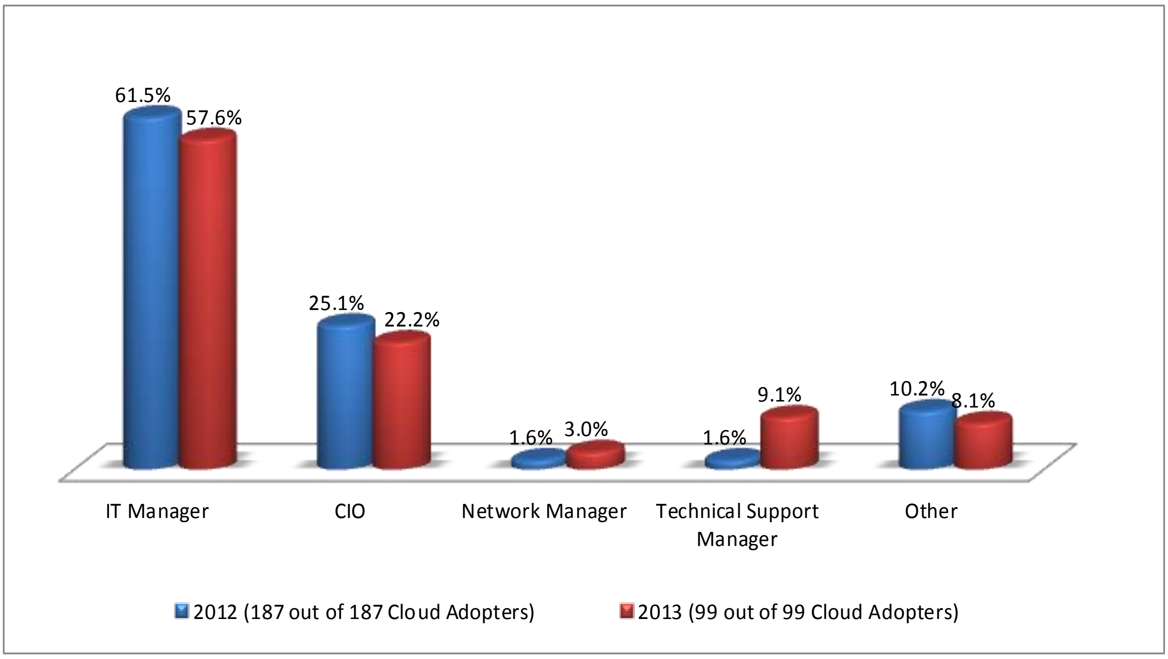


Figure 4.7: Job title of respondents of Cloud Adopters in 2012 and 2013

4.1.3. Benefits

4.1.3.1. Importance of Expected Benefits

The reviewed literature listed many expected benefits (advantages) of CC, but without ranking or indicating the importance level of these advantages for Cloud Adopters. Thus, this study adds value by highlighting the importance level of these expected benefits for Cloud Adopters in both surveys, as illustrated in Figure 4.8. Although the responses for the ‘importance of expected benefits’ were similar in both the 2012 and 2013 surveys for Cloud Adopters, there was a noticeably higher proportion of people indicating greater importance of efficiency, capacity and accessibility benefits; and of facilitating internal communication in 2013. By contrast, the proportion of respondents indicating the importance of ‘green IT’ as an expected benefit of CC adoption was lower in 2013 than in 2012.

CC facilitates internal communication between an organisation’s employees, enabling them to work as if they were all located in the one building (JB, 2009). For example, it enables them to use collaborative and integrated tools such as sharing calendar information, translation, live chatting, video and other tools more effectively (JB, 2009, Greengard, 2010). It was therefore expected that participants from larger organisations or those operating in multiple States would consider ‘facilitating internal communication’ more important than would respondents from smaller organisations or those who were located in a single State. However, this difference was not seen in the statistical analysis (OR 1.03; 95% CI 0.61 to 1.74; p=0.92). This finding is rather surprising and invites further investigation, perhaps in the form of qualitative studies to enable deeper and more subjective analysis.

In 2012, the terms ‘mitigating risk’ and ‘business continuity’ were not specifically identified in the survey questionnaire, but some participants included them in the ‘other’ option nonetheless. Therefore, in 2013, these terms were explicitly included and, even though the number of respondents identifying these issues as important was small (2 of 6) the concepts did appear to be of real interest. Although these expected benefits were only listed for the first time in 2013 (meaning that no specific cross-year comparison was possible), they attracted a greater degree of importance than some of the expected benefits which had been listed in the 2012 survey.

Given the relative ‘newness’ of CC and its rapid rate of acceptance and uptake, it is not at all surprising to see the business community starting to move from a somewhat utilitarian attitude, i.e. one in which CC is seen predominantly as a technological enabler, towards a more strategic approach to the phenomenon. Follow-up surveys will enable a more detailed investigation of this possible change in attitude.

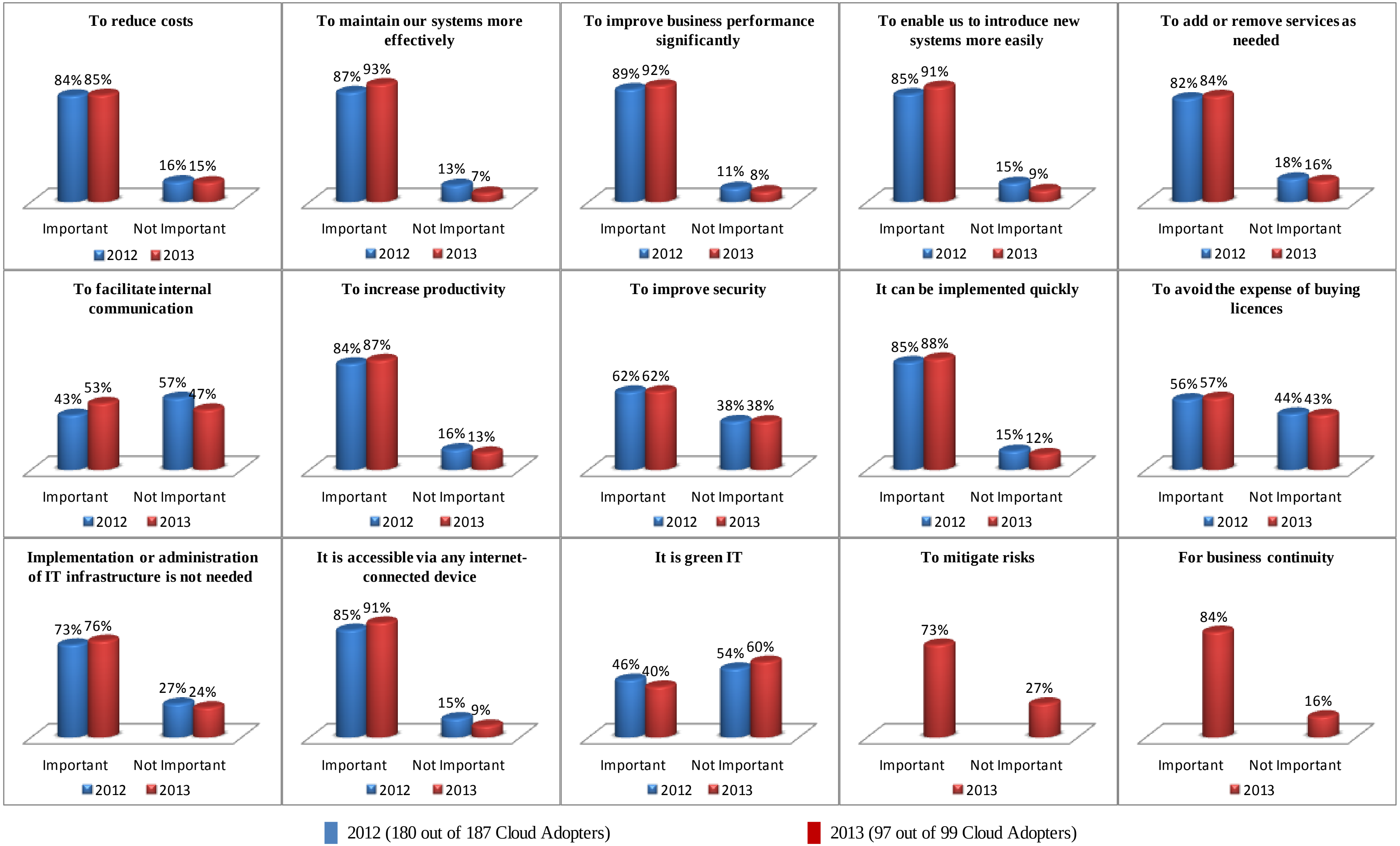


Figure 4.8: Importance of expected benefits of Cloud Adopters in 2012 and 2013

After identifying the importance level of these expected benefits for Cloud Adopters, the next step was to rank them in terms of their importance so as to add value which would highlight the top five important expected benefits in both surveys, as illustrated in

Figure 4.9. Since the ideal CSP's infrastructure is generally believed to be an up-to-date and effective architecture that provides advanced visualisation, customised hardware and HPC instantaneously (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010), such a service can improve business performance significantly (Linthicum, 2010a, Schaffer, 2009).

In addition, it has been widely claimed that CSPs would maintain the services they offered more effectively than would be possible for many businesses to achieve themselves, because they had teams of responsible and capable IT specialists on hand (Murah, 2012, Srinivasan and Getov, 2011, Avram, 2014, Linthicum, 2010a). As expected, therefore, the results of both the 2012 and 2013 surveys showed 'improving business performance significantly' and 'maintaining the systems more effectively' as the top two expected benefits – but they exchanged their positions in the 2013 survey. However, the difference in terms of importance was very small (2% in 2012 and 1% in 2013). Thus, they are almost at the same level of importance.

The importance of 'accessibility via any internet-connected device' and 'ability to introduce new systems more easily' remained the third most important benefit for Cloud Adopters in both surveys, indicating the on-going importance of both immediate access via both fixed and mobile devices, as well as the much-touted CC benefit of rapid system start-up. The literature emphasises the importance of 'reducing costs' as a major benefit leading organisations to adopt CC, which provides almost immediate access to computing resources without upfront capital investments on IT infrastructure and with reduced OPEXs compared with many in-house software solutions (O'Driscoll et al., 2013, Rimal et al., 2011, Linthicum, 2010a, Sultan, 2014). However, the importance of 'reducing costs' only held fourth place in the 2012 survey and sixth place in the 2013 survey, suggesting there were other expected benefits that were more important than 'reducing costs' and attracting Australian organisations to adopt CC.

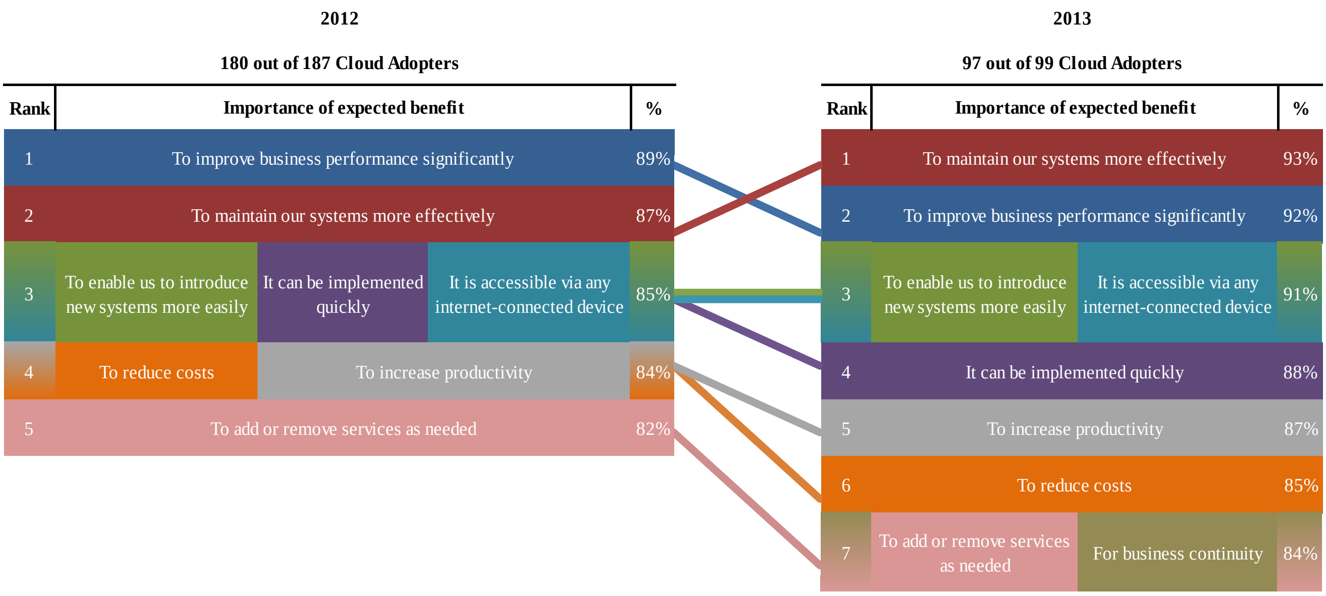


Figure 4.9: Ranking response rate of the importance of expected benefits of Cloud Adopters in 2012 and 2013

The mean (±SD) of responses for survey questions on the importance of expected benefits was similar across 2012 and 2013 (Table 4.5). Ordered logistic regression analysis showed no statistically significant differences in the beliefs of Cloud Adopters for the importance of various expected benefits between 2012 and 2013. Although the proportion of people believing that CC is important in 'reducing costs' was similar over the two years (~84%), there was a slight shift of responses towards very- and extremely-important (Table 4.6) leading to a trend (p=0.06) towards statistically significant results. This is consistent with the literature stating the importance of 'reducing costs' as a major expected benefit for CC (O'Driscoll et al., 2013, Rimal et al., 2011, Linthicum, 2010a, Sultan, 2014). Similar to 'reducing costs' there was a slight trend towards 2013 participants believing that 'facilitating internal communications' was more important compared with 2012 participants, but this was not significant (p=0.09) and was the last and the second-last important expected benefit in the 2012 and 2013 surveys, respectively.

Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change the result across the two surveys. However, there were differences in the importance level for some expected benefits between industry sectors. For instance, 'reducing costs' was of less importance for respondents from healthcare & education (OR 0.41; 95% CI 0.18 to 0.94), finance & ICT (OR 0.39; 95% CI 0.18 to 0.86), government

(OR 0.20; 95% CI 0.08 to 0.50) and the ‘other’ sector (OR 0.35; 95% CI 0.15 to 0.82) than for respondents from the manufacturing & goods distribution sector (all $p<0.046$). Similarly, respondents from these same sectors, healthcare & education (OR 0.23; 95% CI 0.10 to 0.53), finance & ICT (OR 0.23; 95% CI 0.10 to 0.50), government (OR 0.18; 95% CI 0.07 to 0.42) and ‘other’ sector (OR 0.15; 95% CI 0.06 to 0.38) had lower belief in the importance of ‘avoiding the expense of buying licences’ than did respondents from the manufacturing & goods distribution sector ($p<0.002$). These expected benefits, which are associated with one another, seemed to be more important for manufacturing & goods distribution sector because of the nature of their activities, where costs must be very tightly controlled and where many different types of software package must be purchased, compared to healthcare & education, finance & ICT, government and the ‘other’ sector.

Moreover, ‘improving security’ had lower importance for healthcare & education (OR 0.38; 95% CI 0.16 to 0.87), government (OR 0.33; 95% CI 0.14 to 0.82) and ‘other’ sector (OR 0.38; 95% CI 0.17 to 0.89) compared with manufacturing & goods distribution sector (all $p<0.036$). In addition, respondents from the government (OR 0.39; 95% CI 0.16 to 0.95) and ‘other’ sector (OR 0.26; 95% CI 0.11 to 0.61) considered ‘improving business performance significantly’ of lower importance than did the manufacturing & goods distribution sector (all $p<0.046$). Furthermore, ‘facilitating internal communication’ had lower importance for participants from government sector (OR 0.31; 95% CI 0.12 to 0.76) than those from manufacturing & goods distribution sector ($p=0.01$).

These findings suggested that the government sector was less concerned about improving security, business performance or facilitating internal communication than was the manufacturing & goods distribution sector, which might well simply reflect the different priorities existing between the public and private sectors.

Interestingly, ‘accessibility via any internet connected device’ was more important for respondents from the resources and construction sector (OR 3.43; 95% CI 1.44 to 8.14; $p=0.01$) than for respondents from the manufacturing & goods distribution sector. This also appears logical, because the resources and construction sector have many remote fields and sites which require a variety of ways to access CC.

Analysing these findings by location and size, however, shows far less variability – with most expected benefits being equally important for all States and organisation sizes, except for two expected benefits:

- The first difference was between States which showed participants from multi-State organisations (OR 0.54; 95% CI 0.32 to 0.91) having lower ($p=0.02$) belief in the importance of 'avoiding the expense of buying licences' compared with participants from single State organisations;
- The second difference was between organisation sizes which showed 'quickness of implementation' was considered more important for participants from organisations having between 1000 and 4999 employees (OR 2.83; 95% CI 1.32 to 6.08) than for those from organisations with fewer than 101 employees ($p=0.01$). Since systems implementation usually takes longer in large organisations than in small organisations, this finding explains why 'quickness of implementation' was important for large organisations. The same difference was expected for multi-State organisations but, somewhat surprisingly, this was not seen in the statistical analysis (OR 0.93; 95% CI 0.55 to 1.57; $p=0.78$) which suggests that further study in the future is needed to explain this apparent anomaly.

Table 4.5: Results of comparing importance of expected benefits for Cloud Adopters between 2012 and 2013

Importance of Expected Benefit	2012	2013	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
	Mean ± SD	Mean ± SD				
To reduce costs	3.38 ± 0.99	3.60 ± 1.00	1.54 (0.98 to 2.41)	0.06	1.43 (0.89 to 2.27)	0.14
To maintain our systems more effectively	3.55 ± 0.95	3.71 ± 0.87	1.35 (0.86 to 2.13)	0.19	1.39 (0.87 to 2.22)	0.17
To improve business performance significantly	3.49 ± 0.97	3.60 ± 0.93	1.16 (0.74 to 1.82)	0.52	1.12 (0.70 to 1.78)	0.64
To enable us to introduce new systems more easily	3.57 ± 0.99	3.72 ± 0.94	1.31 (0.83 to 2.05)	0.24	1.40 (0.88 to 2.24)	0.16
To add or remove services as needed	3.42 ± 1.00	3.33 ± 0.90	0.84 (0.54 to 1.32)	0.45	0.83 (0.52 to 1.31)	0.42
To facilitate internal communication	2.48 ± 1.01	2.68 ± 1.04	1.47 (0.94 to 2.32)	0.09	1.51 (0.94 to 2.43)	0.09
To increase productivity	3.38 ± 0.99	3.35 ± 0.90	0.94 (0.60 to 1.47)	0.77	0.92 (0.58 to 1.46)	0.71
To improve security	2.81 ± 1.04	2.87 ± 0.96	1.09 (0.70 to 1.70)	0.71	1.02 (0.65 to 1.61)	0.93
It can be implemented quickly	3.64 ± 1.06	3.61 ± 1.04	0.92 (0.59 to 1.44)	0.72	0.95 (0.60 to 1.50)	0.82
To avoid the expense of buying licences	2.78 ± 1.21	2.87 ± 1.12	1.13 (0.73 to 1.75)	0.58	0.93 (0.59 to 1.47)	0.77
Implementation or administration of IT infrastructure is not needed	3.19 ± 1.13	3.19 ± 1.06	1.01 (0.65 to 1.57)	0.96	0.98 (0.62 to 1.55)	0.94
It is accessible via any internet connected device	3.61 ± 1.10	3.71 ± 0.93	1.12 (0.72 to 1.73)	0.63	1.21 (0.76 to 1.90)	0.42
It is green IT	2.43 ± 1.00	2.34 ± 0.83	0.89 (0.57 to 1.38)	0.59	0.90 (0.57 to 1.42)	0.64

* Data analysed using ordered logistic regression.
SD: Standard Deviation.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.
180 observations in 2012 97 observations in 2013

Table 4.6: Importance of ‘to reduce costs’ as an expected benefit for Cloud Adopters

Expected Benefit	Year	Extremely important	Very important	Important	Not very important	Not at all important	Total
To reduce costs	2012	28 15.6%	46 25.6%	77 42.8%	24 13.3%	5 2.8%	180
	2013	19 19.6%	36 37.1%	27 27.8%	14 14.4%	1 1.0%	97

4.1.3.2. Realised Benefits

The reviewed literature did not rank or even state the realised benefits from adopting CC, although many expected benefits (advantages) were stated. This study, therefore, fills a gap in the existing CC literature, by identifying the top five realised benefits for Cloud Adopters in both surveys, as shown in Figure 4.10. There were only very slight differences between the proportions of these top realised benefits between 2012 and 2013 which added support to the finding that these were the true benefits that had been gained from CC. It was noticeable that ‘ease of adding or removing services as needed’ had dropped to the fifth place in 2013, however, being replaced by ‘reducing costs’, which may indicate that many of the early Cloud Adopters had now completed their cloud applications and were looking at long term benefits such as cost reduction. Follow-up qualitative research will help to refine the ‘top five’ list and, ideally, will provide richer data to explain why adopters hold these views.

Although ‘improving business performance significantly’ and ‘maintaining the systems more effectively’ were the two most important *expected* benefits in both surveys, as shown in

Figure 4.9, they were not included in the top five *realised* benefits in either survey. ‘Maintaining the systems more effectively’ was very close and occupied the sixth place in both surveys, with 45.8% (82 of 179) in 2012 and 44.3% (43 of 97) in 2013. However, ‘improving business performance significantly’ occupied the tenth and eleventh places in 2012 and 2013 respectively, with 22.9% (41 of 179) and 21.6% (21 of 97).

Moreover, ‘increasing productivity’, which was ranked as the fourth and fifth most important expected benefit in 2012 and 2013 respectively, also failed to make one of the top five realised benefits, being ranked eighth in realised benefits for 2012, with 27.4%

(49 of 179), and ninth in 2013, with 29.9% (29 of 97). Although all the top five realised benefits were listed in the five most important expected benefits in both surveys, the proportions of importance and realisation of benefits did not match. It appears, therefore, that the reality of CC had not at that time matched the expectations of Cloud Adopters.

2012
179 out of 187 Cloud Adopters

Rank	Realised Benefit	%	N
1	It enabled us to introduce new systems more easily	63.7%	114
2	It was implemented quickly	62.6%	112
3	It was accessible via any internet-connected device	55.3%	99
4	It was easy to add or remove services as needed	51.4%	92
5	It reduced costs	46.9%	84

2013
97 out of 99 Cloud Adopters

Rank	Realised Benefit	%	N
1	It enabled us to introduce new systems more easily	62.9%	61
2	It was implemented quickly	59.8%	58
3	It was accessible via any internet-connected device	52.6%	51
4	It reduced costs	46.4%	45
5	It was easy to add or remove services as needed	45.4%	44

Figure 4.10: Ranking response rate of the realised benefits of Cloud Adopters in 2012 and 2013

Logistic regression analysis showed no statistically significant differences in the beliefs of Cloud Adopters for the realisation of benefits between 2012 and 2013, as illustrated in Table 4.7. Even after adjusting the analyses for demographic covariates (industry sectors, State and organisation size), these results did not change. Although there were no statistically significant differences across the two years, however, there were some differences between the realised benefits in terms of industry sector, organisation size and State. Respondents from the government sector had less belief that CC ‘reduced costs’ (OR 0.31; 95% CI 0.11 to 0.91) or ‘avoided the expense of buying licences’ (OR 0.28; 95% CI 0.09 to 0.88) than respondents from the manufacturing & goods distribution sector (p=0.03). This was consistent with the difference between these two sectors in terms of importance of these expected benefits. In other words, ‘reducing costs’ and ‘avoiding the expense of buying licences’ were more important to (and more fully realised by) the manufacturing & goods distribution sector than the government sector. The government sector responses might also be partly explained by the view expressed by Bersin (2009) who compared the total cost of ownership of ‘conventional’ licensed software to that of SaaS, finding that savings obtained from SaaS may not be as great as users believe. Since the services sector may well make more use of internal communications than the manufacturing & goods distribution sector, the finding that ‘facilitating internal communication’ was more fully realised by participants from the services sector (OR 6.11; 95% CI 1.49 to 25.09) than by those from the manufacturing & goods distribution sector ($p=0.01$) was, again, not entirely surprising.

Respondents from the finance & ICT sector were more convinced that CC ‘increased productivity’ (OR 4.42; 95% CI 1.52 to 12.85) and that ‘it was easy to add or remove CC services as needed’ (OR 2.88; 95% CI 1.16 to 7.11) than respondents from the manufacturing & goods distribution sector ($p=0.02$). Both finance & ICT organisations are familiar with technologies such as CC – as well as being software-based industries – which might explain why this sector realised these expected benefits more fully than the hardware and transport-oriented manufacturing & goods distribution sector.

From the point of view of location, participants with multi-State operations (OR 1.94; 95% CI 1.06 to 3.56) were more convinced that CC ‘enabled them to introduce new systems more easily’ than were respondents operating in a single State ($p=0.03$), a finding which might well be indicative of the fact that multi-State organisations are not necessarily larger than single State organisations. In addition, there was no statistical difference between small and larger organisations in the realisation of this benefit.

In terms of organisational size, ‘reducing costs’ was more effectively realised by organisations with 1000–4999 employees (OR 3.94; 95% CI 1.60 to 9.71) or more than 4999 employees (OR 3.30; 95% CI 1.08 to 10.03) than by respondents from organisations with fewer than 101 employees (all $p<0.046$). This finding is compatible with the greater cost reductions possible for larger organisations with many IT systems compared with the relatively small number of systems existing in small organisations. Participants from organisations with 500–999 employees (OR 5.13; 95% CI 1.78 to 14.79) were more convinced that ‘implementation or administration of IT infrastructure was not needed in CC’ than were participants from organisations with fewer than 101 employees ($p=0.002$), possibly because these rather larger organisations had more up-to-date IT infrastructure than the smallest companies responding to the surveys.

Table 4.7: Results of comparing realised benefits for Cloud Adopters between 2012 and 2013

Realised Benefit	2012 vs 2013			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
It reduced costs	0.98 (0.60 to 1.61)	0.93	1.05 (0.61 to 1.80)	0.86
It led to more effective systems maintenance	0.94 (0.57 to 1.55)	0.81	0.93 (0.55 to 1.57)	0.79
It improved our business performance significantly	0.93 (0.51 to 1.69)	0.81	0.92 (0.49 to 1.73)	0.80
It enabled us to introduce new systems more easily	0.97 (0.58 to 1.61)	0.90	1.06 (0.62 to 1.82)	0.84
It was easy to add or remove services as needed	0.79 (0.48 to 1.29)	0.34	0.89 (0.52 to 1.51)	0.67
It facilitated internal communication	1.03 (0.52 to 2.04)	0.93	1.32 (0.63 to 2.79)	0.47
It increased productivity	1.13 (0.66 to 1.95)	0.66	1.25 (0.70 to 2.21)	0.45
It improved security	1.12 (0.52 to 2.41)	0.77	1.12 (0.51 to 2.48)	0.78
It was implemented quickly	0.89 (0.54 to 1.48)	0.65	0.88 (0.52 to 1.48)	0.62
It avoided the expense of buying licences	1.23 (0.71 to 2.13)	0.45	1.15 (0.65 to 2.05)	0.63
Implementation or administration of IT infrastructure was not needed	0.95 (0.56 to 1.59)	0.84	0.95 (0.55 to 1.64)	0.85
It was accessible via any internet connected device	0.90 (0.55 to 1.47)	0.66	1.02 (0.61 to 1.71)	0.95
It was green IT	1.23 (0.58 to 2.60)	0.59	1.25 (0.58 to 2.72)	0.57

* Data analysed using logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

179 observations in 2012 97 observations in 2013

4.1.4. Beliefs

The beliefs of Cloud Adopters towards CC in both surveys, after excluding 'don't know' answers, are shown in Figure 4.11. In both surveys, more than 95% of respondents indicated they understood the concept of CC although the reviewed literature indicated considerable uncertainty and confusion among Australian CIOs over the concept of CC in the last 4-5 years (Kotadia, 2010, Macquarie Telecom, 2011).

Respondents' beliefs concerning CC were remarkably similar across the two surveys, with the most significant difference between respondents' agreement with each statement in both surveys being a mere 6% – except for the statement 'Cloud Computing is the future of IT', where respondents' agreement with the statement increased by 13% in 2013 over 2012.

The most popular statements about CC had very high levels of agreement. 85% of respondents in both surveys (159 of 187 in 2012; and 84 of 99 in 2013) agreed that 'Cloud Computing will be one of the top ten strategic technologies for the next 5 years' and 80% (150 of 187 in 2012) and 86% (85 of 99 in 2013) agreed that 'the main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery'.

With slightly less consistency, the statements 'Cloud Computing is a tool that enables the organisation to be more productive and cost effective', 'Cloud Computing in Australia is currently immature' and 'Cloud Computing is the future of IT' had levels of agreement varying between 49% and 62% in both years.

The reviewed literature had suggested that virtualisation is a primary enabler for CC (Linthicum, 2010a, O'Driscoll et al., 2013, Rimal and Choi, 2012, Mancini et al., 2009) because it facilitates and enhances the scalability and flexibility of hardware services on-demand (Padhy and Patra, 2012, Guha and Al-Dabass, 2010, Wang et al., 2008). However, the statement 'Virtualisation is required to enable Cloud Computing' had only 43% agreement from respondents (80 of 187 in 2012 and 43 of 99 in 2013), which could indicate either genuine disagreement with the statement itself (i.e. respondents do not believe that virtualisation is a requirement for effective CC), or that respondents were not sufficiently familiar with the technologies underlying CC to grasp the importance of virtualisation to its effective deployment. Future research using qualitative techniques to enable richer and more nuanced data gathering might well provide an answer to this question.

Although the reviewed literature considered SOA a foundation for CC (Banerjee et al., 2012, Murah, 2012, Wang et al., 2008, Linthicum, 2010a), the same potential explanation for low levels of agreement with the statement ‘SOA is required to enable CC’, which received not only very low levels of agreement 33% (62 of 187 in 2012 and 33 of 99 in 2013) overall, but also the second greatest discrepancy across the two surveys. As with virtualisation, SOA is a more technical aspect of CC and it is quite possible that survey respondents were simply unfamiliar with this technique – rather than genuinely believing SOA offers little in terms of supporting effective CC deployment.

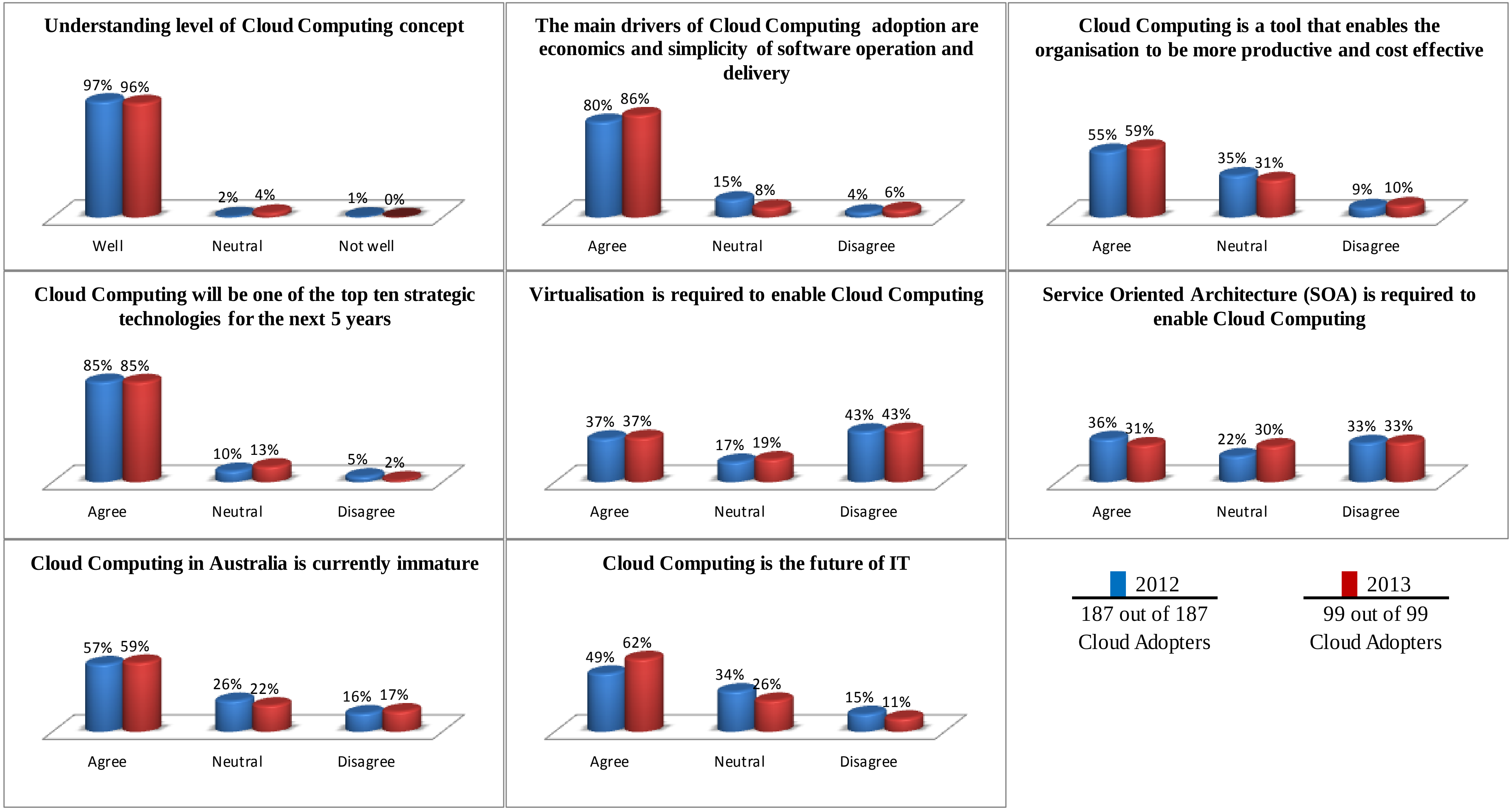


Figure 4.11: Beliefs of Cloud Adopters in both survey surveys

The results of ordered logistic regression analysis showed no statistically significant differences in Cloud Adopters' beliefs between 2012 and 2013 (Table 4.8). There was a slightly greater trend towards 2013 participants believing that 'CC is the future of IT' compared with 2012 participants, but this was not significant (p=0.07). In addition, the number of 'Don't know' answers indicated considerable uncertainty about the requirement of SOA and virtualisation as CC enablers (as discussed above, however, there are at least two possible explanations for the low levels of agreement with these two belief statements, which could be teased out by more qualitative data gathering approaches).

Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not alter the results. There was no difference in belief on the basis of State (location), although there were some differences between the beliefs of sectors and organisation size. For instance, respondents from the services sector (OR 2.66; 95% CI 1.14 to 6.20) were more strongly in agreement with the statement that 'CC is a tool to be more productive and cost effective' compared with the manufacturing & goods distribution sector (p=0.02). This might be because CC has the potential to facilitate the work of the services sector than of the more physically-oriented manufacturing & goods distribution sector. However, since this difference did not occur between these same sectors in either listed importance of expected benefits or realised benefits of 'reducing costs' and 'increasing productivity' for Cloud Adopters, it is difficult to be sure what caused this (admittedly fairly slight) discrepancy without further investigation.

Another difference between sectors occurred in responses to the statement that SOA was an enabler for CC. Respondents from the government sector (OR 0.28; 95% CI 0.11 to 0.71) and the 'other' sector (OR 0.35; 95% CI 0.14 to 0.85) were less inclined to believe that 'SOA is required to enable CC' compared with respondents from the manufacturing & goods distribution sector (all p<0.026). This difference might, as already suggested, potentially relate to the levels of technical expertise of the respondents from these sectors – or might relate to the very different ways these sectors make use of CC.

From the point of view of organisation size, there was a difference in understanding the concept of CC and in believing in the maturity of CC. Respondents from organisations having 500–999 employees (OR 2.72; 95% CI 1.09 to 6.80) and 1000–4999 employees

(OR 2.86; 95% CI 1.22 to 6.71) were more inclined to believe they understood the concept of CC, compared with organisations having fewer than 101 employees (all $p<0.036$). Participants from larger organisations, those with 1000–4999 employees (OR 2.20; 95% CI 1.02 to 4.75; $p=0.045$), were also more inclined to believe that 'CC in Australia is currently immature' compared with organisations with fewer than 101 employees.

Respondents from larger organisations, not entirely surprisingly, thus felt both more confident of their understanding of CC, as well as seeing this technology as still being relatively immature in Australia than respondents from small organisations. Given the greater depth of technical expertise available to larger organisations, this result is both anticipated and consistent with the reviewed literature, which suggests that CC is not yet entirely mature in any country (Damshenas et al., 2012, Rimal et al., 2011, Hunter, 2009) and may be particularly immature in Australia (Macquarie Telecom, 2011, Australian Government Information Management Office, 2011, Dearne, 2011). It would be very interesting to follow this group up in the next year or so, to see whether organisation size is still the major determinant of belief in CC's maturity level – or whether the rapid uptake of this technology has rendered the size divide no longer relevant.

Table 4.8: Results of comparing Cloud Adopters' beliefs between 2012 and 2013 (after excluding the answers of 'Don't know' option)

Belief	2012 vs 2013 (Don't Know were Excluded)						Number of Don't Know
	2012 Mean ± SD	2013 Mean ± SD	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	
Understanding level of CC	4.46 ± 0.62	4.45 ± 0.58	0.95 (0.59 to 1.53)	0.83	0.97 (0.59 to 1.61)	0.91	
Main drivers of CC adoption are economics and simplicity	3.96 ± 0.74	4.02 ± 0.78	1.28 (0.79 to 2.09)	0.31	1.28 (0.77 to 2.11)	0.34	1
CC is a tool to be more productive and cost effective	3.56 ± 0.80	3.57 ± 0.82	1.05 (0.66 to 1.66)	0.84	1.19 (0.74 to 1.91)	0.48	2
CC will be one of the top ten strategic technologies for the next 5 years	4.08 ± 0.77	4.16 ± 0.72	1.21 (0.75 to 1.94)	0.43	1.47 (0.89 to 2.40)	0.13	1
Virtualisation is required to enable CC	3.01 ± 1.20	2.98 ± 1.22	0.96 (0.62 to 1.49)	0.86	0.96 (0.61 to 1.51)	0.88	6
SOA is required to enable CC	3.02 ± 1.04	2.97 ± 1.11	0.90 (0.57 to 1.42)	0.65	0.83 (0.52 to 1.32)	0.43	21
CC in Australia is currently immature	3.55 ± 0.98	3.52 ± 0.89	0.92 (0.59 to 1.44)	0.72	0.91 (0.57 to 1.44)	0.68	4
CC is the future of IT	3.45 ± 0.96	3.62 ± 0.94	1.46 (0.93 to 2.29)	0.10	1.55 (0.97 to 2.46)	0.07	4

* Data analysed using ordered logistic regression.
SD: Standard Deviation.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.
171-187 observations in 2012 94-99 observations in 2013

4.1.5. Experiences with Cloud Computing

Approximately 92.6% (163 of 176) of the Cloud Adopters in the 2012 survey stated that they had achieved all, most, or some of their CC goals; and this proportion increased by 2.2% in the 2013 survey to reach 94.8% (92 of 97), as shown in Figure 4.12. In addition, 61.9% (109 of 176) of Cloud Adopters in the 2012 survey had experienced no (zero) average unavailability of CC services per month and by the 2013 survey this percentage had increased to approximately 69% (67 of 97). These results showed that from 30% to 40% of Cloud Adopters might have unavailability concerns, which will be investigated further in Section 4.1.7 of this Chapter.

The reviewed literature (Fasihuddin et al., 2012, Jain and Gupta, 2012, Celar et al., 2011, Abah and Francisca, 2012) identified five characteristics of CC, extracted from the definition of CC: on-demand self-service (registering online and receiving the services immediately); multi-device access (accessing via any internet-connected device); multi-tenancy; scalability (scaling the service up or down immediately); and measurability (measuring the provided services by the provider to issue the invoices). The reality of all of these characteristics will be investigated in this Section, with the exception of multi-tenancy which is a part of public, community or hybrid cloud and is covered in the following Section.

The most widely-realised characteristic of CC was multi-device access, with 69.9% (123 of 176) in 2012 and 72.2% (70 of 97) in 2013; followed by scalability, with 54.5% (96 of 176) in 2012 and 56.7% (55 of 97) 2013, as illustrated in Figure 4.12. The other two CC characteristics (on-demand self-service and measurability) were realised by fewer than half the Cloud Adopters and varied from 39.2% to 43.3% across the two surveys. The results of the 2013 survey showed that realisation of all of these characteristics had increased by at most 4.1%, except for on-demand self-service which declined by 2.3% to become the least-realised characteristic (replacing measurability, which had been the least-realised characteristic in 2012). These findings are consistent with adoption of any new technology, where users begin to discover additional uses – or stop using aspects of the technology which prove less helpful than they had originally expected them to be. The richer data which a qualitative follow-up to this study would provide might well offer a more nuanced understanding of these changes in realisation.

The four key properties required to build an effective CC infrastructure, as described in the reviewed literature, are: transparency (adding more computer resources to the cloud without affecting the provided services); scalability (stated earlier in the characteristics); monitoring; and security (Mikkilineni and Sarathy, 2009, MacVittie, 2008, Rimal and Choi, 2012).

Figure 4.12 shows that transparency was the most widely-experienced infrastructure property in 2012 for 64.2% (113 of 176) of respondents, but declined in importance by 4.4% in the 2013 survey, to be replaced as the top property by security, which increased by 7.3%. Although security of provided CC services was realised by 59.7% (105 of 176) of Cloud Adopters in 2012 and 67% (65 of 97) in 2013, as illustrated in Figure 4.12, it is nonetheless also considered one of the major concerns associated with CC, as many authors have noted (see, for example: Rimal et al., 2011, Xiaoqi, 2012, Baghdadi, 2013, Cloud Security Alliance, 2013) . This apparent contradiction is not entirely surprising – placing one's precious data in the hands of an external service provider is a very unnerving experience for almost any CIO!

The least realised infrastructure properties, which were experienced by between 53.6% and 56.7% were scalability (which increased by 2.2%) and monitoring (which decreased by 2.7%). As with the summary of CC characteristics above, these findings lend support to respondents' views that CC in Australia is still in its infancy – experimentation, learning and consequent variation in usage are exactly what one would expect to find in the diffusion of a new technology.

Since the reviewed literature illustrated the significance of virtualisation and SOA as CC enablers, it is important to analyse the answers of those who have applied these approaches, in order to investigate their opinion regarding applying them and the impacts of applying them on achieving CC goals and realising the related cost reductions.

In terms of virtualisation, the findings are somewhat contradictory: approximately half (33 of 65) the respondents to the 2012 survey who indicated they had applied virtualisation before they moved to CC agreed that virtualisation is required to enable CC, while the remainder of this group either disagreed (35.4%; 23 of 65) or had a neutral opinion (13.8%; 9 of 65). Although the 2013 survey showed that the percentage Cloud Adopters who had virtualised their existing systems before moving to CC improved by 1.2% in 2013, only 45.9% (17 of 37) of this group agreed that virtualisation is required to enable CC, while the remainder either disagreed (35.1%; 13 of 37) or had a neutral opinion (18.9%; 7 of 37). At first glance, this would seem to suggest the survey respondents did not believe virtualisation is a valuable prerequisite for CC.

This result, however, contradicts the finding that only 6.2% (4 of 65 in 2012) and 5.4% (2 of 37 in 2013) of those who applied virtualisation before they moved to CC had failed to achieve their CC goals, whereas the remainder of this group (93.8% (61 of 65) in 2012 and 94.6% (35 of37) in 2013) had achieved their CC goals fully, mostly or partially. In addition, 56.9% (37 of 65 in 2012) of those who stated they had applied virtualisation before they moved to CC had also realised their hoped-for cost reductions. However, their realisation of cost reductions decreased by almost 10% to reach 45.9% (17 of 37) in 2013.

Slightly less than half of those respondents who had applied virtualisation prior to CC in the 2012 survey (48.6%; 54 of 111), did not believe virtualisation was an effective enabler of CC, while the remainder of this group were fairly widely divided: 27% (30 of 111) felt that virtualisation was, indeed, an effective enabler of CC; 18.9% (21 of 111) had a neutral opinion; and the remaining 5.4% (6 of 111) were unsure one way or the other.

The 2013 survey showed that the proportion of Cloud Adopters who had virtualised their existing systems before moving to CC increased by a very small 1.2%, while the levels of agreement and neutrality regarding the value of virtualisation as an enabler of CC increased by 4.7% (to 31.7%) and 1.1% (to 20%) respectively. The level of disagreement remained very close to the results of the 2012 survey (48.3%; 29 of 60).

Once again, these figures suggest that applying virtualisation prior to CC is not generally valuable. And yet, 91.9% (102 of 111) of the 2013 group who had applied virtualisation achieved some, most, or all their CC goals, with only 8.1% (9 of 111) failing to achieve these goals. These findings are, however, further complicated by the fact that the percentage of realisation of cost reductions for those who indicated they had <u>not</u> applied virtualisation before they moved to CC increased from 41.4% (46 of 111) in 2012 to 46.7% (28 of 60) in 2013, which was slightly more than the realisation of those who applied virtualisation by 0.8%. Does this mean that virtualisation adds sufficient additional costs to outweigh its other benefits? Or do these results simply mean that the respondents to the two surveys were sufficiently diverse that their experiences cannot be effectively compared at this level?

Clearly, comparisons of the opinions and consequences within and between the two groups applying and not applying virtualisation (both within and across the two surveys) indicated the necessity of further qualitative study to investigate these apparently contradictory (or, at least, confusing) findings.

This rather confusing picture is similar for organisations applying SOA prior to a move to CC. The 2012 survey indicated that only 10.2% (18 of 176) of Cloud Adopters had applied SOA before they moved to CC and this proportion reduced by 4% in the 2013 survey to a level of only 6.2% (6 of 97) of respondents to the 2013 survey (although this figure should be treated with considerable caution, since there is no means of establishing whether this is the same group of respondents).

Two-thirds (12 of 18) of those who indicated they had applied SOA prior to CC uptake in the 2012 survey agreed that SOA is required to enable CC, while the average opinion of those who stated they had applied SOA prior to CC in the 2013 survey was neutral, suggesting that SOA was less popular as a prerequisite for CC just one year later. As with virtualisation, however, all those who had applied SOA in both surveys had also achieved most or some of their CC goals (and 1 of the 18 respondents in this group in the 2012 survey fully achieved these CC goals!). Although 83.3% (15 of 18) of those who indicated they had applied SOA had also realised cost reductions in the 2012 survey, only one-third (2 of 6) of those who stated they had applied SOA in the 2013 survey had also realised cost reductions.

As with virtualisation, respondents were not overly enthusiastic about the additional effort involved in applying SOA as a precursor to CC. Approval and disapproval of SOA as an effective enabler of CC was fairly evenly balanced in the 2012 survey: 36.1% (57 of 158) of those who had applied SOA before they moved to CC did not believe SOA is required to enable CC, while 33.5% (53 of 158) did support SOA. The remainder either had a neutral opinion (20.9%; 33 of 158), or did not know (9.5%; 15 of 158). The proportion of agree, disagree and do not know options on this statement by this group decreased by 4% in 2013, while the proportion of those holding a neutral option increased by 8.8%. Interestingly, the percentage of achieving some, most, or all of the CC goals for this group increased from 91.8% (145 of 158) to 94.5% (86 of 91) over the same period. This is consistent with the realisation of cost reductions, which increased from 43% (68 of 158) to 47.3% (43 of 91).

These results suggest that those who applied SOA before they moved to CC had higher achievement levels of their CC goals than the average achievement level for all Cloud Adopters in both surveys. And yet the opinion of this group regarding SOA as a CC enabler and the realisation of cost reductions in both surveys was totally at odds with this finding. Does this mean that some other factor was, in truth, the enabler of goal achievement and cost reduction? Or were these respondents simply unable to see the benefits they had gained from implementing SOA? Or was this simply the result of the very small number (6 of 97) of respondents indicating they had applied SOA in 2013? Clearly, further study of the influence and impact of both virtualisation and SOA as precursors to CC is required for any truly effective understanding of the importance of either virtualisation or SOA to CC.

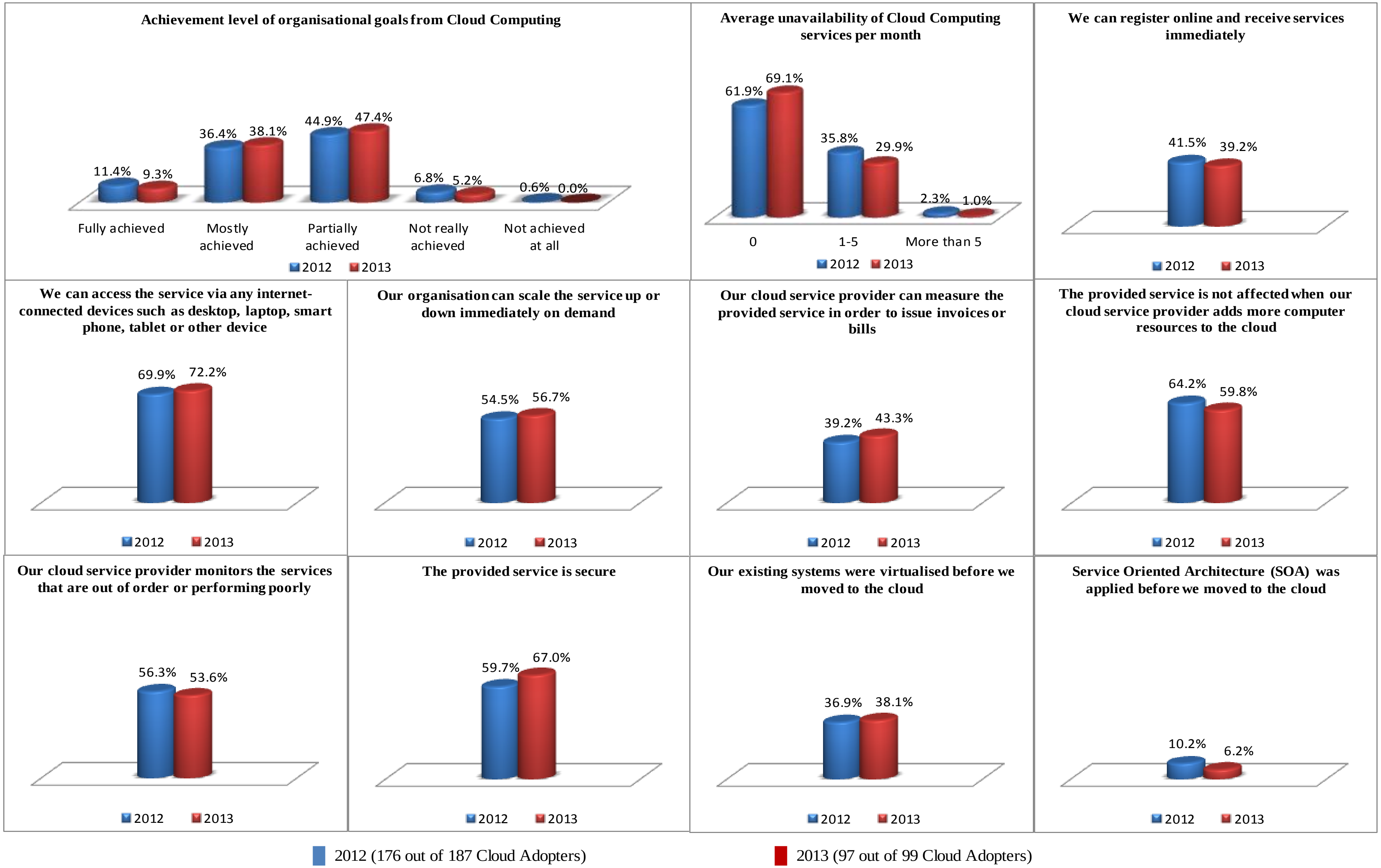


Figure 4.12: Experiences of Cloud Adopters with CC in 2012 and 2013

Ordered logistic regression analysis showed that no statistically significant differences in the achievement level of CC goals and unavailability of CC services between 2012 and 2013 (Table 4.9). Even after adjusting the analyses for demographic covariates (industry sectors, State and organisation size), the results did not change. Although the achievement level of CC goals was not stated in the reviewed literature, this study has identified this level for at least one group of industry respondents and, interestingly, discovered that participants from the resources & construction sector (OR 0.33; 95% CI 0.13 to 0.87; p=0.02) had a lower achievement level for their CC goals than respondents from the manufacturing & goods distribution sector. This may well be the result of differing usage of CC, or uptake of different types of CC (for example, resources & construction sector companies frequently make use of home-grown big data analyses and might thus be more likely to use PaaS applications, whereas the manufacturing sector is more likely to be using SaaS applications such as CRM or Enterprise Resource Planning ERP) but, clearly, more detailed research will be required to tease out the reality of these differences.

Another difference exists between organisations of varying size. Respondents from organisations with more than 4999 employees (OR 0.29; 95% CI 0.09 to 0.89; p=0.03) experienced fewer unavailability occasions for CC services per month than small organisations having fewer than 101 employees. This might well indicate that larger organisations expect to have advanced IT infrastructure and contract with larger CSP which, in turn, might well provide greater stability of CC services compared with smaller organisations which are forced to adopt cheaper (and possibly less reliable) alternatives.

Table 4.9: Results of achievement level of CC goals & unavailability of CC services for Cloud Adopters between 2012 and 2013

Achievement level of CC goals & Unavailability of CC service per month	**2012 vs 2013**					
	2012	**2013**	**OR[1](95% CI)**	**p value[1]**	**OR[2](95% CI)**	**p value[2]**
	Mean ± SD	**Mean ± SD**				
Achievement level of organisational goals from CC	3.51 ± 0.81	3.52 ± 0.74	1.00 (0.63 to 1.59)	0.99	0.95 (0.59 to 1.54)	0.84
Average unavailability of CC service per month	5.58 ± 0.63	5.66 ± 0.59	1.39 (0.82 to 2.34)	0.22	1.40 (0.80 to 2.43)	0.24

* Data analysed using ordered logistic regression.
SD: Standard Deviation.
OR: Odds Ratio.
95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates.
[2] adjusted for covariates including industry sector, state and organisation size.
176 observations in 2012
97 observations in 2013

The results of logistic regression analysis indicated no statistical significant differences in the experiences of Cloud Adopters between 2012 and 2013, as illustrated in Table 4.10. Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change the results. This confirmed that these were the real experiences of Cloud Adopters with CC. However, there were slight differences between the experiences of industry sectors, organisation size and States.

In terms of industry sector, participants from the services sector (OR 2.81; 95% CI 1.06 to 7.44; p=0.04) were more likely to experience that 'the provided service was not affected if more resources are added' than participants from the manufacturing & goods distribution sector. While it is difficult to propose an explanation for this difference, one possibility is the type of CSP used by these two sectors and/or the type of CC application used. As already suggested above, there is some indication (PR Newswire, 2015) that companies within the services sector are more likely to use PaaS than those within the manufacturing & goods distribution sector.

Another difference occurred in 'accessibility via any internet-connected device' which was more widely cited by respondents from the government sector (OR 3.26; 95% CI

1.07 to 9.91; p=0.04) than those from the manufacturing & goods distribution sector. This might well be because government sector agencies provide more (and more varied) internet-connected devices to their staff than do companies in the manufacturing & goods distribution sector.

Respondents from the healthcare & education (OR 0.28; 95% CI 0.10 to 0.75) and the resources & construction sectors (OR 0.14; 95% CI 0.04 to 0.50) had lower experience that ‘their existing systems were virtualised before they moved to CC’ compared with those in the manufacturing & goods distribution sector (all p<0.016). This might well be a consequence of lower levels of technical expertise in healthcare or education providers than in manufacturing – especially as many manufacturing organisations are mainframe users and are thus likely to be already utilising virtualisation – but might equally indicate the types of CC applications in use. Further investigation is clearly needed to elicit sufficient detail to establish the possible explanations for this discrepancy.

From the perspective of organisation size and location, participants from organisations with 500–999 employees (OR 3.49; 95% CI 1.26 to 9.62; p=0.02) were more likely to ‘virtualise their existing systems before they moved to CC’ than organisations with fewer than 101 employees. This is not surprising, as very few small organisations have the expertise (or, indeed, the interest) to consider virtualisation.

Oddly, however, multi-State organisations (OR 0.48; 95% CI 0.25 to 0.91; p=0.03) were less likely to ‘virtualise their existing systems before they moved to CC’ than single State organisations. Another difference occurred in ‘accessibility via any internet-connected device’ which was reported by respondents from multi-State organisations (OR 1.99; 95% CI 1.03 to 3.83; p=0.04) to a greater extent than by those from single State organisations. One possible explanation for this differing experience is that the CC systems of multi-State organisations have a greater need for remote access than those of single State organisations even though this difference did not exist between single and multi-States in either importance of expected benefits or realised benefits of ‘accessibility via any internet-connected device’ for Cloud Adopters. These outcomes emphasise the need for follow-up qualitative research.

Table 4.10: Results of comparing experiences with CC for Cloud Adopters between 2012 and 2013

Experiences with CC	2012 vs 2013			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Achievement level of organisational goals from Cloud Computing	1.00 (0.63 to 1.59)	0.99	0.95 (0.59 to 1.54)	0.84
Average unavailability of Cloud Computing service per month	1.39 (0.82 to 2.34)	0.22	1.40 (0.80 to 2.43)	0.24
The provided service is not affected if more resources added	0.83 (0.50 to 1.38)	0.47	0.94 (0.55 to 1.60)	0.81
Our CSP monitors out of order services or performing poorly	0.90 (0.55 to 1.48)	0.67	0.96 (0.57 to 1.61)	0.86
Our CSP can measure the provided service to issue invoices	1.18 (0.72 to 1.96)	0.51	1.23 (0.72 to 2.11)	0.46
The provided service is secure	1.37 (0.82 to 2.31)	0.23	1.28 (0.74 to 2.19)	0.37
Our org can scale service up or down immediately on demand	1.09 (0.66 to 1.80)	0.73	1.20 (0.71 to 2.04)	0.50
We can register online and receive services immediately	0.91 (0.55 to 1.51)	0.71	0.96 (0.56 to 1.65)	0.89
We can access the service via any internet connected devices	1.12 (0.65 to 1.93)	0.69	1.37 (0.76 to 2.45)	0.29
Our existing sys were virtualised before we moved to CC	1.05 (0.63 to 1.76)	0.84	0.95 (0.54 to 1.64)	0.84
SOA was applied before we moved to the cloud	0.58 (0.22 to 1.51)	0.26	0.52 (0.18 to 1.46)	0.22

* Data analysed using logistic regression.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.
176 observations in 2012 97 observations in 2013

4.1.6. Usage of Cloud Computing

This Section explores ways in which Cloud Adopters were using CC. Their practices include the service delivery models (SaaS, PaaS or IaaS), type of CSPs (International, Australian or both of them), deployment models (Public, Private, Community or Hybrid Cloud) and cloud systems (e.g. email, storage, database & backup systems).

4.1.6.1. Service Delivery Models and their Cloud Service Providers

Both surveys showed Australian organisations used all types of service delivery models identified in the reviewed literature. This study identified not only the usage proportions of these models and the type of CSP offering them, but also the association between the models, which was not identified in the reviewed literature (see Table 4.11).

Table 4.11: Service delivery models and CSP types for Cloud Adopters in 2012 and 2013

Service Delivery Model	2012 (168 out of 187 Cloud Adopters)			2013 (97 out of 99 Cloud Adopters)		
	International CSP	Both Australian & International CSPs	Australian CSP	International CSP	Both Australian & International CSPs	Australian CSP
SaaS	76	24	49	48	21	19
PaaS	25	2	20	23	3	8
IaaS	26	13	45	20	4	23

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

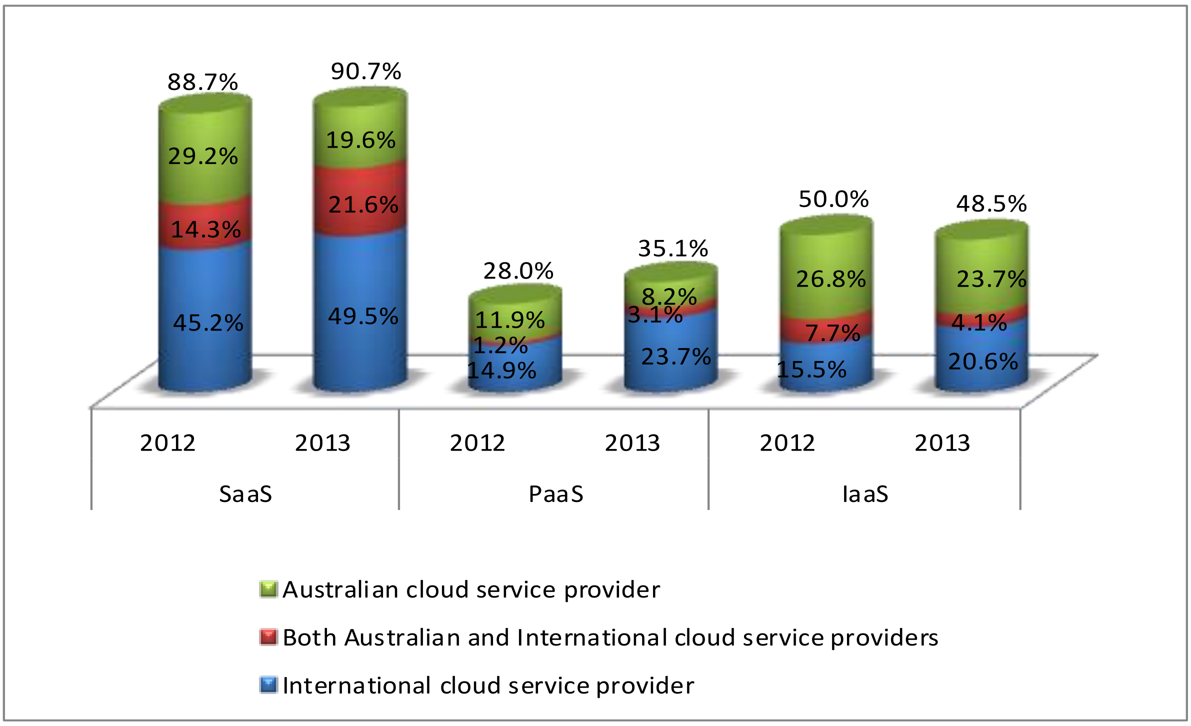
In 2012 approximately 89% of Cloud Adopters were using SaaS, 50% were using IaaS and 28% were using PaaS, as shown in Figure 4.13. The popularity of SaaS was expected, as the ability to 'rent' software – rather than having to purchase, install, maintain, upgrade and, ultimately, retire it – is very obviously attractive to organisations of all sizes and types; and has been the most widely publicised benefit of CC since its inception. The greater popularity of IaaS over PaaS is, again, unlikely to come as a surprise given the readily-identifiable benefits of accessing raw machine processing power and storage space at will vs. the less obvious attractions of building software in a 'rented' development environment.

There was no significant change in the usage of SaaS and IaaS models in 2013, though the number of SaaS users increased by 2% and IaaS users decreased by 1.5%. Interestingly, however, the number of organisations using PaaS increased by 7% in 2013. This may indicate that SaaS was not meeting the requirements of some users, because the customisation possibilities are very limited in SaaS (Kepes, 2011, Padhy and Patra, 2012, Xiaoqi, 2012).

Not surprisingly, both surveys showed that Cloud Adopters were more likely to use SaaS or PaaS with international CSPs, as illustrated in Figure 4.13. International CSPs (particularly US-based providers) were the initiators of CC and were the most experienced providers at that time, especially compared with Australian ones; and offered the widest range of pre-configured software solutions. However, Figure 4.13 shows that in both surveys Cloud Adopters were more likely to use IaaS with Australian CSPs. The most likely explanation of this trend is that Australian organisations prefer to use IaaS with local CSPs because they can gain HPC facilities instantaneously (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010), without the delay or interruptions likely to occur with an international CSP-provided platform.

The proportion of Australian organisations having contracts with international CSPs overall increased in 2013, while the proportion of those having contracts with Australian CSPs declined, for all service delivery models; although the percentage of respondents with both Australian and international CSP contracts simultaneously in SaaS and PaaS rose in 2013 and decreased for IaaS. How much of this was due to awareness of the forthcoming changes to the federal Privacy Act (which came into effect in March 2014) is difficult to tell without interviewing individual CIOs, but it seems likely that awareness of the considerably more complex requirements for offshore data storage played at least some part in this trend towards increased reliance on local (or, at least, on-shore) CSPs.

CSPs themselves were aware of the impending changes to legal requirements for data storage in the Australian CC atmosphere and, whether for this reason or simply because of the growing interest in CC within Australia (or both), a number of major international CSPs, such as AWS and IBM, have opened datacentres in Australia (Amazon Web Services Inc., 2012) in recent years – and it is not clear whether individual respondents considered these providers as international, even though their datacentres are physically located in Australia. Many of these issues will be clarified by means of qualitative enquiry in future research.



2012 (168 out of 187 Cloud Adopters) **2013** (97 out of 99 Cloud Adopters)

Figure 4.13: Service delivery models and CSP types for Cloud Adopters in 2012 and 2013

4.1.6.2. Deployment and Service Delivery Models

Respondents in both surveys indicated that Australian organisations used all the types of deployment and service delivery models which were identified in the reviewed literature. In terms of service delivery models and CSPs, not only were the usage proportions of the deployment models stated in this study, but the relationship between these models and service delivery models, which was not found in the reviewed literature, was also identified (see Table 4.12).

Table 4.12: Deployment models and service delivery models for Cloud Adopters in 2012 and 2013

Deployment Model	**2012** (168 out of 187 Cloud Adopters)			**2013** (97 out of 99 Cloud Adopters)		
	SaaS	**PaaS**	**IaaS**	**SaaS**	**PaaS**	**IaaS**
Hybrid Cloud	26	13	24	16	10	13
Out-sourced Community Cloud	21	7	6	7	3	2
On-site Community Cloud	7	5	4	3	1	3
Out-sourced Private Cloud	52	13	38	32	11	25
On-site Private Cloud	47	29	42	15	16	24
Public Cloud	92	17	30	53	14	17

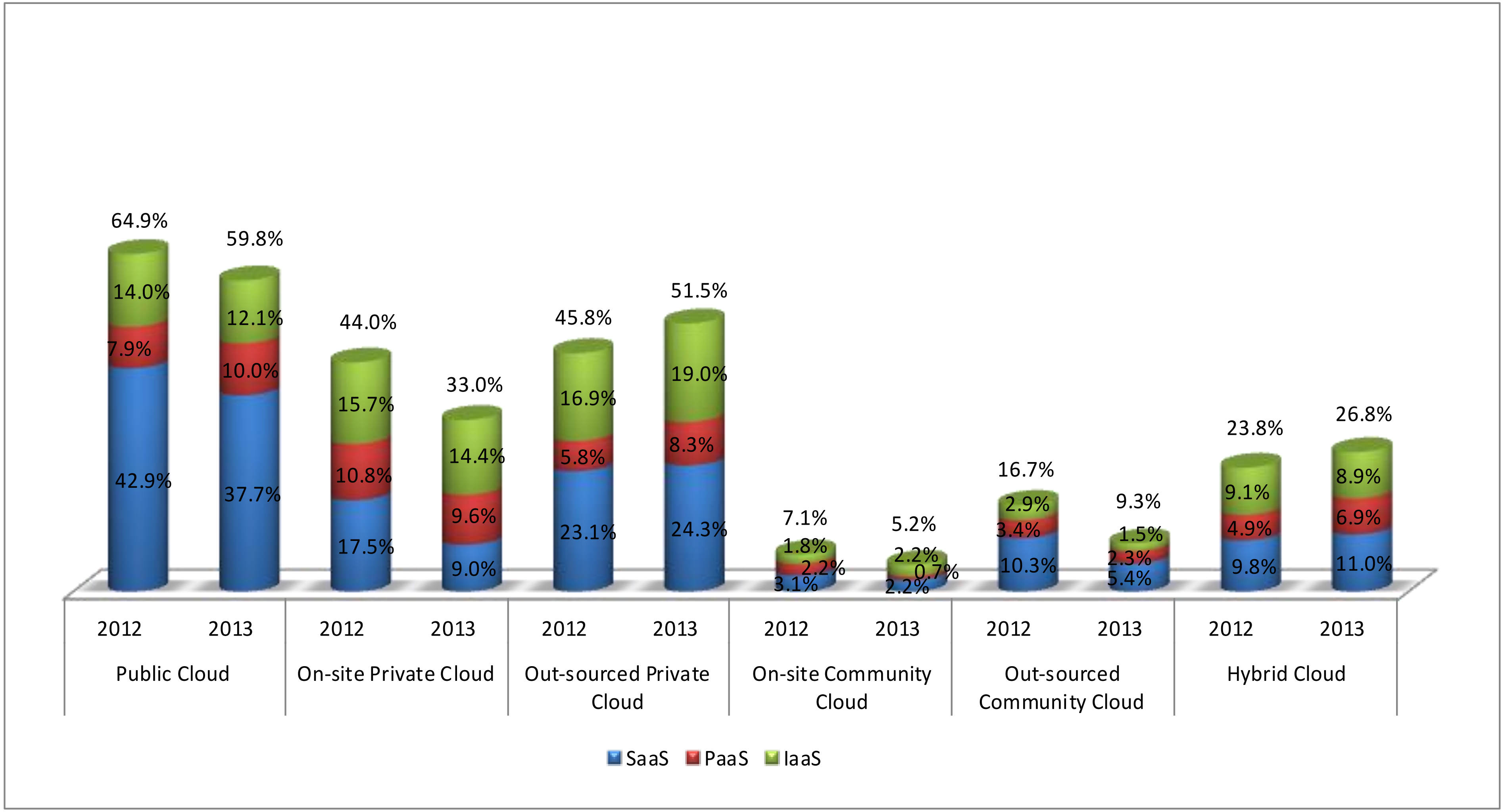
* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

The most popular deployment model for Cloud Adopters was Public Cloud, followed by Out-sourced Private Cloud and then On-site Private Cloud in both surveys, as shown in Figure 4.14. The major attraction of these deployments models might be their greater ease of both comprehension and implementation than is true of either type of Community Cloud or Hybrid Cloud (although, as Figure 4.15 shows, Hybrid Cloud had almost caught up to On-site Private Cloud in usage terms by 2013).

Usage of most deployment models decreased between 2012 and 2013, apart from Out-sourced Private Cloud and Hybrid Cloud which both grew. The greatest decline (11%) was in On-site Private Cloud, while the greatest increase (5.7%) occurred in Out-sourced Private Cloud. This might indicate there was a shift from Public, On-site Private and both types of Community Cloud toward Out-sourced Private and Hybrid Cloud, although the variation in terms of usage proportions between these deployment models did not change their popularity rank. However, this assumption could not be tested in this study, as already explained, due to the anonymous nature of the surveys.

In both surveys, SaaS was the largest service delivery model in all deployment models except in On-site Private Cloud in 2013, when it became the smallest. This may well be due to organisations' need for more flexible software development environments and for HPC hardware to be located On-site. Another possible explanation might lie in the growing attractions of Big Data, with its concomitant need for substantially increased storage and analysis facilities. Figure 4.15 does seem to suggest a minor decline in SaaS and an equally minor move towards IaaS (and an even smaller move towards PaaS) usage between 2012 and 2013, but this appearance may well be misleading – the size of the samples and the fact that the two surveys did not necessarily target the same groups makes it difficult to draw such conclusions with confidence.

PaaS was the smallest service delivery model being used by Cloud Adopters across all deployment models except in On-site Private Cloud in 2013, On-site Community Cloud in 2012 and Out-sourced Community Cloud in both surveys. Interestingly, usage of PaaS in Public Cloud, Out-sourced Private Cloud and Hybrid Cloud increased in 2013 while its usage decreased in all other delivery models (Public Cloud, On-site Private Cloud and Out-sourced Community Cloud). A follow-up quantitative study may help to explain the causes of these changes, because they are not obvious from these data alone.



2012 (168 out of 187 Cloud Adopters) **2013** (97 out of 99 Cloud Adopters)

Figure 4.14: Deployment models their service delivery models of Cloud Adopters in 2012 and 2013

4.1.6.3. Cloud Systems and their Deployment Models

The reviewed literature identified many cloud systems, but without ranking or indicating the usage of these systems for Cloud Adopters. This study not only highlighted the usage proportions of these systems but also identified their deployment models for Cloud Adopters in both surveys (see Table 4.13).

The top five cloud systems used by Cloud Adopters showed that email, storage/archiving; and marketing and sales systems were the most popular cloud solutions in both surveys, as illustrated in Figure 4.15. Although web hosting was added only in the 2013 survey as a result of 4 out of 27 respondents' comments in 2012 it, together with email, became the top-ranked cloud system used by Cloud Adopters in 2013.

In addition collaboration systems, which were also not listed in the questionnaire for the 2012 survey and identified by only 2 out of 27 who selected the option 'Other', became the fourth most-popular cloud solution in 2013. Database and backup systems lost their 2012 ranking in the top five cloud systems, while human resource management, financial and accounting; and test and development systems joined the top five cloud systems in 2013. This would seem to indicate that more organisations' finance, accounting and human resources departments had become involved in CC adoption over the 16 months between the two surveys, so that popular cloud-based products were moving away from more technical solutions and towards end-user applications.

Table 4.13: Number of responses for cloud systems and their deployment models for Cloud Adopters in 2012 and 2013

Cloud System	**2012** (165 out of 187 Cloud Adopters)						**2013** (96 out of 99 Cloud Adopters)					
	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	12	38	16	0	3	4	4	20	16	0	2	2
Manufacturing	0	12	4	0	0	1	0	7	0	0	0	0
Real time	4	19	8	0	0	4	2	7	4	0	0	1
Marketing and sales e.g. CRM	46	18	17	0	3	8	24	8	9	0	1	1
Human resource management	21	27	19	0	2	1	14	12	14	0	4	0
Database	14	46	20	0	3	4	6	15	18	1	1	3
Storage / Archiving	23	45	18	2	3	4	15	15	16	1	3	2
Backup	15	40	20	0	3	6	5	16	14	1	2	1
Email	55	42	25	1	4	5	22	15	15	0	2	6
Critical business systems	9	42	21	0	3	5	4	17	14	0	1	1
Processing	6	22	8	1	0	1	2	10	3	0	1	1
Test and development	19	36	14	1	5	9	12	19	9	0	1	3
Project Management	21	20	11	2	1	1	10	10	8	0	2	0
Collaboration	-	-	-	-	-	-	17	10	9	1	3	2
Content Filtering	-	-	-	-	-	-	15	7	9	0	1	1
E-Learning	-	-	-	-	-	-	17	11	9	1	1	0
Library Services	-	-	-	-	-	-	4	8	5	2	1	0
Phone System	-	-	-	-	-	-	2	13	8	1	1	2
Web Hosting	-	-	-	-	-	-	29	9	21	2	1	5

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

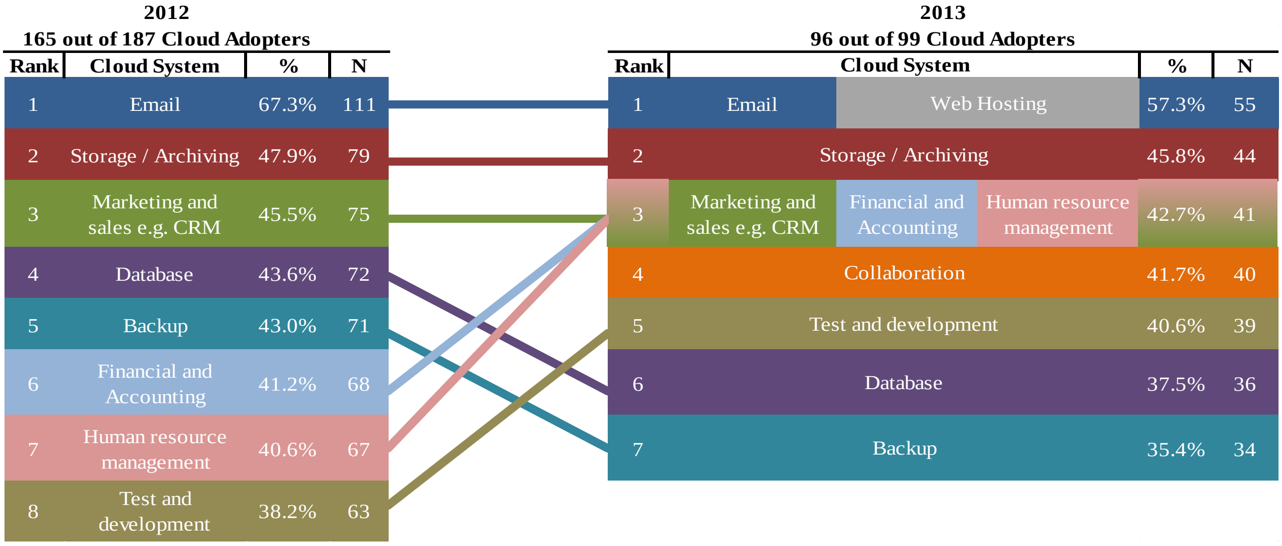


Figure 4.15: Ranking response rate of cloud systems of Cloud Adopters in 2012 and 2013

The main cloud systems for Cloud Adopters were located in either Public Cloud or On-site Private Cloud in 2012 as shown in Table 4.14. However, in 2013, Out-sourced Private Cloud became a third location. The majority of the most popular systems were located as in 2012 except for storage/archiving and database systems which moved to Out-sourced Private Cloud. In addition, human resource management systems moved to both Public and Out-sourced Private Cloud in 2013. This may support the assumption stated earlier in Section 4.1.6.2 about the shift toward Out-sourced Private Cloud; however, this assumption could not be tested because of the anonymous nature of the surveys.

Table 4.14: Top cloud systems and their deployment models for Cloud Adopters in 2012 and 2013

Cloud System	2012 (165 out of 187 Cloud Adopters)	2013 (96 out of 99 Cloud Adopters)	
Email	Public Cloud	Public Cloud	
Web Hosting	----------------	Public Cloud	
Storage / Archiving	On-site Private Cloud	Out-sourced Private Cloud	
Marketing and sales e.g. CRM	Public Cloud	Public Cloud	
Database	On-site Private Cloud	Out-sourced Private Cloud	
Backup	On-site Private Cloud	On-site Private Cloud	
Financial and Accounting	On-site Private Cloud	On-site Private Cloud	
Human resource management	On-site Private Cloud	Public Cloud	Out-sourced Private Cloud
Test and development	On-site Private Cloud	On-site Private Cloud	
Collaboration	----------------	Public Cloud	

Table 4.15 shows that no cloud system remained the top system for any of the deployment models. This displacement illustrates the dynamic changes within all deployment models being used by Cloud Adopters. Interestingly web hosting, included for the first time in the 2013 survey, was the top system in three deployment models in 2013.

Table 4.15: Main cloud system for each deployment model for Cloud Adopters in 2012 and 2013

Cloud System	2012 (165 out of 187 Cloud Adopters)			2013 (96 out of 99 Cloud Adopters)		
Public Cloud	Email		23%	Web Hosting		14%
On-site Private Cloud	Storage / Archiving	Database	11%	Financial and Accounting		9%
Out-sourced Private Cloud	Email		12%	Web Hosting		10%
On-site Community Cloud	Storage / Archiving	Project Management	29%	Web Hosting	Library Services	20%
Out-sourced Community Cloud	Test and development		17%	Human resource management		14%
Hybrid Cloud	Test and development		17%	Email		19%

4.1.7. Concerns

Although the reviewed literature identified many concerns associated with CC, it did not rank or even indicate the proportions of these concerns for Cloud Adopters. This study offers greater insight into this important area, identifying the top five concerns for Cloud Adopters in both the 2012 and 2013 surveys, as shown in Figure 4.16. These concerns were expressed by between 36.8% (68 of 185) and 70.3% (130 of 185) of Cloud Adopters in 2012; and between 43.9% (43 of 98) and 62.2% (61 of 98) of the equivalent group in 2013.

The top five concerns shared by respondents to both surveys were security, privacy and integration problems with 70.3% (130 out of 185), 59.5% (110 of 185) and 46.5% (86 of 185) respectively in 2012. All responses were lower in 2013, however, being mentioned by 62.2% (61 of 98), 50% (49 of 98) and 43.9% (43 of 98) of Cloud Adopters respectively.

The level of concern for security and privacy problems declined in the 2013 survey by 8.1% and 9.5% respectively, even though Cloud Adopters considered them, in both surveys, to be the two most important concerns. This could possibly indicate that as CC became more mature, it gained more trust and the actual concern level of these issues became clearer for Cloud Adopters, although industry publications suggest this is not the case. For example, the CSA 'notorious nine' cloud computing threats survey (Cloud Security Alliance, 2013) identified: "*data breaches, data loss, account hijacking, insecure Application Programming Interfaces (APIs), denial of service, malicious insiders, abuse of cloud services, insufficient due diligence; and shared technology issues*" as the major security concerns of CC users. Sadly, CSA did not replicate this very useful survey in later years, but more recent lists published by Talkin' Cloud (2015) or ZDNet (2014) identify very similar problems (ZDNet identifies issues caused by individual corporate disasters, but the issues causing these problems are essentially the same).

The most likely explanation for this slightly lessened concern with security on the part of Cloud Adopters in 2013 seems likely to be their focus on other issues. The CSA website, for example, shows far greater emphasis on issues such as Big Data these days, while Bitdefender (a security specialist site) identifies the importance of data analytics for information security (Bitdefender, 2015). This modified focus suggests that at least some CC users may well be focusing on the next ‘big thing’, rather than worrying as much about CC which, after all, is no longer such a novelty.

Although security was the greatest concern for Cloud Adopters, with 70.3% (130 of 185) in 2012 and 62.2% (61 of 98) in 2013, security of CC services provided had been realised by 59.7% (105 of 176) of Cloud Adopters in 2012 and by 67% (65 of 97) in 2013, as illustrated earlier in Figure 4.12. In 2012, 70.5% (74 of 105) of those who stated that ‘the provided service is secure’ also indicated they had security concerns about CC although, in 2013, this proportion decreased by 5.9% to reach 64.6% (42 of 65). These contradictions emphasise the ambiguity of the security issues in CC as described in the reviewed literature and require further qualitative investigation in the future.

Some additional concerns, which were not originally listed in the questionnaire for the 2012 survey, were included in the 2013 survey. Performance, bandwidth and data sovereignty concerns were extracted from the ‘Other’ option in the 2012 survey and occupied the third, fourth and fifth positions respectively, with 45.9% (45 of 98), 44.9% (44 of 98) and 43.9% (43 of 98) of responses in the 2013 survey. These added concerns were selected by 7, 3 and 3 respectively out of 24 Cloud Adopters who selected option ‘Other’ in the 2012 survey.

Interestingly, Internet outages were the only concern that increased (although only by 3%) in the 2013 survey – yet its ranking decreased by one place because of the new added concerns, as shown in Figure 4.16.

Since the majority of CC unavailability was caused by Internet outages (Nolle, 2013), it seemed worth investigating the relationship between Internet outages as a concern and unavailability of CC services.

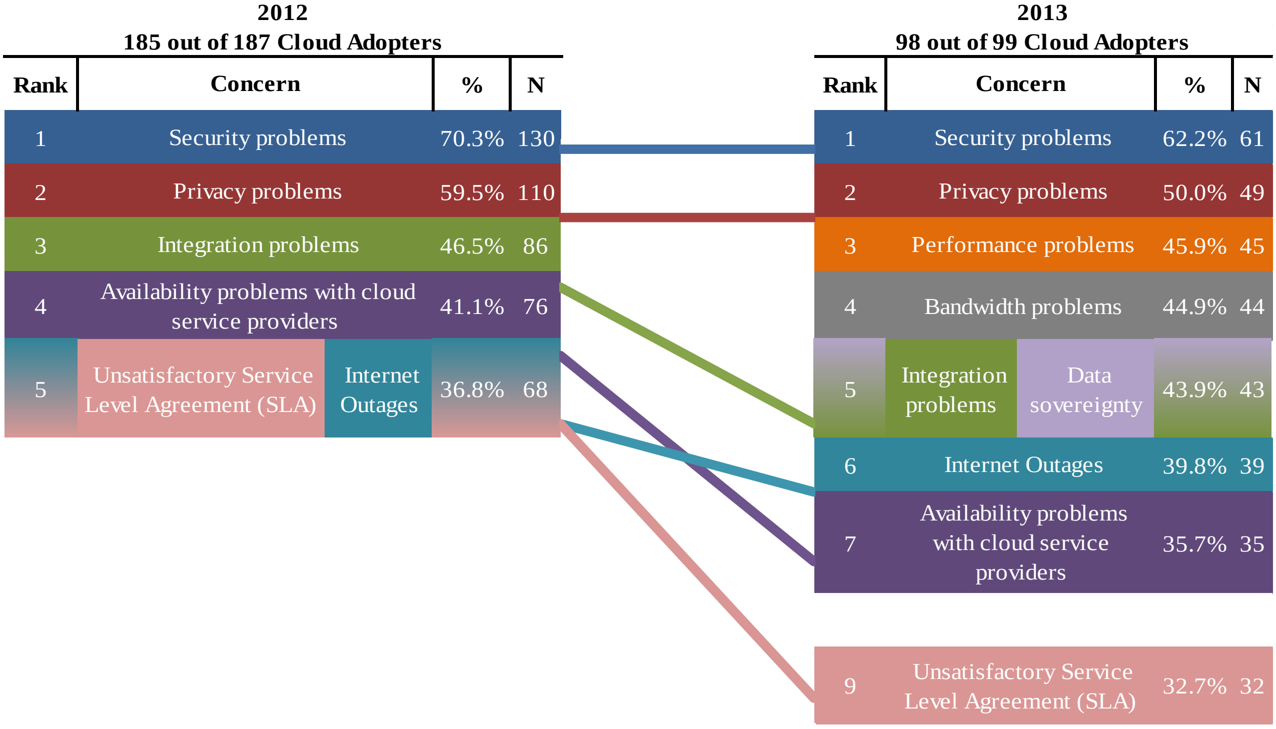


Figure 4.16: Concerns of Cloud Adopters in 2012 and 2013

As described earlier in Section 4.1.5, the percentage of Cloud Adopters who had experienced (zero) average unavailability of CC services per month increased from 61.9% (109 of 176) in 2012 to 69% (67 of 97) in 2013. Surprisingly, 48.5% (32 of 66) of those who had concerns about Internet outages indicated that they had experienced (zero) average unavailability of CC services per month in 2012 and this proportion, still more surprisingly, increased by 31% to reach 61.5% (24 of 39) to in 2013. These results would seem to show that the concerns of Cloud Adopters did not reflect their experienced reality after adopting CC. Further qualitative research may articulate this confusion.

Quality problems in CC involve data quality and meeting quality-of-service requirements (Srinivasan and Getov, 2011, Linthicum, 2010a, Miller, 2013). There are many issues associated with data quality including: data decay time-related factors, accuracy and completeness; while system reliability, timeliness, volume, criticality, quality of perception and cost are the main dimensions of quality-of-service (Pawluk et al., 2011). CC related quality problems also include transparency and business service management issues (Rimal et al., 2011), where there is no *de facto* standard for CC (Rimal et al., 2011, Damshenas et al., 2012).

The results of logistic regression analysis showed that 'quality problems' was the only statistically significant difference in Cloud Adopters' concerns between 2012 and 2013, as shown in Table 4.16. Cloud Adopters in 2013 were less concerned about 'quality problems' than respondents from the same category in 2012 ($p=0.01$). This concern declined dramatically from 25.4% (47 of 185) in 2012 to 12.2% (12 of 98) in 2013. In addition, Cloud Adopters in 2013 were also less concerned about 'lack of service orientation' than those in 2012, leading a trend towards significance ($p=0.07$). This concern decreased from 11.9% (22 of 185) in 2012 to 5.1% (5 of 98) in 2013. These changes may show that the quality and service orientation of CC had improved over time and met the expectations of Cloud Adopters which ultimately will lead CC to reach maturity level, but further investigation is required to confirm this.

Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change the results across the two surveys. However, there were some differences in concerns between industry sectors, organisation size and State. Interestingly, respondents from the services (OR 0.36; 95% CI 0.13 to 0.99) and healthcare & education sectors (OR 0.27; 95% CI 0.10 to 0.75) had less concern about 'security problems' compared with respondents from the manufacturing & goods distribution sector (all $p<0.05$). This may indicate that respondents from manufacturing & goods distribution sector were more cautious about security than those from the services and healthcare & education sector because of their technical experience, or may simply reflect the difference in attitude of those who deal in physical goods compared with those who use the cloud most for exchange and storage of information-related data. In addition, due to the variety in priorities, 'improving security' was more important to respondents from the manufacturing & goods distribution sector than to those from the healthcare & education and government sectors, as discussed earlier in Section 4.1.3.1.

'Quality problems' were also less a matter for concern for participants from the resources & construction sector (OR 0.19; 95% CI 0.04 to 0.79) compared with respondents from the manufacturing & goods distribution sector ($p=0.02$). This might indicate that CC met the required quality-of-service for resources & construction sector while it did not for manufacturing & goods distribution sector, even though the concerns of Cloud Adopters regarding 'quality problems' reduced significantly from 25.4% (47 of 185) in 2012 to 12.2% (12 of 98) in 2013. Of course, this finding might also reflect the fact that the resources & construction sector is dealing with raw materials, while the manufacturing & goods distribution sector handles finished products of considerably higher unit value.

From the perspective of organisation size, 'integration problems' (OR 3.95; 95% CI 1.33 to 11.74) and 'insufficient skills in organisation' (OR 5.20; 95% CI 1.34 to 20.21) were a greater concern for respondents from organisations with more than 4999 employees than for organisations with fewer than 101 employees (all $p<0.025$). Larger organisations, of course, have more systems to be integrated and require higher skill levels than do smaller ones.

Another difference between organisation size showed that participants from organisations having 1000–4999 employees (OR 2.94; 95% CI 1.09 to 7.94) and organisations with more than 4999 (OR 5.84 (1.81 to 18.89) which were more concerned about 'legal problems' than organisations with fewer than 101 employees (all $p<0.036$). This might indicate that larger organisations have more sensitive data or are more concerned about its security.

From the point of view of location, 'lack of trust with cloud service providers' was a greater concern for respondents from multi-State organisations (OR 2.17; 95% CI 1.05 to 4.49; $p=0.04$) than for those from single State organisations. This might be because CC brings back bad memories of poorly-handled outsourcing projects (Schaffer, 2009) for multi-State organisations. Interestingly, participants from multi-State organisations (OR 0.54; 95% CI 0.30 to 0.99; $p=0.045$) had lower levels of concern regarding 'internet outages' than those from single State organisations. The opposite situation was expected because multi-State organisations are theoretically supposed to suffer from 'internet outages' more than single State organisations. However, multi-State organisations may plan in advanced for that and have more than a single ISP to prevent this problem, since their business requirements and financial status make this imperative. This issue requires further qualitative investigation, however, to clarify these apparently contradictory findings.

Table 4.16: Results of comparing Cloud Adopters' concerns between 2012 and 2013

Concern	2012 vs 2013			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Security problems	0.70 (0.42 to 1.17)	0.17	0.59 (0.34 to 1.02)	0.06
Privacy problems	0.68 (0.42 to 1.12)	0.13	0.63 (0.38 to 1.07)	0.09
Availability problems with cloud service providers	0.80 (0.48 to 1.32)	0.38	0.73 (0.43 to 1.25)	0.25
Integration problems	0.90 (0.55 to 1.47)	0.68	0.90 (0.54 to 1.50)	0.68
Development problems	1.32 (0.68 to 2.53)	0.41	1.36 (0.68 to 2.71)	0.39
Recovery problems	1.04 (0.59 to 1.84)	0.90	0.88 (0.48 to 1.61)	0.68
Legal problems	0.76 (0.45 to 1.28)	0.30	0.78 (0.45 to 1.37)	0.39
Unsatisfactory Service Level Agreement	0.83 (0.50 to 1.40)	0.49	0.82 (0.48 to 1.41)	0.48
Quality problems	0.41 (0.21 to 0.82)	0.01	0.35 (0.17 to 0.74)	0.01
Organisational and cultural problems	0.87 (0.47 to 1.62)	0.66	0.98 (0.51 to 1.88)	0.95
Loss of control	1.03 (0.61 to 1.73)	0.91	0.90 (0.52 to 1.55)	0.71
Lack of trust with cloud service Providers	1.09 (0.60 to 1.99)	0.78	1.10 (0.59 to 2.08)	0.76
Lack of service orientation	0.40 (0.15 to 1.09)	0.07	0.38 (0.13 to 1.08)	0.07
Insufficient skills in your organisation	1.07 (0.57 to 1.99)	0.84	1.15 (0.59 to 2.24)	0.68
Immaturity of technology	1.01 (0.57 to 1.76)	0.99	1.03 (0.57 to 1.87)	0.92
Internet Outages	1.14 (0.69 to 1.88)	0.62	1.02 (0.60 to 1.72)	0.95

* Data analysed using logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

185 observations in 2012 98 observations in 2013

4.2. Future Adopters

The second category of respondents was Future Adopters, who were expecting their organisations to adopt CC in the near future. The results of both surveys showed that this category formed 16.4% (64 of 390) of all responding organisations in 2012 and 15.2% (26 of 171) in 2013. These proportions indicated that Australian organisations were still interested in CC even though there was a slight decrease (1.2%) in 2013. Not surprisingly, the percentage of Future Adopters in 2013 was marginally less than 2012 because the remaining proportion of those who did not adopt CC (Undecided and Definite Non-Adopters) in 2012 was only 35.7% (139 of 390). The following sub-sections discuss the differences between the Future Adopters of both surveys in terms of adoption date, demographic profile, importance of expected benefits, beliefs, their expected usage of CC and concerns.

4.2.1. Adoption Date

The adoption proportions of Future Adopters per year are illustrated in Figure 4.17. Both surveys had virtually the same shape for the adoption curve following the year of the survey (with different proportions) except for the very first year (because the 2012 survey was conducted in the middle of 2012 whereas the 2013 survey was conducted at the end of the year).

The difference in adoption year for Future Adopters added support to the assumption that participants in the 2013 survey were not a subset of the 2012 survey. Thus, the participants of both surveys would be either independent or overlapping groups, as shown previously in Figure 4.2.

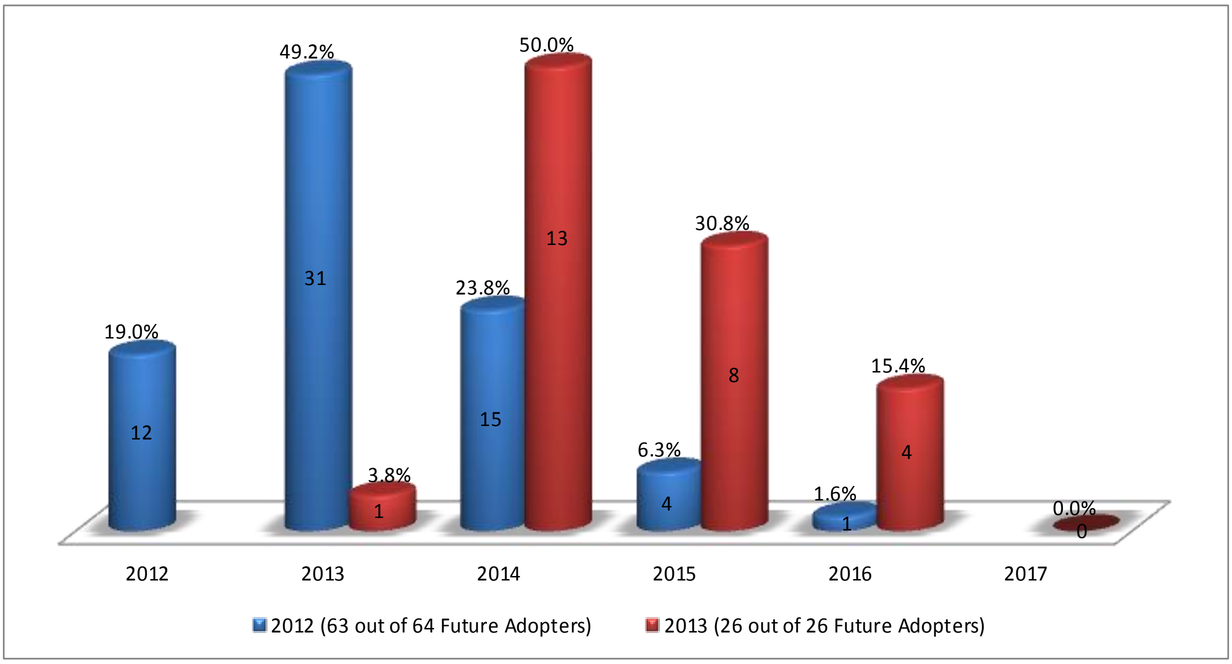


Figure 4.17: Adoption of Future Adopters in 2012 and 2013

4.2.2. Demographic Profile

4.2.2.1. Industry Sectors

There were some variations in the proportion of Future Adopters industry sectors over the two surveys. For instance, the 2013 survey indicated that more respondents from the government sector were expecting to adopt CC than was the case in 2012. Their proportion increased from 15.6% (10 of 64) of Future Adopters in the 2012 survey to 23.1% (6 of 26) in 2013. This increment enabled the government sector to jump from second place in 2012 to first place in 2013. This was consistent with the revised Australian government cloud policy which will "*drive a greater take up of cloud services by federal government agencies by adopting a 'cloud first' approach*" (Department of Finance, 2014b).

The Education sector had the highest response rate after government in 2012, with 20.3% (13 of 64), but shared its second-ranking position with the information technology sector in 2013, with 15.4% (4 of 26) as shown in Figure 4.18. It was noticeable that the information technology, construction, services, government and research/ consulting sectors all achieved higher ranks in 2013, whereas the financial, manufacturing, education and healthcare sectors occupied lower ranks in the 2013 survey. Although the retail sector, which was ranked fourth out of all Future Adopters in 2012, had 0% in 2013, 6 out of the 7 respondents who participated in 2013 from the retail sector had already adopted CC. The very small sample thus made this apparent change effectively meaningless. All other sectors not indicated in Figure 4.18 were below 5% in both surveys.

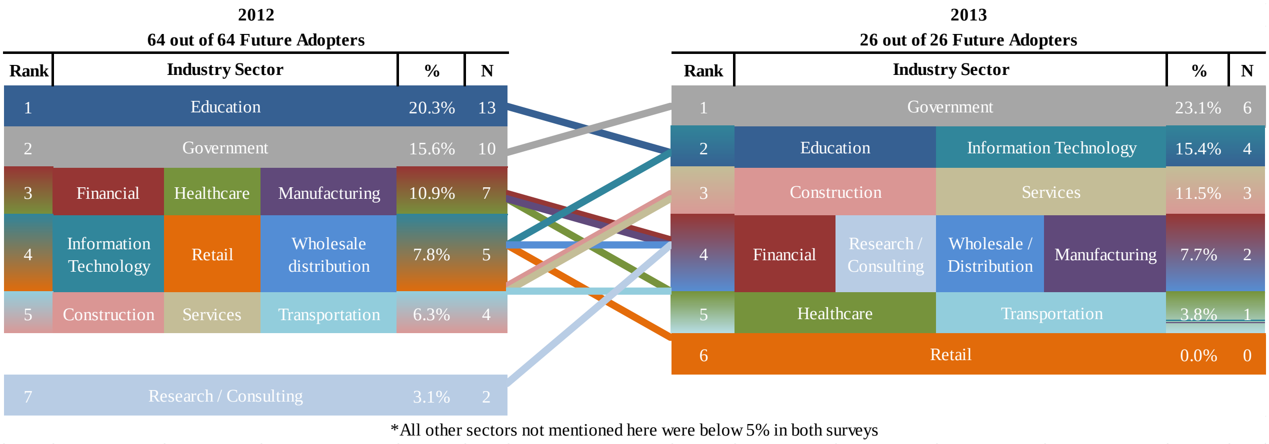


Figure 4.18: Ranking response rate of industry sectors of Future Adopters in 2012 and 2013

4.2.2.2. Location of Respondents

The 2012 survey showed that VIC and NSW were both top-ranked in terms of expecting to adopt CC, with approximately 60% (38 of 64) of Future Adopters, while all other States had between 39.1% (25 out of 64) and 18.8% (12 out of 64), as shown in Figure 4.19. In 2013, however, WA, together with VIC, took the top spot from NSW and ranked as the first State in terms of expecting to adopt CC with 46.2% (12 of 26), while all other States had between 38.5% (10 of 26) and 11.5% (3 of 26). The 2013 survey also showed that NSW and SA dropped by two positions, whereas all other States either remained as they were in 2012 or increased.

Approximately 58% (37 of 64) of Future Adopters were located in a single State in the 2012 survey, while the remaining 42% (27 of 64) were located in multiple States. In 2013, however, 65.4% (17 of 26) of Future Adopters were located in a single State whereas multi-State organisations formed only 34.6% (9 of 26). This finding added support that the shift toward single State lies in the types of organisations responding to the two surveys.

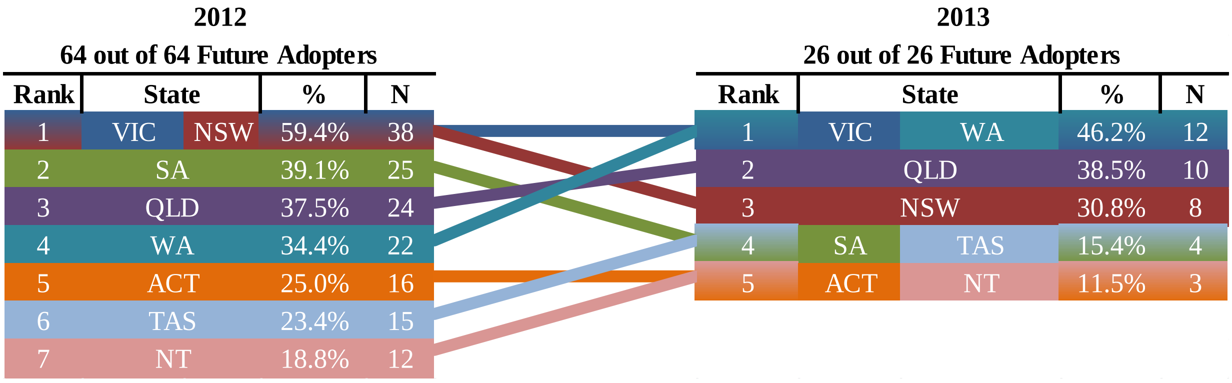


Figure 4.19: Ranking response rate of States of Future Adopters in 2012 and 2013

4.2.2.3. Size of Responding Organisations

Organisations with 101–499 employees was the largest response group of Future Adopters in the 2012 survey, with 39.1% (25 of 64), as illustrated in Table 4.17. The second largest organisation size of Future Adopters responding to the 2012 survey was those with 1000–4999 employees, which accounted for 15.6% (10 of 64) of Future Adopters. However, in the 2013 survey, these two types of organisations exchanged places, so that organisations with 1000–4999 employees took first place, with 30.8% (8 of 26) of Future Adopters, followed by organisations with 101–499 employees with 26.9% (7 of 26) of Future Adopters. All other organisations either kept the same rankings or declined by one position, except for very small organisations with 21–50 employees or few than 5 employees, which both rose by two positions in 2013, suggesting that the follow-up survey was attracting slightly greater numbers of smaller organisations. Although organisations with fewer than 21 employees increased by one or two positions in 2013, they still occupied the last two positions.

The least represented organisation size, in terms of expecting to adopt CC, were those with fewer than 21 employees in the 2012 survey – as one might expect – forming only 1.6% (1 of 64) of Cloud Adopters; while in the 2013 survey the least represented organisation sizes, in terms of expecting to adopt CC, were those with either more than 4999 or fewer than 21 employees. Together, these made up 7.7% (2 of 26), as illustrated in Table 4.17. These respondent numbers are, however, so small that it is difficult to draw any truly meaningful conclusions from changes up or down.

Table 4.17: Ranking response rate of organisation sizes of Future Adopters in 2012 and 2013

Org. Size	2012			2013		
	64 out of 64 Future Adopters			26 out of 26 Future Adopters		
	Rank	%	N	Rank	%	N
More than 10000	6	6.3%	4	7	0.0%	0
5000-10000	5	7.8%	5	6	3.8%	1
1000-4999	2	15.6%	10	1	30.8%	8
500- 999	3	12.5%	8	4	11.5%	3
101-499	1	39.1%	25	2	26.9%	7
51-100	4	9.4%	6	5	7.7%	2
21-50	5	7.8%	5	3	15.4%	4
11-20	7	1.6%	1	7	0.0%	0
5-10	8	0	0	6	3.8%	1
Under 5	8	0.0%	0	7	0.0%	0

4.2.2.4. Job of Respondents

The majority of respondents to both surveys came from IT management rather than general management, while approximately 92% of respondents to both surveys representing Future Adopters were employed in IT management, as shown in Figure 4.20. The proportion of CIOs and technical support managers increased sharply by 19% and 9.9% respectively between 2012 and 2013, while the proportion of IT managers declined significantly by 25.7% in 2013. This finding added support to the assumption that participants in the 2013 survey were not a subset of the 2012 survey, but these were, rather, independent or overlapping groups as illustrated previously in Figure 4.2.

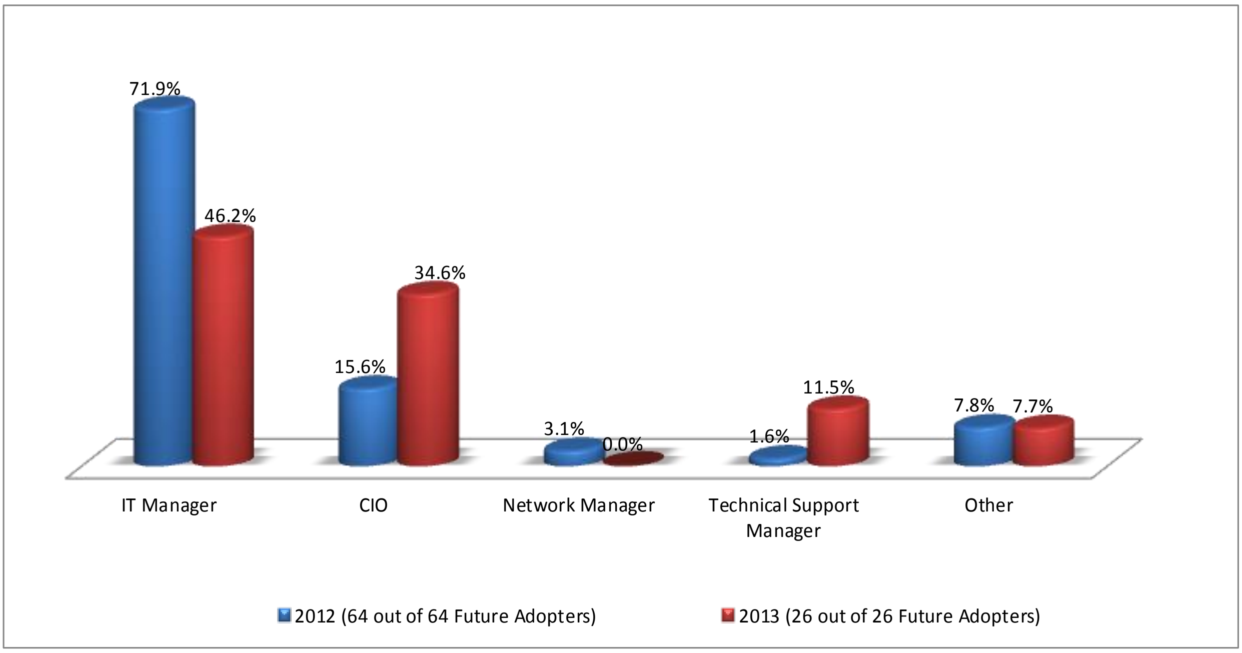


Figure 4.20: Job title of respondents of Future Adopters in 2012 and 2013

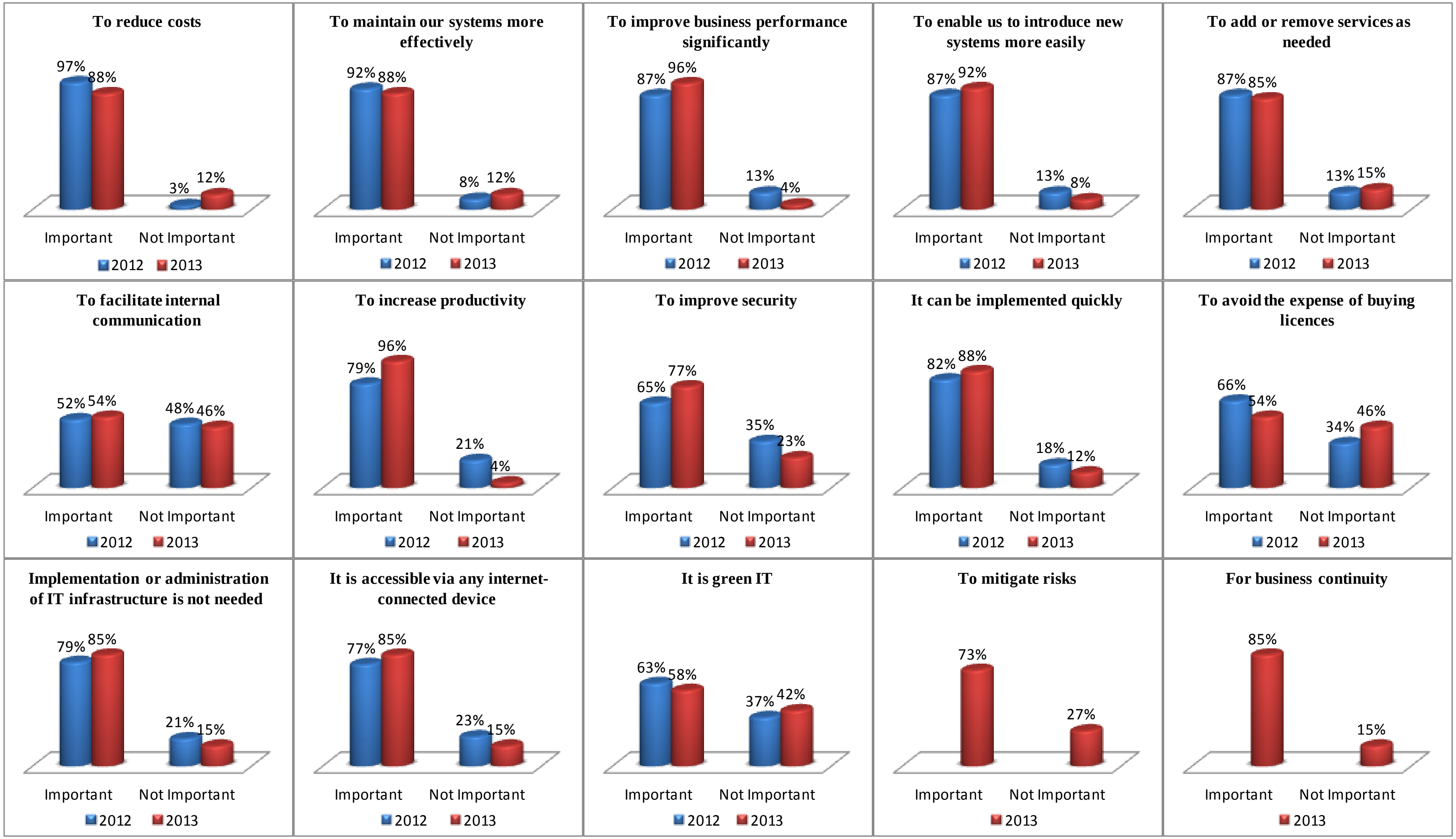
4.2.3. Importance of Expected Benefits

Many expected benefits from adopting CC were identified in the reviewed literature, although neither the ranks nor the importance levels of these expected benefits for Future Adopters were indicated. This study, however, highlighted the importance level of these expected benefits for Future Adopters in both surveys, as illustrated in Figure 4.21.

Although the importance of efficiency, capacity, security, implementation and accessibility for Future Adopters in 2013 was slightly greater than in 2012, there was a larger increase in the importance of ‘increasing productivity’ in 2013. By contrast, a smaller proportion of respondents in 2013 indicated the importance of cutting costs, scalability and ‘green IT’, suggesting that Future Adopters in 2013 had slightly different objectives from adopting CC compared to those in 2012. The objectives of this category moved from tactical (e.g. cutting costs) toward strategic such as increasing productivity, efficiency and security. This might have occurred according to the difference in requirements for running their businesses.

The terms ‘business continuity’ and ‘mitigating risk’ were not listed as expected benefits in the 2012 survey questionnaire, however some respondents in the Cloud Adopters category identified these alternatives in the ‘other’ option as important issues in 2012. Although the number of participants indicating these issues was small (2 of 6) and they were indicated only by Cloud Adopters, these terms were explicitly included in the 2013 survey because this had increasingly becoming an issue. These expected benefits gained higher importance level for the Future Adopters than some of the expected benefits that were originally listed in the 2012 survey.

These results also supported the view that Future Adopters were moving towards more strategic objectives. A further qualitative investigation would provide more details regarding this approach.



2012 (62 out of 64 Future Adopters) 2013 (26 out of 26 Future Adopters)

Figure 4.21: Importance of expected benefits of Future Adopters in 2012 and 2013

Identifying which of these expected benefits were the most important for Future Adopters in 2012 and whether they remain as the top ones in 2013 would add value to the study. Thus, the top five expected benefits for Future Adopters were ranked in Figure 4.22 in terms of their importance. The top five expected benefits in the 2013 survey were the same as 2012 with three additional expected benefits.

While this consistency confirms that these expected benefits were a reliable guide to the views of Future Adopters, the importance level of these expected benefits had changed over the 16 months between the two surveys. For example, ‘reducing costs’ and ‘maintaining the systems more effectively’ were the top two expected benefits in 2012 but they fell 9% and 4% respectively to share the third place in 2013. Moreover, there was a significant increase in the importance of ‘improving business performance significantly’ and ‘increasing productivity’, with 12% and 17% respectively, which enabled them to jump from third and fifth place in 2012 to become the most important expected benefits in 2013.

Although ‘business continuity’ was added for the first time in the 2013 survey, it occupied the fourth position in terms of its importance as an expected benefit. ‘Facilitating internal communication’ was the lowest important expected benefit for Future Adopters in both surveys. As illustrated earlier, these findings supported the view that the objectives of Future Adopters are becoming increasingly strategic, although a follow-up qualitative research would add weight to this supposition.

Many authors considered security as one of the main concerns associated with CC (see, for example: Baghdadi, 2013, Murah, 2012, Xiaoqi, 2012, Cloud Security Alliance, 2013). However, some authors have also noted that ‘improving security’ is one of the potential benefits of CC. For example, Computer Edge (2010) indicated that an organisation’s security systems can be significantly enhanced by adopting CC, because sensitive data is stored away from head office and yet is readily accessible through the organisation’s IT procedures. Moreover, vendors’ supercomputers hosting the organisation’s applications are seen as an advantage for both security and storage issues (Orfano, 2009), while the security capabilities of CSPs are generally considered to be better than those of ordinary organisations (Shagin, 2012).

Interestingly, this view was supported by the findings of the two surveys where ‘improving security’ became an attractive expected benefit for Future Adopters. It jumped from eighth position in 2012 to be one of the top five expected benefits in 2013 with an increment of 12%, as shown in Figure 4.22. This might indicate that CC was indeed gradually becoming more mature and gaining greater trust from potential clients.

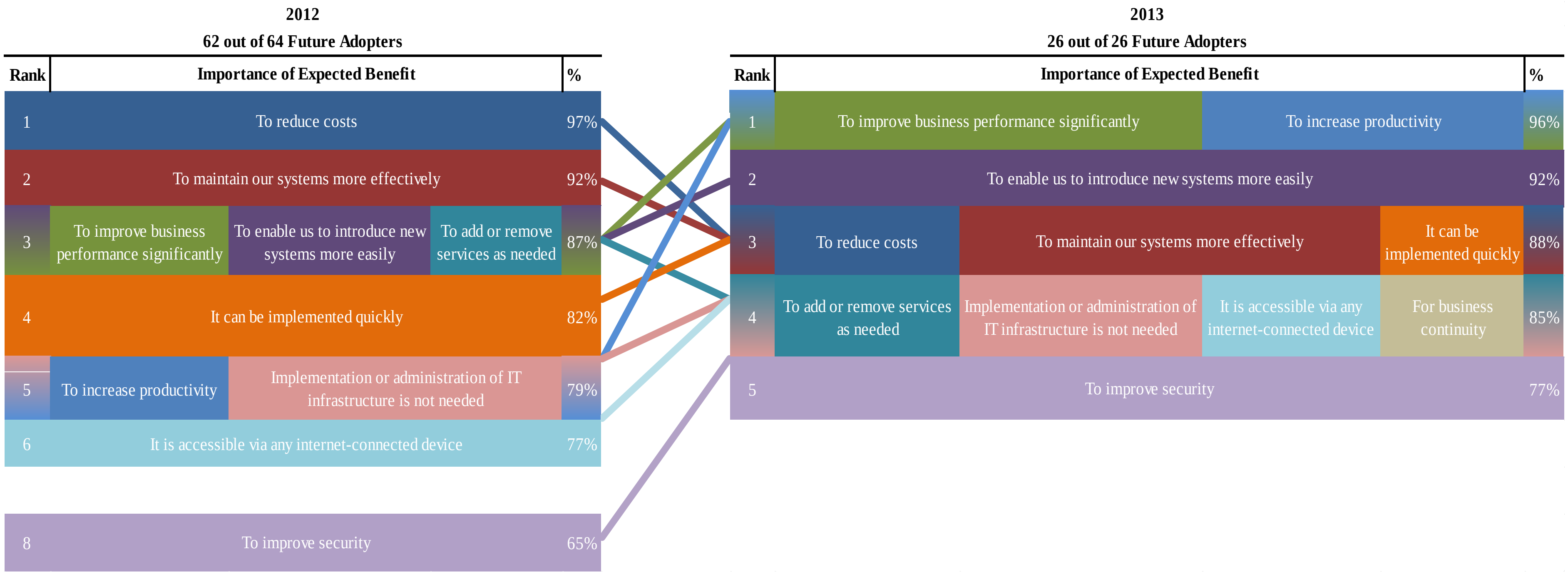


Figure 4.22: Ranking response rate of the top 5 important of expected benefits of Future Adopters in 2012 and 2013

CC allows organisations to focus more on the core activities of their business and to adjust resources to meet unexpected business demand (Wattal and Kumar, 2014, Baghdadi, 2013), rather than needing to spend time and resources on maintaining the software supporting these activities. These organisations may gain competitive advantage by refocusing resources, thus enabling them to build better products, increase market share and promote their mission (Linthicum, 2010a). Ultimately, CC can improve the productivity and business performance significantly (Linthicum, 2010a, Schaffer, 2009).

Ordered logistic regression analysis showed that ‘improving business performance significantly’ and ‘increasing productivity’ were the only two statistically significant differences in the importance of various expected benefits for Future Adopters across 2012 and 2013 (p=0.01), as shown in Table 4.18. Both these expected benefits were much more important for respondents of Future Adopters in 2013 than those in 2012. These expected benefits increased from 87% (54 of 62) and 79% (49 of 62) respectively in 2012 to 96% (25 of 26) in 2013. This is consistent with the reviewed literature that stated the importance of ‘improving business performance significantly’ and ‘increasing productivity’ as a potential benefits from adopting CC. It indicated that Future Adopters were moving toward strategic goals.

Although adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change the results across the two surveys, there were some differences in the importance level of expected benefits between industry sectors, organisation size and State. For example, ‘avoiding the expense of buying licences’ was of less importance for respondents from healthcare & education sector (OR 0.26; 95% CI 0.07 to 0.91; p=0.04) than those from manufacturing & goods distribution sector. This difference might occur because the activities of the manufacturing & goods distribution sector, where many different types of software package must be purchased, indicated the importance of ‘avoiding the expense of buying licences’. In a second difference, participants from the government sector had less belief in the importance of ‘implementation or administration of IT infrastructure is not needed’ (OR 0.13; 95% CI 0.03 to 0.61) and ‘accessing CC via any internet connected device’ (OR 0.20; 95% CI

0.05 to 0.87) compared with those from the manufacturing & goods distribution sector (all $p<0.035$). This might indicate differences between the public and private sector of Future Adopters, where the manufacturing & goods distribution sector was more focused on the accessibility, implementation and administration of CC than the public sector because it reflects their priorities.

In terms of organisation size and States perspectives, there was a difference between organisations of different sizes in the importance of 'increasing productivity', which had a significant statistical difference between 2012 and 2013 and occupied the first place in terms of its importance for Future adopters in 2013. Interestingly, this expected benefit had a lower importance level for respondents from organisations with more than 4999 employees (OR 0.14; 95% CI 0.02 to 0.79; $p=0.03$) compared with those from organisations with fewer than 101 employees. Such an odd difference requires a further qualitative investigation in the future, although it is possible that productivity in larger companies is sufficiently well understood and well implemented that CC is not expected to make any significant difference.

The importance of the benefit 'implementation or administration of IT infrastructure is not needed' varied across both organisation size and State. This expected benefit had a greater importance level for larger organisations, i.e. those with 500–999 employees (OR 13.19; 95% CI 2.64 to 65.95), 1000–4999 employees (OR 6.65; 95% CI 1.73 to 25.57); and organisations with more than 4999 employees (OR 5.21; 95% CI 1.01 to 26.82) compared to organisations with fewer than 101 employees (all $p<0.05$). Not surprisingly, this indicated that 'implementation or administration of IT infrastructure' was more important for larger organisations which frequently have many branches and are located in more than one State.

Somewhat confusingly, this expected benefit had lower importance for respondents from multi-State organisations (OR 0.31; 95% CI 0.12 to 0.81; $p=0.02$) compared with those from single State organisations. The analysis summarised at the start of this Chapter, which showed that organisations responding to these surveys which were located in one State only were often larger in terms of employee numbers than those located in multiple States may hold the key to this apparently contradictory finding.

Table 4.18: Results of comparing importance of expected benefits for Future Adopters between 2012 and 2013

Importance of Expected Benefit	2012	2013	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
	Mean ± SD	Mean ± SD				
To reduce costs	3.79 ± 0.81	3.92 ± 0.98	1.52 (0.63 to 3.68)	0.35	1.52 (0.61 to 3.82)	0.37
To maintain our systems more effectively	3.77 ± 0.84	3.88 ± 0.91	1.41 (0.57 to 3.47)	0.46	1.27 (0.49 to 3.29)	0.62
To improve business performance significantly	3.48 ± 0.88	4.04 ± 0.82	3.65 (1.42 to 9.37)	0.01	3.42 (1.27 to 9.25)	0.02
To enable us to introduce new systems more easily	3.56 ± 0.88	3.77 ± 0.91	1.42 (0.58 to 3.49)	0.44	1.99 (0.75 to 5.26)	0.17
To add or remove services as needed	3.48 ± 0.86	3.62 ± 0.98	1.31 (0.55 to 3.13)	0.54	1.45 (0.57 to 3.68)	0.43
To facilitate internal communication	2.66 ± 0.99	2.69 ± 1.16	1.05 (0.45 to 2.47)	0.91	1.02 (0.42 to 2.51)	0.96
To increase productivity	3.26 ± 0.90	3.88 ± 0.91	3.34 (1.39 to 8.05)	0.01	2.64 (1.04 to 6.71)	0.04
To improve security	2.89 ± 1.06	3.27 ± 0.96	1.85 (0.81 to 4.24)	0.15	1.80 (0.76 to 4.26)	0.18
It can be implemented quickly	3.29 ± 1.01	3.58 ± 0.90	1.54 (0.66 to 3.60)	0.32	1.46 (0.60 to 3.56)	0.40
To avoid the expense of buying licences	2.89 ± 1.09	2.85 ± 1.12	0.87 (0.38 to 1.99)	0.74	0.88 (0.37 to 2.06)	0.77
Implementation or administration of IT infrastructure is not needed	3.26 ± 1.01	3.58 ± 1.10	1.79 (0.76 to 4.19)	0.18	2.28 (0.89 to 5.80)	0.08
It is accessible via any internet connected device	3.47 ± 1.24	3.81 ± 1.17	1.66 (0.73 to 3.81)	0.23	1.89 (0.79 to 4.56)	0.16
It is green IT	2.73 ± 0.93	2.77 ± 1.03	1.14 (0.48 to 2.68)	0.77	1.18 (0.48 to 2.87)	0.72

* Data analysed using ordered logistic regression.

SD: Standard Deviation.

OR: odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including organisation size, industry sector and state.

62 observations in 2012 26 observations in 2013

4.2.4. Beliefs

The beliefs of Future Adopters towards CC in both surveys, after excluding the ‘don’t know’ responses, are shown in Figure 4.23. Although the reviewed literature showed substantial confusion and uncertainty among Australian CIOs about the concept of CC in the last 4-5 years (Kotadia, 2010, Macquarie Telecom, 2011), approximately 89% Future Adopters respondents to both surveys stated that they understood this concept.

The agreement on all statements in 2013 either remained as it was in 2012 or increased, except for agreement on the ‘immaturity of Cloud Computing’, which decreased by 18%. This suggests that by 2013 even the Future Adopters group were beginning to see improved maturity of CC over the previous year.

The most significant agreement in the 2012 survey was on ‘the main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery’, with 84% (54 of 64) of Future Adopters agreeing to the statement, while the most popularly-held belief in the 2013 survey was that ‘Cloud Computing will be one of the top ten strategic technologies for the next 5 years’ with a 100% response rate (26 of 26). This strategic movement toward CC aligns with the importance level of expected benefits explained earlier for Future Adopters. Moreover, the agreement on ‘Cloud Computing is a tool that enables the organisation to be more productive and cost effective’ and ‘Cloud Computing is the future of IT’, which were popular statements, varied between 59% and 77% in both surveys.

The reviewed literature stated that virtualisation was an enabler for CC (Linthicum, 2010a, O'Driscoll et al., 2013, Rimal and Choi, 2012, Mancini et al., 2009) as was SOA (Banerjee et al., 2012, Murah, 2012, Wang et al., 2008, Linthicum, 2010a). However, the statement ‘Virtualisation is required to enable Cloud Computing’ gained the most disagreement, with 36% (23 of 64), followed by the statement ‘SOA is required to enable CC’, with 30% (19 of 64), in 2012. This is not entirely surprising, given that this group of respondents were from organisations which had not yet begun to implement CC and, thus, really had not begun to investigate the hands-on details which would be required in order to do so.

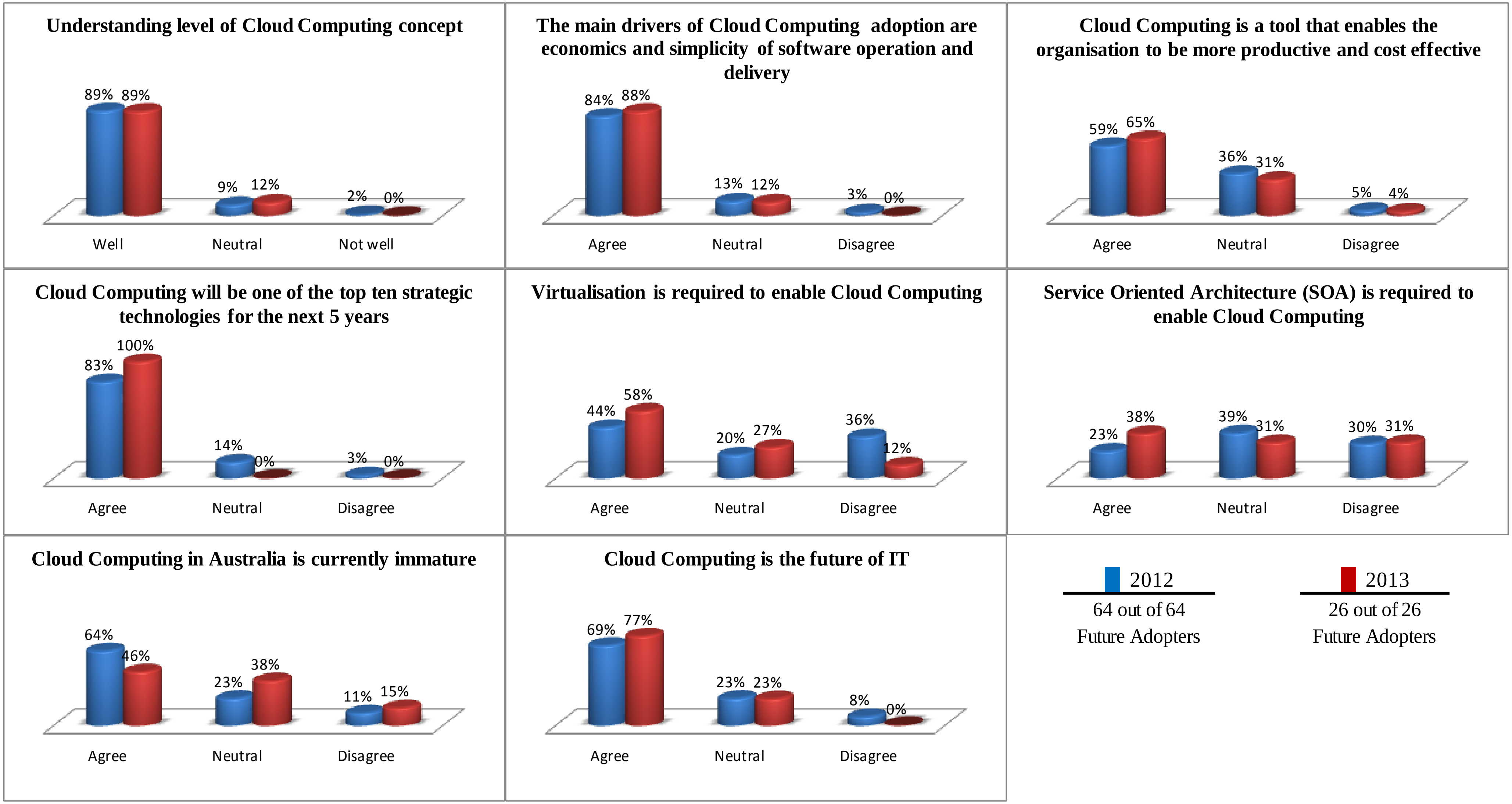


Figure 4.23: Beliefs of Future Adopters in 2012 and 2013

Ordered logistic analysis showed that agreement with the statement ‘CC will be one of the top ten strategic technologies for the next 5 years’ was the only statistically significant difference between Future Adopters’ beliefs across both surveys, as shown in Table 4.19. Respondents of Future Adopters in 2013 were more inclined to believe that ‘CC will be one of the top ten strategic technologies for the next 5 years’ compared with those in 2012 (p=0.004). This belief increased dramatically from 83% (53 of 64) in 2012 to 100% (26 of 26) in 2013, which was consistent with the views stated by Gartner (2010).

The 2013 respondents’ belief that ‘virtualisation is required to enable CC’ was slightly higher than 2012, although the difference did not reach significance level (p= 0.08). Agreement with this statement increased from 44% (28 of 64) in 2012 to 58% (15 of 26) in 2013. Despite the likely differences in respondent makeup between the two surveys, this may indicate not only that participants in 2013 were more familiar with virtualisation and realised its usefulness than respondents in 2012, but possibly even that the IT community in general was becoming more aware of the benefits of virtualisation. The number of ‘Don’t know’ responses, however, showed that there was continuing uncertainty among Future Adopters about the requirement for SOA as a CC enabler. More detailed qualitative investigation would help to clarify these issues.

The results did not change after adjusting the analyses for demographic covariates (industry sector, State and organisation size). However, there were some differences in the beliefs between industry sectors, organisation size and State. For instance, respondents from the services (OR 0.17; 95% CI 0.03 to 0.90), finance & ICT (OR 0.05; 95% CI 0.01 to 0.25) and resources & construction sectors (OR 0.12; 95% CI 0.02 to 0.63) had less belief that ‘SOA is required to enable CC’ compared with those from the manufacturing & goods distribution sector (all p<0.045). Similarly, organisations with 101–499 employees also had less belief that ‘SOA is required to enable CC’ (OR 0.22; 95% CI 0.06 to 0.80; p=0.02) compared with organisations with fewer than 101 employees. This may indicate that respondents from the manufacturing & goods distribution sector and/or small organisations were more cautious when adopting CC to minimise the risks or, quite possibly, that this group was less likely to be familiar with the concept of SOA and, thus, also less likely to see its potential benefit for CC.

Although there was significant change toward believing that 'CC will be one of the top ten strategic technologies', multi-State organisations (OR 0.20; 95% CI 0.07 to 0.60; p=0.004) were less convinced of this than respondents from single State organisations. While this might at first seem counter-intuitive, the analysis of respondent organisation size suggested that, in this survey at least, single State respondents tended to be larger in terms of employee numbers than multi-State respondents. In addition, single State organisations formed 58% (37 of 64) of Future Adopters in 2012 and 65.4% (17 of 26) in 2013, making them the single largest group of this kind.

Table 4.19: Results of comparing Future Adopters' beliefs between 2012 and 2013 (after excluding the answers of 'Don't know' option)

Belief	2012 vs 2013 (Don't Know were Excluded)						Number of Don't Know
	2012 Mean ± SD	2013 Mean ± SD	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	
Understanding level of CC	4.23 ± 0.68	4.15 ± 0.61	0.73 (0.30 to 1.78)	0.49	0.70 (0.27 to 1.78)	0.45	
Main drivers of CC adoption are economics and simplicity	3.92 ± 0.60	4.12 ± 0.59	1.99 (0.72 to 5.49)	0.18	1.54 (0.53 to 4.49)	0.43	0
CC is a tool to be more productive and cost effective	3.63 ± 0.70	3.77 ± 0.76	1.46 (0.60 to 3.54)	0.40	1.52 (0.59 to 3.88)	0.39	0
CC will be one of the top ten strategic technologies for the next 5 years	4.06 ± 0.73	4.54 ± 0.51	3.80 (1.52 to 9.49)	0.004	3.78 (1.37 to 10.45)	0.01	0
Virtualisation is required to enable CC	3.20 ± 1.07	3.64 ± 1.04	2.14 (0.93 to 4.93)	0.08	2.13 (0.88 to 5.14)	0.09	1
SOA is required to enable CC	2.95 ± 0.80	3.08 ± 0.98	1.37 (0.58 to 3.28)	0.47	1.34 (0.52 to 3.43)	0.55	5
CC in Australia is currently immature	3.63 ± 0.81	3.50 ± 0.99	0.69 (0.29 to 1.65)	0.40	0.60 (0.24 to 1.48)	0.27	1
CC is the future of IT	3.75 ± 0.91	3.92 ± 0.63	1.30 (0.55 to 3.06)	0.56	1.41 (0.56 to 3.56)	0.47	0

* Data analysed using ordered logistic regression.
SD: Standard Deviation.
OR: odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including organisation size, industry sector and state.
64 observations in 2012 26 observations in 2013

4.2.5. Usage of Cloud Computing

This Section investigates how Future Adopters anticipate they will use CC. Their usage includes the service delivery models (SaaS, PaaS or IaaS), type of CSPs (International, Australian or both), deployment models (Public, Private, Community or Hybrid Cloud); and cloud systems (e.g. email, storage, database & backup systems).

4.2.5.1. Service Delivery Models and their Cloud Service Providers

All types of service delivery models explained in the reviewed literature were expected to be used by Future Adopters. Not only are the expected usage proportions of these models and the type of CSP highlighted in this study but the relationship between them, which was not explained in the reviewed literature, was also identified here. However, regression analysis could not be applied to identify whether any statistically significant change had occurred between the surveys in terms of service delivery models and their CSPs because there was such a small number of responses in many options, as shown in Table 4.20.

More than 84% of Future Adopters expected to use SaaS, around 76% expected to use IaaS; and between 48% and 60% expected to use PaaS in both surveys, as shown in Figure 4.24. This pattern is very similar to the proportions observed with Cloud Adopters in the two surveys, showing that even those organisations not yet using CC had similar expectations for types of cloud application. There was no significant change in the expectation usage of SaaS or IaaS models in 2013, even though the expected number of SaaS users increased slightly by 3.5% and IaaS decreased very slightly by 1.6% in 2013. The number of Future Adopters expecting to use PaaS showed the greatest increase (of 12.3%) in 2013. This may support the view expressed by some industry commenters that SaaS has not met the requirement of some organisations because it has very limited customisation (Kepes, 2011, Padhy and Patra, 2012, Xiaoqi, 2012).

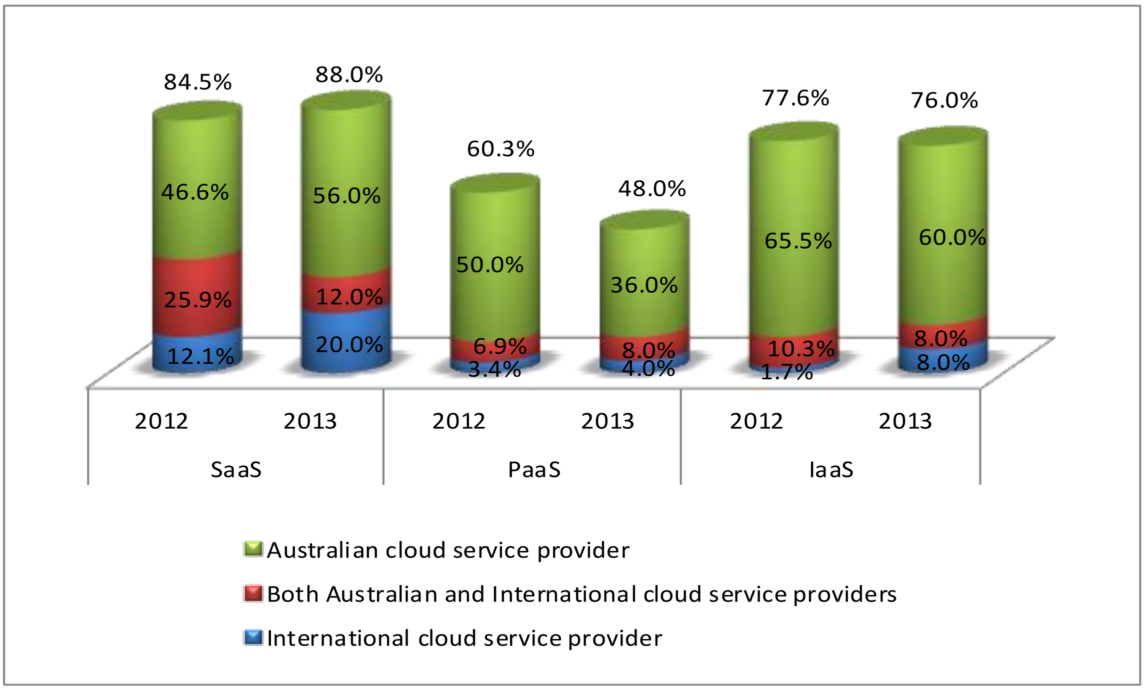
The proportions of organisations expecting to have contracts with international CSPs increased, while the proportions of those expecting to have contracts with Australian CSPs declined in 2013 for all service delivery models – except for those Future Adopters considering SaaS, as illustrated in Figure 4.24. This is somewhat counter-intuitive, given the significant changes to the federal Privacy Act from 2014 which would place considerably greater demands on users of international CSPs. The explanation for this curious finding may lie in the number of Future Adopters who selected international CSPs for PaaS and IaaS in both years, however, as this was very small (fewer than 3), so that the changes in these particular results may not be very meaningful.

Future Adopters in both surveys expected to use most of the service delivery models offered by Australian CSPs. This might occur because Future Adopters would like to gain HPC instantaneously, which is provided by ideal CSPs' infrastructure (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010), without any delay or interruption that may occur with international CSPs.

Table 4.20: Number of responses for service delivery models and the type of CSPs for Future Adopters in 2012 and 2013

Service Delivery Model	2012 (58 out of 64 Future Adopters)			2013 (25 out of 26 Future Adopters)		
	International CSP	Both Australian & International CSPs	Australian CSP	International CSP	Both Australian & International CSPs	Australian CSP
SaaS	7	15	27	5	3	14
PaaS	2	4	29	1	2	9
IaaS	1	6	38	2	2	15

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.



2012 (58 out of 64 Future Adopters) **2013** (25 out of 26 Future Adopters)

Figure 4.24: Service delivery models and their type of CSP of Future Adopters in 2012 and 2013

4.2.5.2. Deployment and Service Delivery Models

Both surveys showed Australian organisations expected to use all the types of deployment models and service delivery models that were identified and discussed in the reviewed literature. In terms of service delivery models and CSPs, not only were the proportions of expected usage for these models identified in this study, but the association between these models and service delivery models, indicated in the reviewed literature, was also stated. However, because insufficient responses were found in some cases, as presented in Table 4.21, the logistic regression analysis could not be applied to identify statistically significant differences.

The deployment model most Future Adopters expected to use was Out-sourced Private Cloud in both surveys, as shown in Figure 4.25. On-site Private Cloud was the second most popular expected deployment model in the 2012 survey, whereas Hybrid Cloud was the second most popular in the 2013 survey. Oddly, expected usage of all deployment models decreased in 2013, except for Hybrid Cloud which increased by 2.6%. The maximum decline was 12.3% in On-site Private Cloud. While the decreased popularity of

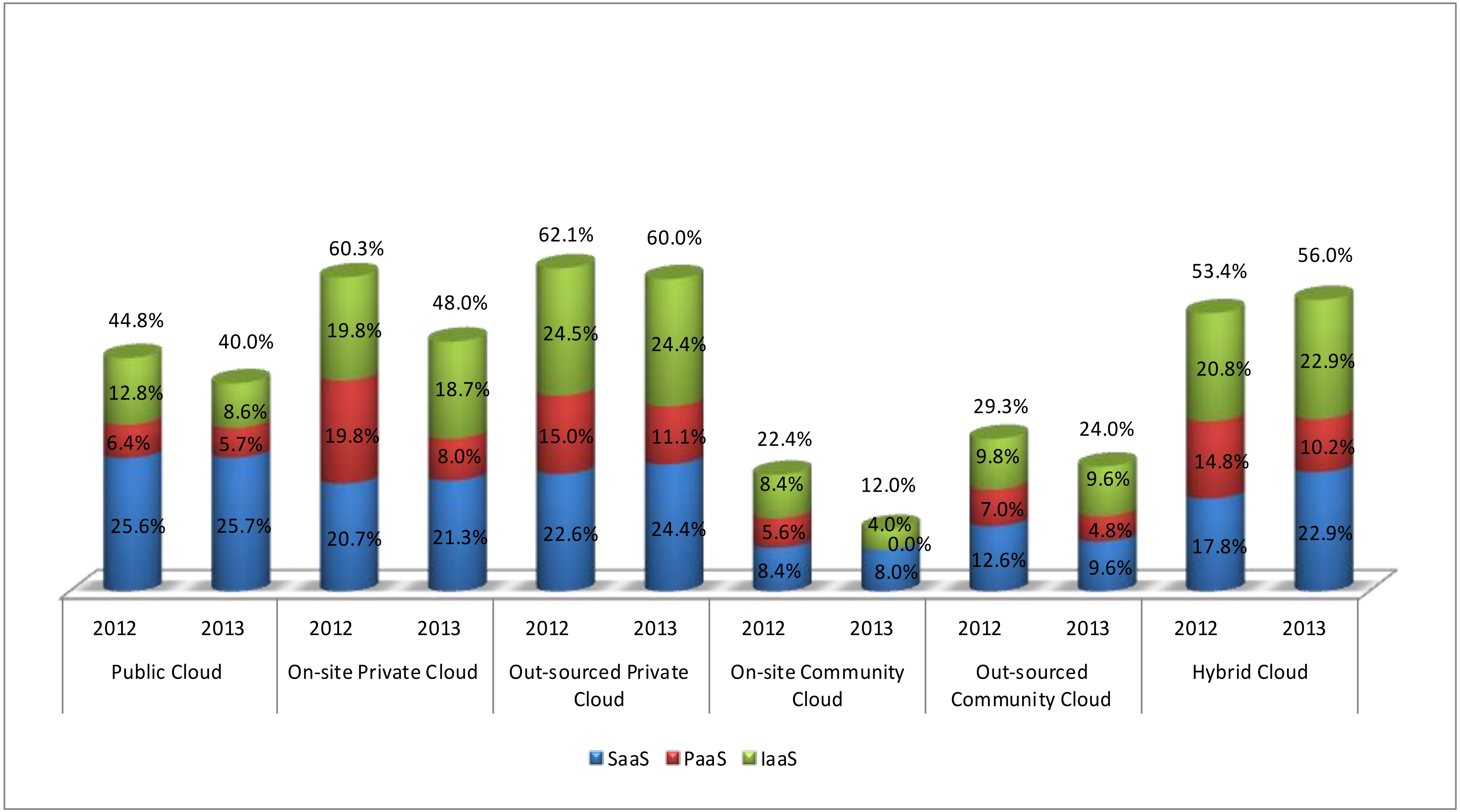
On-site Private Cloud is consistent with the actual change in usage shown by the Cloud Adopters group, there seems to have been at least a partial increase in the popularity of Hybrid Cloud among the Future Adopters group – but this assumption could not be tested because the anonymous nature of the surveys.

SaaS was the most popular anticipated service delivery model in all expected deployment models in both surveys, although it came second to IaaS for those Future Adopters expecting to make use of Out-sourced Private Cloud and Hybrid Cloud in 2012. PaaS was the smallest anticipated service delivery model for Future Adopters in all deployment models, consistent with the views of Cloud Adopters. Interestingly, SaaS was more popular with those Future Adopters planning to use Public Cloud and both types of Private Cloud in the 2013 survey, although these deployment models declined in percentage terms. The opposite situation happened with respect to IaaS in Hybrid Cloud in 2013. Although the increase in popularity of SaaS with Public Cloud and both types of Private Cloud is understandable, the decrease in demanding IaaS in Hybrid Cloud is somewhat mysterious and would benefit from qualitative follow-up.

Table 4.21: Number of responses for deployment models and their service delivery models for Future Adopters in 2012 and 2013

Deployment Model	2012 (58 out of 64 Future Adopters)			2013 (25 out of 26 Future Adopters)		
	SaaS	**PaaS**	**IaaS**	**SaaS**	**PaaS**	**IaaS**
Hybrid Cloud	18	15	21	9	4	9
Out-sourced Community Cloud	9	5	7	4	2	4
On-site Community Cloud	6	4	6	2	0	1
Out-sourced Private Cloud	24	16	26	11	5	11
On-site Private Cloud	23	22	22	8	3	7
Public Cloud	20	5	10	9	2	3

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.



2012 (58 out of 64 Future Adopters) **2013** (25 out of 26 Future Adopters)

Figure 4.25: Deployment models their service delivery models of Future Adopters in 2012 and 2013

4.2.5.3. Cloud Systems and their Deployment Models

Although the reviewed literature identified many cloud systems, it did not rank or indicate the usage proportions for these systems for Future Adopters. Thus, this study stated the usage proportions of these systems and highlighted their deployment models for Future Adopters in both surveys. However, logistic regression analysis could not be applied to investigate the statistically significant changes between the surveys because a very small number of responses were found in many occasions, as shown in Table 4.22.

The top five anticipated cloud systems for Future Adopters, as illustrated in Figure 4.26, show that backup, email, storage/archiving, database, financial and accounting and critical business systems were the main cloud systems this group expected to use in both surveys. Although web hosting was only added in the 2013 survey as a result of 4 of 27 respondents' comments of Cloud Adopters in 2012, it ranked with critical business systems as the fifth most popular cloud system. Backup systems lost its position as the most anticipated cloud system in 2012 and slid to third place, after email and storage/archiving systems in 2013, suggesting that even for those respondents not already active cloud users, a more strategic mindset was becoming the norm.

Table 4.22: Number of responses for cloud systems and their deployment models for Future Adopters in 2012 and 2013

Cloud System	**2012** (57 out of 64 Future Adopters)						**2013** (23 out of 26 Future Adopters)					
	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	3	16	13	0	2	4	2	7	6	0	1	1
Manufacturing	1	6	2	0	0	1	0	1	2	0	0	0
Real time	2	11	5	0	1	4	0	1	2	0	0	1
Marketing and sales e.g. CRM	5	11	13	0	2	6	6	3	3	0	1	1
Human resource management	6	12	13	0	1	3	2	4	8	0	1	0
Database	2	20	11	0	2	4	1	8	7	0	0	2
Storage / Archiving	5	19	18	1	4	5	4	7	9	0	0	2
Backup	7	19	21	0	4	5	2	5	10	1	0	1
Email	13	14	17	1	5	6	8	5	8	0	0	1
Critical business systems	2	18	13	0	2	4	0	6	6	0	1	2
Processing	3	13	14	0	2	6	0	2	3	0	0	2
Test and development	9	12	14	0	3	7	2	4	2	0	0	4
Project Management	5	13	14	0	2	4	2	4	4	0	0	0
Collaboration	-	-	-	-	-	-	7	3	2	0	0	0
Content Filtering	-	-	-	-	-	-	5	2	3	0	1	0
E-Learning	-	-	-	-	-	-	6	1	5	1	1	2
Library Services	-	-	-	-	-	-	2	2	2	1	0	1
Phone System	-	-	-	-	-	-	3	5	4	0	0	0
Web Hosting	-	-	-	-	-	-	5	3	3	1	1	2

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

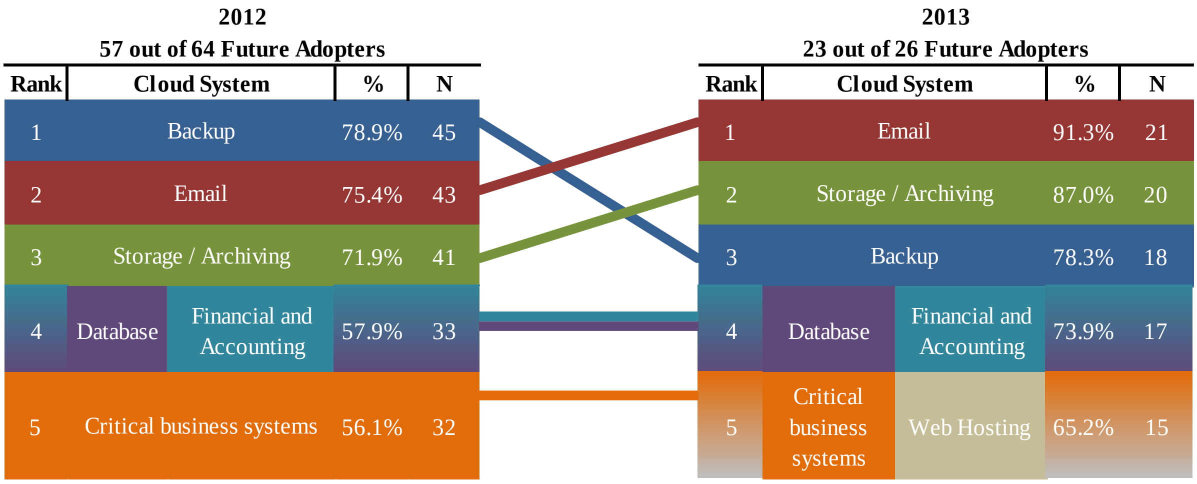


Figure 4.26: Ranking response rate of cloud systems of Future Adopters in 2012 and 2013

In the 2012 survey most Future Adopters expected cloud systems to be located in either Out-sourced Private Cloud or On-site Private Cloud, as shown in Table 4.23. However, by the time of the 2013 survey, Public Cloud had become a third option – quite possibly due to the publicity public cloud was receiving. There was little change in the expectations of location of cloud systems between 2012 and 2013, except for storage/archiving which was anticipated to move to Out-sourced Private Cloud. In addition, in the 2013 survey, email systems were expected to move to both Public and Out-sourced Private Cloud (possibly reflecting those respondents' anticipated corporate usage of public vs. private cloud), while critical business systems were expected to move to both types of Private Cloud. This shift towards Public and Out-sourced Private Cloud could not be tested because of the anonymous nature of the surveys.

Table 4.23: Top cloud systems and their deployment models for Future Adopters in 2012 and 2013

Cloud System	2012 (57 out of 64 Future Adopters)	2013 (23 out of 26 Future Adopters)
Backup	Out-sourced Private Cloud	Out-sourced Private Cloud
Email	Out-sourced Private Cloud	Public Cloud, Out-sourced Private Cloud
Storage / Archiving	On-site Private Cloud	Out-sourced Private Cloud
Database	On-site Private Cloud	On-site Private Cloud
Financial and Accounting	On-site Private Cloud	On-site Private Cloud
Critical business systems	On-site Private Cloud	On-site Private Cloud, Out-sourced Private Cloud
Web Hosting	----------------	Public Cloud

Most of the expected cloud systems remained as they were in the 2012 survey for all deployment models except the cloud systems for both types of Community Cloud, as shown in Table 4.24. It is interesting to note that email was expected to be the main system in three deployment models in the 2012 survey, while backup and web hosting were expected to be the main system in two deployment models in the 2013 survey. Whether this reflects a more sophisticated view of CC, or whether the small sample size is merely providing non-representative findings is open to question.

Table 4.24: Main cloud system for each deployment model for Future Adopters in 2012 and 2013

Cloud System	2012 (57 out of 64 Future Adopters)		2013 (23 out of 26 Future Adopters)	
Public Cloud	Email	21%	Email	14%
On-site Private Cloud	Database	11%	Database	11%
Out-sourced Private Cloud	Backup	13%	Backup	11%
On-site Community Cloud	Email, Storage / Archiving	50%	Backup, Web Hosting, Elearning, Library Services	25%
Out-sourced Community Cloud	Email	17%	Financial and Accounting, Web Hosting, Critical business systems, Elearning, Marketing and sales e.g. CRM, Content Filtering, Human resource management	14%
Hybrid Cloud	Test and development	12%	Test and development	18%

4.2.6. Concerns

The literature (both academic and industry) has identified many concerns related to adopting CC. However, neither the ranks nor the proportion of these concerns as expressed by the Future Adopters respondents can be found in these articles. The present study has therefore highlighted the top five concerns likely to prevent Future Adopters from adopting CC in both the 2012 and 2013 surveys, as shown in Figure 4.27.

The proportions of these concerns varied between 34.9% (22 of 63) and 69.8% (44 of 63) of Future Adopters in 2012; and, more narrowly, between 38.5% (10 of 26) and 61.5% (16 of 26) of the same category in 2013. The most frequently occurring of the top five concerns in both surveys were security, privacy and integration problems, with 69.8% (44 of 63), 68.3% (43 of 63) and 34.9% (22 of 63) respectively in 2012. These concerns formed 53.8% (14 of 26), 61.5% (16 of 26) and 42.3% (11 of 26) respectively, in 2013.

Although Future Adopters considered security problems the top concern in the 2012 survey, followed by privacy problems, these issues exchanged their rank and dropped lower in the 2013 survey by 16% and 6.8% respectively. By contrast, integration problems were the only concern in the top five of Future Adopters that increased in the 2013 survey, rising to fourth position. This indicated that Future Adopters in 2013 had slightly different priority of concerns according to their business needs. The increase in concern about integration suggests that those organisations still pondering the decision to adopt CC are, nonetheless, becoming more strategic in their views.

Some concerns in the 2013 survey were not originally listed in the 2012 survey. Bandwidth and data sovereignty were among the issues which were extracted from the results of the ‘Other’ option in the 2012 survey, reaching third and fifth place, respectively, with 46.2% (12 of 26), and 38.5% (11 of 26) in the 2013 survey. Usage costs concerned 4 out of 9 of Future Adopters who selected the ‘Other’ option in the 2012 survey and this issue was also added to the 2013 survey, where it was selected by 38.5% (10 of 26) respondents. The addition of these three new issues for Future

Adopters in 2013, appear to have been the reason why concerns about Internet outages, availability problems with CSPs and legal problems declined from third and fourth places in 2012 to sixth and seven place in 2013. This may well be because, even for organisations which have not yet 'taken the plunge' into CC, awareness of the issues associated with the cloud is becoming more strategic.

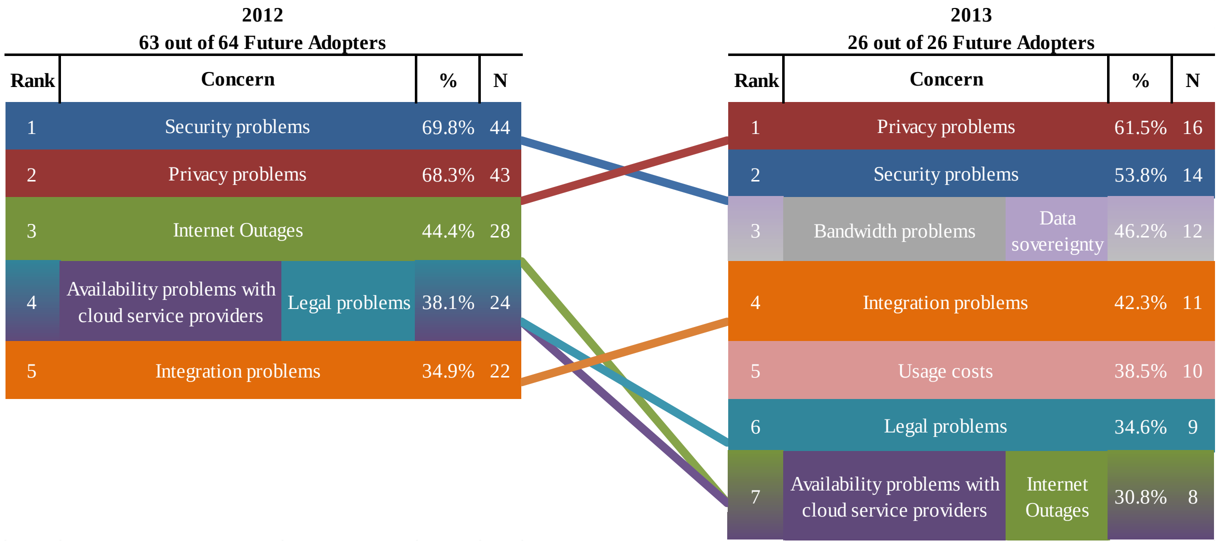


Figure 4.27: Concerns of Future Adopters in 2012 and 2013

The results of logistic regression analysis showed that 'immaturity of technology' was the only statistically significant difference in Future Adopters' concerns between 2012 and 2013, as shown in Table 4.25. In 2013, respondents from the Future Adopters group were less concerned about 'immaturity of technology' than this group had been in 2012 (p=0.03). This concern declined significantly from 31.7% (20 of 63) in 2012 to 7.7% (2 of 26) in 2013 and was consistent with the belief of Future Adopters 'immaturity of Cloud Computing' which decreased by 18% in 2013, as stated earlier in 4.2.4. This view chimes in with industry opinion concerning the growing maturity of this technology (see, for example the Disys (2015) summary of industry surveys, or the ExpertON (2015) summary of CC's current status).

After adjusting the analyses for demographic covariates (industry sectors, State and organisation size), 'security problems' showed up as another statistically significant difference in Future Adopters' concerns between 2012 and 2013. Participants from Future Adopters in 2013, just like respondents from the Cloud Adopters group, discussed in Section 4.1.7, were less concerned about ‘security problems’ than the equivalent group had been in 2012 (p=0.04). This concern declined from its top spot at 69.8% (44 of 64) in 2012 to become the second major concern for Future Adopters in 2013, with 53.8% (14 of 26). It seems likely that the explanation for this slight decrease in concern about security, despite the fact that security issues remain a major problem for CC, is similar to that for Cloud Adopters, i.e. that the new ‘buzz’ around Big Data, which was gaining momentum at that time, may have distracted would-be adopters of the cloud from other issues. Only qualitative investigation, however, will truly be able to answer this question.

There were also some differences in Future Adopters’ concerns between industry sectors, organisation size and State. Respondents from the finance & ICT sector (OR 4.98; 95% CI 1.01 to 24.47) more concerned about ‘integration problems’ than those from the manufacturing & goods distribution sector (p=0.048), most probably because they had more immediate experience of the difficulties of integrating new systems into existing operations. Participants from the government sector (OR 6.85; 95% CI 1.01 to 46.64) had higher levels of concern about ‘loss of control’ than with those from the manufacturing & goods distribution sector (p=0.049). ‘Legal problems’ concerned participants from the services (OR 7.47; 95% CI 1.24 to 45.11) and government sectors (OR 7.15; 95% CI 1.15 to 44.38) more than it did those from the manufacturing & goods distribution sector (all p<0.045). These differences in ‘loss of control’ and ‘legal problems’ seem likely to be a logical consequence of the public sector’s need for auditability. The sensitivity of so much of the data held by the public sector may well provide the explanation for its greater concern in these issues.

Organisation size also led to some differences in concerns. For instance, respondents from organisations with 101–499 employees (OR 0.15; 95% CI 0.03 to 0.81; p=0.03) were less concerned about ‘security problems’ those from organisations with fewer than 101 employees. This apparently counter-intuitive finding may be because smaller organisations are less familiar with security issues than larger ones and, thus, more anxious about them; or it may be the result of very small organisations’ limited staffing which results in their having no security experts readily available.

Another difference related to ‘loss of control’, which was far less a concern for participants from organisations with 101–499 employees (OR 0.10; 95% CI 0.02 to 0.43), 500–999 employees (OR 0.05; 95% CI 0.01 to 0.43), 1000–4999 employees (OR 0.08; 95% CI 0.01 to 0.47) and more than 4999 employees (OR 0.11; 95% CI 0.01 to 0.91) than for organisations with fewer than 101 employees (all $p<0.045$). As with security, it seems quite possible that very small organisations, where individual employees may well play more than a single role, would be particularly concerned about the control implications of handing over their precious systems and/or data to an outside provider.

The risk of an ‘unsatisfactory Service Level Agreement’ was less concerning for respondents from organisations with 101–499 employees (OR 0.24; 95% CI 0.06 to 1.00) and those with 1000–4999 employees (OR 0.04; 95% CI 0.00 to 0.44) than for respondents from organisations with fewer than 101 employees (all $p<0.055$). ‘Loss of control’ and ‘unsatisfactory SLA’ did not concern larger organisations nearly as much as it did smaller ones, most probably because larger organisations already have significantly more experience in dealing with outsourcing, where these problems are common (Schaffer, 2009). The surprise here was that relatively small organisations with only 101–499 employees were as sanguine about these issues as larger organisations – while one might hazard a guess that organisations of this size are simply accustomed to dealing with unsatisfactory service from their providers, this would clearly be a very interesting topic to discuss with representatives from this group.

A third difference related to concerns about ‘internet outages’. Respondents from organisations with 1000–4999 employees (OR 0.14; 95% CI 0.03 to 0.73; $p=0.02$) were less concerned about this issue than those from organisations with fewer than 101 employees – though this does not appear surprising, given the utter dependence of small organisations on continuing Internet access.

‘Availability problems with cloud service providers’ had, perhaps less obviously, not such a concern for multi-State organisations (OR 0.23; 95% CI 0.07 to 0.82; $p=0.02$) than it was for those from single State organisation. Most probably, however, this relative lack of concern is because larger or multi-State organisations are likely to have more than one ISP, thus making the risk of 'internet outages' and, thus, availability of CC services far less probable. However, this assumption needs to be tested using qualitative research.

Table 4.25: Results of comparing Future Adopters' concerns between 2012 and 2013

Concern	2012 vs 2013			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Security problems	0.50 (0.20 to 1.29)	0.15	0.30 (0.10 to 0.94)	0.04
Privacy problems	0.74 (0.29 to 1.93)	0.54	0.81 (0.29 to 2.30)	0.69
Availability problems with cloud service providers	0.72 (0.27 to 1.92)	0.51	0.59 (0.18 to 1.90)	0.38
Integration problems	1.37 (0.54 to 3.48)	0.51	1.68 (0.55 to 5.18)	0.37
Development problems	0.97 (0.18 to 5.33)	0.97	1.37 (0.20 to 9.15)	0.75
Recovery problems	2.21 (0.72 to 6.76)	0.16	3.33 (0.88 to 12.56)	0.08
Legal problems	0.86 (0.33 to 2.23)	0.76	0.83 (0.29 to 2.37)	0.73
Unsatisfactory Service Level Agreement	0.69 (0.24 to 2.00)	0.50	0.60 (0.17 to 2.11)	0.43
Quality problems	0.38 (0.10 to 1.45)	0.16	0.29 (0.07 to 1.27)	0.10
Organisational and cultural problems	0.83 (0.27 to 2.61)	0.75	0.82 (0.23 to 2.89)	0.76
Loss of control	0.79 (0.29 to 2.19)	0.65	0.65 (0.20 to 2.18)	0.49
Lack of trust with cloud service Providers	0.49 (0.15 to 1.64)	0.25	0.50 (0.13 to 1.89)	0.31
Lack of service orientation	1.24 (0.29 to 5.38)	0.78	1.71 (0.27 to 10.97)	0.57
Insufficient skills in your organisation	1.59 (0.51 to 4.95)	0.42	1.53 (0.38 to 6.08)	0.55
Immaturity of technology	0.18 (0.04 to 0.83)	0.03	0.10 (0.02 to 0.66)	0.02
Internet Outages	0.56 (0.21 to 1.47)	0.24	0.44 (0.14 to 1.39)	0.16

* Data analysed using logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including organisation size, industry sector and state.

63 observations in 2012 26 observations in 2013

4.3. Undecided Non-Adopters

Undecided Non-Adopters formed the third category of respondents and referred to respondents from those organisations which had not decided whether to adopt CC or not at the time of the survey. The results of both surveys indicated that this category formed 28.5% (111 of 390) of all respondents in 2012 and 21.6% (37 of 171) of them in 2013. The decline in this category indicated the increasing acceptance of CC over the period. However, due to the anonymity of this study, tracking the status of respondents from 2012 was not possible. The following sub-sections discuss the differences between the Undecided Non-Adopters of both surveys in terms of demographic profile, their beliefs and concerns about CC.

4.3.1. Demographic Profile

4.3.1.1. Industry Sectors

Although there were some variations across the two surveys, the government sector contained the largest proportion of Undecided Non-Adopters in both surveys, accounting for 25.2% (28 of 111) of Undecided Non-Adopters in 2012 and a quite significant 37.8% (14 of 37) in 2013, as shown in Figure 4.28. The manufacturing sector had the second highest response rate for this group in 2012, with 15.3% (17 of 111), and was equal second with the information technology sector in 2013, with 16.2% (6 of 37). It was noticeable that the healthcare, information technology, transportation, utilities, wholesale / distribution and engineering / aerospace sectors were more strongly represented in this category in 2013 over 2012, whereas uncertainty about adopting CC by the services, education, construction and retail sectors declined. All other sectors not shown in Figure 4.28 were below 5% in both surveys.

2012
111 out of 111 Undecided Non Adopters

Rank	Indstry Sector	%	N
1	Government	25.2%	28
2	Manufacturing	15.3%	17
3	Services	9.9%	11
4	Financial	9.0%	10
5	Education, Healthcare	8.1%	9
6	Construction, Retail, Information Technology	5.4%	6
7	Transportation	4.5%	5
8	Utilities, Wholesale / distribution	3.6%	4
11	Engineering / Aerospace	0.9%	1

2013
37 out of 37 Undecided Non Adopters

Rank	Indstry Sector	%	N
1	Government	37.8%	14
2	Information Technology, Manufacturing	16.2%	6
3	Healthcare	13.5%	5
4	Services, Transportation, Financial	10.8%	4
5	Utilities, Wholesale / Distribution	8.1%	3
6	Engineering / Aerospace	5.4%	2
7	Education, Retail, Construction	2.7%	1

*All other sectors not mentioned here were below 5% in both surveys

Figure 4.28: Ranking response rate of industry sectors of Undecided Non-Adopters in 2012 and 2013

4.3.1.2. Location of Respondents

More than half the respondents to both surveys in the Undecided Non-Adopters category were located in NSW, as shown in Figure 4.29. The remaining States' Undecided Non-Adopters category varied widely from 17.1% (19 of 111) to 48.6% (54 of 111) in 2012, while in 2013 this category varied from 16.2% (16 of 37) to 40.5% (15 of 37) of non-NSW States. Victorian organisations uncertainty about adopting CC declined by 16.2% in 2013, compared with organisations in the other States. This change meant that uncertain Victorian adopters dropped from second place in 2012 to fourth place in 2013.

Approximately 67% (74 of 111) of Undecided Non-Adopters were single State organisations in the 2012 survey while the remainder 33% (37 of 111) had multi-State locations. However, in 2013, only 59.5% (22 of 37) of Undecided Non-Adopters were located in a single State whereas multi-State organisations formed 40.5% (15 of 37). The shift of uncertainty about adopting CC from single State towards multi-State organisations may lie in the types of organisations responding to the two surveys, because there was no significant change in the distribution of Australian organisations over the period of this study (Australian Bureau of Statistics, 2015b).

2012
111 out of 111 Undecided Non Adopters

Rank	State	%	N
1	NSW	51.4%	57
2	VIC	48.6%	54
3	QLD	41.4%	46
4	WA	31.5%	35
5	SA	26.1%	29
6	TAS	18.9%	21
7	NT	18.0%	20
8	ACT	17.1%	19

2013
37 out of 37 Undecided Non Adopters

Rank	State	%	N
1	NSW	54.1%	20
2	QLD	40.5%	15
3	WA	37.8%	14
4	VIC	32.4%	12
5	TAS	24.3%	9
6	SA ACT	21.6%	8
7	NT	16.2%	6

Figure 4.29: Ranking response rate of States of Undecided Non-Adopters in 2012 and 2013

4.3.1.3. Size of Organisations

The largest group of Undecided Non-Adopters in both surveys was made up of organisations with 101–499 employees which formed 35.1% (39 of 111) in 2012 and 27% (10 of 37) in 2013, as shown in Table 4.26. Only organisations with 51–100 employees declined as a proportion of Undecided Non-Adopters between 2012 and 2013. Unexpectedly, the proportion of organisations with 500–999 employees and those with more than 4999 employees (13 of 37) joining the Undecided Non-Adopters group doubled in size in 2013.

The least represented organisation sizes in the 2012 survey, in terms of uncertainty about adopting CC, were those which had either fewer than 21 employees or 5000–10000 employees. Even together, these two organisation sizes formed only 3.5% (5 of 111) of Cloud Adopters; and in the 2013 the least represented organisation sizes, in terms of uncertainty about adopting CC, were still those with fewer than 21 employees, which formed 2.7% (1 of 37), as illustrated in Table 4.26. It is interesting to notice that the proportion of organisations with 21–50 employees uncertain about whether or not to adopt CC doubled in 2013. These differences may lie in the types of organisations responding to the two surveys since there was no significant change in Australian organisations in terms of their sizes (Australian Bureau of Statistics, 2015b).

Table 4.26: Ranking response rate of organisation sizes of Undecided Non-Adopters in 2012 and 2013

Org. Size	2012			2013		
	111 out of 111 Undecided Non Adopters			37 out of 37 Undecided Non Adopters		
	Rank	%	N	Rank	%	N
More than 10000	5	5.4%	6	3	8.1%	3
5000-10000	7	1.8%	2	3	8.1%	3
1000-4999	2	17.1%	19	2	18.9%	7
500- 999	4	9.0%	10	2	18.9%	7
101-499	1	35.1%	39	1	27.0%	10
51-100	2	17.1%	19	3	8.1%	3
21-50	3	11.7%	13	3	8.1%	3
11-20	6	2.7%	3	4	2.7%	1
5-10	8	0	0	5	0.0%	0
Under 5	8	0.0%	0	5	0.0%	0

4.3.1.4. Job of Respondents

The majority of the respondents representing the Undecided Non-Adopters in both surveys came from IT management rather than general management. Approximately 86% (69 of 111) of the 2012 survey respondents in this group were employed in IT management, as illustrated in Figure 4.30. This percentage remained almost constant in 2013, declining by only about 5%. In addition, the proportion of IT managers, CIOs and Network managers decreased by 6.3%, 8.1% and 2.7% respectively while the proportion of technical support managers increased sharply by 11.7% in 2013. It is most likely that the 2013 survey was referred to more technical IT staff because CC is widely perceived as ‘technical’ issue.

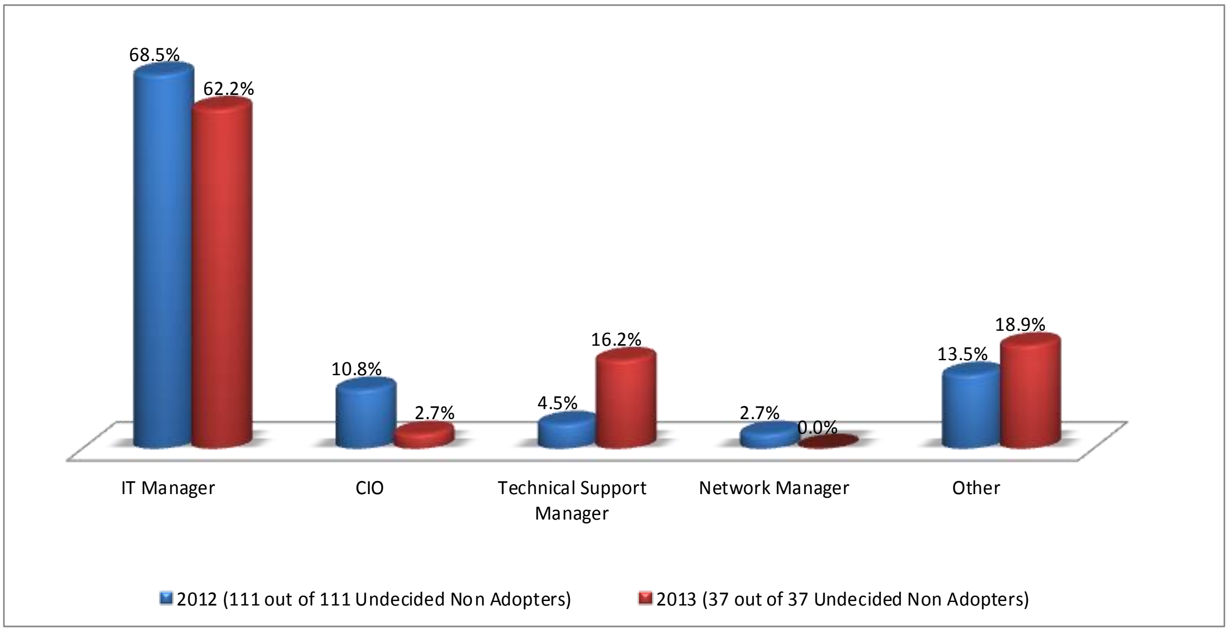


Figure 4.30: Job title of respondents of Undecided Non-Adopters in 2012 and 2013

4.3.2. Beliefs

The beliefs of Undecided Non-Adopters towards CC in both surveys, after excluding the ‘don’t know’ answers, are shown in Figure 4.31. 78% (87 of 111) of respondents in 2012 and 81% (30 of 37) in 2013 claimed they understood the concept of CC, although the reviewed literature has identified considerable uncertainty and confusion among

Australian CIOs concerning the concept of CC over the last 4-5 years (Kotadia, 2010, Macquarie Telecom, 2011). This may simply be embarrassment over admitting to a lack of understanding of the CC concept, of course, but clearer understanding would result from qualitative investigation.

The most significant difference between respondents’ agreement with each statement in both surveys was just 10% - with the exception of agreement with the statement ‘Cloud Computing in Australia is currently immature’ which declined by 14% in 2013. The reviewed literature showed that CC is still not entirely mature, either internationally (Damshenas et al., 2012, Rimal et al., 2011, Hunter, 2009) or nationally (Macquarie Telecom, 2011, Australian Government Information Management Office, 2011, Dearne, 2011). This is consistent with the 2012 findings which indicated that the second most popular topic of agreement for Undecided Non-Adopters was that ‘Cloud Computing in Australia is currently immature’, with 68% (67 of 111) in 2012. However, levels of agreement with this statement declined by 14% in 2013 to 54% (20 of 37) and it fell to the third place, suggesting that even this group of respondents was becoming more convinced of CC’s maturity (whatever the reality).

The assertion that ‘the main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery’ gained the highest level of agreement in both survey, with 71% (79 of 111) in 2012 and 81% (30 of 37) in 2013. This is consistent the reviewed literature which indicated economics and simplicity of software operation and delivery are the main drivers of CC (Erdogmu, 2009).

Agreement with the statement that ‘Cloud Computing will be one of the top ten strategic technologies for the next 5 years’ jumped from third place in 2012, with 66% (73 of 111), to become the second most popular topic in 2013, with 62% (23 of 37). In both surveys, there was least confidence by the Undecided Non-Adopters that ‘Cloud Computing is the future of IT’ and ‘Cloud Computing is a tool that enables the organisation to be more productive and cost effective’. Both of these topics gained the highest proportion of ‘neutral’ responses compared with other statements.

The statement ‘Virtualisation is required to enable Cloud Computing’ gained the highest level of disagreement, with 33% (37 of 111) and 27% (10 of 37) in 2012 and 2013 respectively. This was followed by the statement ‘Service Oriented Architecture (SOA) is required to enable CC’, with 30% (33 of 111) and 22% (8 of 37), in the same respective manner. These findings are similar to the responses from other groups of respondents and, given the lack of certainty about CC altogether by this group, are easy to understand.

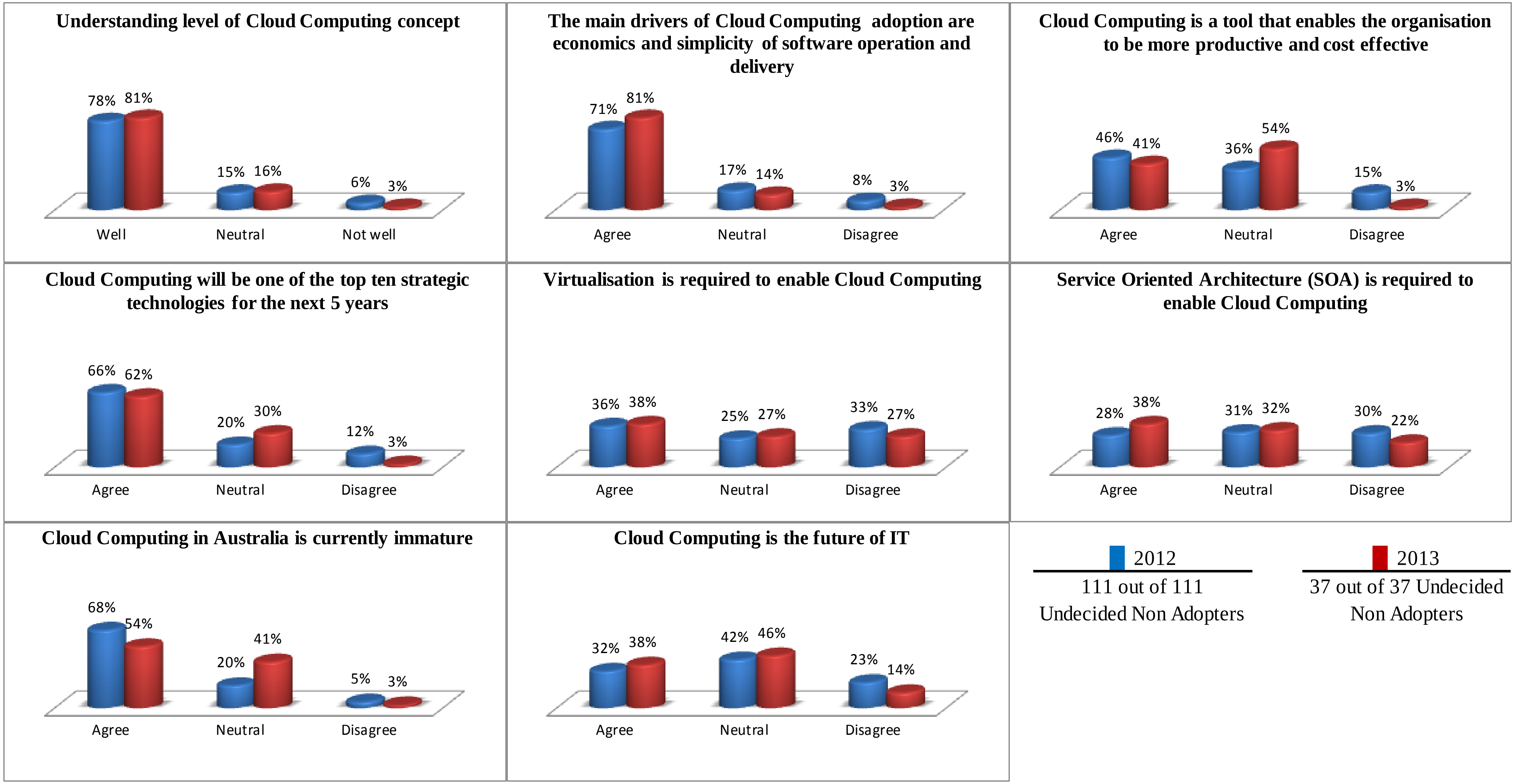


Figure 4.31: Beliefs of Undecided Non-Adopters in 2012 and 2013

Ordered logistic regression analysis revealed that there were no statistically significant differences in the Undecided Non-Adopters' beliefs between 2012 and 2013, as shown in Table 4.27. However, adjusting the analyses for demographic covariates (industry sectors, State and organisation size) showed that agreement on 'CC in Australia is currently immature' was the only statement with a statistically significant difference in the Undecided Non-Adopters' beliefs between 2012 and 2013. Respondents from this group in 2013 were less likely to believe that 'CC in Australia is currently immature' than their equivalents in 2012 (p=0.04) – and respondents from all industry sectors, organisation sizes and States shared this perspective. This suggests that Undecided Non-Adopters, while clearly not yet convinced of the usefulness of CC to their own organisation were nonetheless gaining confidence that the maturity of CC in Australia was increasing over time, just like respondents from the Cloud and Future Adopters groups(Australian Government Information Management Office, 2011, Motta et al., 2012, Damshenas et al., 2012, Rimal et al., 2011) – which is consistent with general industry views (which might well be the source of these respondents' confidence).

Adjusting the analyses for demographic covariates across the two surveys also showed that there were some differences between the beliefs by sector, organisation size and State. For instance, respondents from the services sector (OR 5.05; 95% CI 1.69 to 15.12) felt more confident of their understanding of CC than those from the manufacturing & goods distribution sector (p=0.004). Given the greater chance for the services sector to experience outsourcing, which shares several issues with CC (Schaffer, 2009), respondents from this sector may well have been more familiar with CC than those from the manufacturing & goods distribution sector.

The second difference between industry sectors was in their belief that 'CC will be one of the top ten strategic technologies'. Participants from the finance & ICT sector (OR 3.83; 95% CI 1.28 to 11.42) had higher levels of belief in this statement than those from the manufacturing & goods distribution sector (p=0.02). This may be because people working in the finance & ICT sector have more opportunity to experience innovative technology than those working in the manufacturing & goods distribution sector.

Although there was a decline in believing that ‘CC in Australia is currently immature’ in 2013, respondents from the ‘other’ sector (OR 0.23; 95% CI 0.06 to 0.93) were less inclined to believe in this statement than those from the manufacturing & goods distribution sector (p=0.04). The relatively small numbers in this group and the wide variance in sectors represented by this group may, however, make this finding less relevant than it initially appears.

From the point of view of organisation size and State, there was a difference in the levels of belief that ‘CC is a tool to be more productive and cost effective’. Respondents from organisations with more than 4999 employees (OR 4.25; 95% CI 1.01 to 17.81) believed in this statement more than those from organisations having fewer than 101 employees (p=0.05). Further, participants from multi-State organisations (OR 0.46; 95% CI 0.22 to 0.94) were less inclined to believe that ‘CC is a tool to be more productive and cost effective’ than those from single State organisations (p=0.03). These two outcomes may appear to suggest that respondents from larger and multi-State organisations share the same point of view. Nevertheless, as stated at the beginning of this Chapter, participants from multi-State organisations in this study do not necessarily belong to larger organisations and participants from organisations located in single State do not necessarily belong to smaller organisations (Table 4.3). This apparent cross-tabulation may be a chimera, but more detailed qualitative investigation would be required to tease out a possible explanation.

Table 4.27: Results of comparing Undecided Non-Adopters' beliefs between 2012 and 2013

Belief	2012 vs 2013 (Don't Know were Excluded)						Number of Don't Know
	2012	2013	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	
	Mean ± SD	Mean ± SD					
Understanding level of CC	3.97 ± 0.88	3.84 ± 0.69	0.65 (0.32 to 1.30)	0.22	0.63 (0.30 to 1.31)	0.22	
Main drivers of CC adoption are economics and simplicity	3.77 ± 0.83	3.94 ± 0.63	1.46 (0.69 to 3.12)	0.33	1.42 (0.64 to 3.13)	0.39	5
CC is a tool to be more productive and cost effective	3.31 ± 0.80	3.44 ± 0.65	1.15 (0.57 to 2.30)	0.70	1.18 (0.57 to 2.46)	0.66	4
CC will be one of the top ten strategic technologies	3.74 ± 0.93	3.69 ± 0.63	0.78 (0.39 to 1.55)	0.48	0.75 (0.37 to 1.56)	0.45	5
Virtualisation is required to enable CC	3.15 ± 1.15	3.24 ± 1.02	1.15 (0.58 to 2.26)	0.69	1.05 (0.51 to 2.13)	0.90	9
SOA is required to enable CC	3.03 ± 0.97	3.21 ± 0.84	1.46 (0.72 to 2.93)	0.29	1.26 (0.60 to 2.64)	0.54	16
CC in Australia is currently immature	3.81 ± 0.78	3.64 ± 0.72	0.56 (0.27 to 1.17)	0.12	0.45 (0.21 to 0.97)	0.04	8
CC is the future of IT	3.15 ± 0.96	3.28 ± 0.85	1.34 (0.68 to 2.65)	0.40	1.29 (0.63 to 2.64)	0.49	4

* Data analysed using logistic regression.
SD: Standard Deviation.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including organisation size, industry sector and state.
111 observations in 2012 37 observations in 2013

4.3.3. Concerns

The reviewed literature identified many concerns of CC but without stating the ranks or even indicating the proportions of these concerns for Undecided Non-Adopters. Thus, this study showed the top five concerns that were most likely to prevent Undecided Non-Adopters from adopting CC in the 2012 and 2013 survey, as presented in Figure 4.32. These 'top five' concerns varied between 72.7% (80 of 110) and 42.7% (47 of 110) of Undecided Non-Adopters in 2012; and between 78.4% (29 of 37) and 43.2% (16 of 37) of the same category in 2013. The most commonly mentioned among the top five concerns both surveys shared were security, privacy, integration problems and loss of control with 72.7% (80 out of 110), 69.1% (76 of 110), 47.3% (52 of 110) and 42.7% (47 of 110) respectively in 2012 – a finding very similar to that for the Future Adopters. In 2013 they concerned 78.4% (29 of 37), 67.6% (25 of 37), 43.2% (16 of 37) and 56.8% (21 of 37) of Undecided Non-Adopters respectively, with loss of control appearing to be the issue causing the greatest additional concern over 2012. Security and privacy problems were the top two concerns of Undecided Non-Adopters in both surveys, although all the top five concerns of Undecided Non-Adopters decreased in terms of response rate except 'security' and 'loss of control' concerns which rose by 5.7% and 14.1% respectively. This may be a consequence of CC's similarity with outsourcing and respondents' experiences of poorly-handled projects (Schaffer, 2009).

Some concerns included in the 2013 survey were not originally listed in the 2012 survey. Bandwidth and data sovereignty concerns, for example, were some of those which were extracted from the results of the 'Other' option in the 2012 survey and these occupied the third and fourth position, with 56.8% (21 of 37) and 48.6% (18 of 37) respectively, in the 2013 survey. This is consistent with the reviewed literature which stated that bandwidth problems are a genuine concern for CC customers (Rimal et al., 2011, Greengard, 2010, Linthicum, 2010a) because they frequently need to transfer 'big data' rapidly into and out of the cloud via the Internet. Moreover, data sovereignty, which affects data ownership, data governance and intellectual property rights (O'Driscoll et al., 2013, Hooper et al., 2013, Rimal et al., 2011), became one of the top five concerns of Undecided Non-Adopters because the sensitivity of their data.

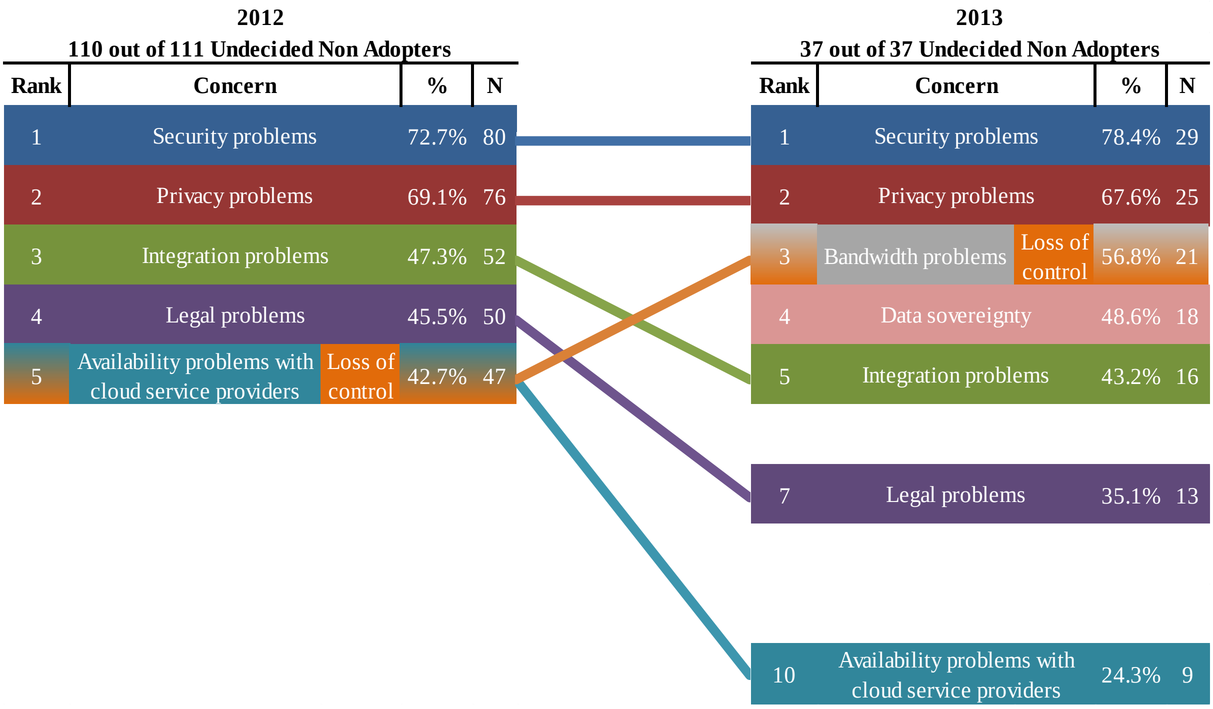


Figure 4.32: Ranking response rate of the top 5 concerns of Undecided Non-Adopters in 2012 and 2013

Logistic regression analysis identified that ‘availability problems with cloud service providers’ was the only statistically significant difference in Undecided Non-Adopters’ concerns between 2012 and 2013, as shown in Table 4.28. Respondents of Undecided Non-Adopters in 2013 were less concerned about ‘availability problems with cloud service providers’ than respondents in 2012 (p=0.05), though this is not consistent with the reviewed literature (Sarathy et al., 2010, Rimal et al., 2011, Baghdadi, 2013, Xiaoqi, 2012). This concern declined significantly from 42.7% (47 of 110) in 2012 to 24.3% (9 of 37) in 2013, possibly because of the widely reported views (discussed in Section 4.3.2) that CC in Australia was becoming more mature (whether or not this is, in fact, the case).

Although adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change the results between both surveys, some differences in concerns between these demographic covariates occurred. For example, participants from the finance & ICT sector (OR 3.70; 95% CI 1.03 to 13.29; p=0.045) were more concerned about ‘availability problems with cloud service providers’ than those from the manufacturing & goods distribution sector in 2012, although this concern declined in 2013, which may conceivable be the result of unhappy experiences with outsourcing for finance & ICT sector respondents, since respondents from this sector were more likely to have had experience with external data or service provision previously – even though this may not have been ‘true’ CC.

Another difference between industry sectors occurred in ‘integration problems’ (OR 4.26; 95% CI 1.30 to 13.99) and ‘recovery problems’ (OR 3.44; 95% CI 1.02 to 11.59) which concerned respondents from the services sector more than those from the manufacturing & goods distribution sector ($p<0.05$). The cause for this difference may lie in the variety of their business requirements and their past experience.

From the perspective of organisation size and State, respondents from organisations with 101–499 employees were more concerned about ‘availability problems with cloud service providers’ (OR 2.93; 95% CI 1.13 to 7.59; $p=0.03$) than those from organisations with fewer than 101 employees. This apparently counter-intuitive finding may be the result of medium size organisations experiencing difficulties in outsourcing (some of) their systems in the past – something respondents from the smallest companies are less likely to have experienced.

Respondents from organisations with more than 4999 employees had less concern about ‘integration problems’ (OR 0.15; 95% CI 0.03 to 0.92) than those from organisations with fewer than 101 employees ($p=0.04$). This may be because respondents from lager organisations are more familiar with integrating systems and with outsourcing generally than are very small companies.

Finally, ‘unsatisfactory service level agreement’ concerned participants from multi-State organisations (OR 2.67; 95% CI 1.14 to 6.25) more than those from single State organisations ($p=0.02$). The physical distribution nature of multi-State organisations may require more attention to SLAs than is the case for single State organisations.

Table 4.28: Results of comparing Undecided Non-Adopters' concerns between 2012 and 2013

Concern	2012 vs 2013			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Security problems	1.36 (0.56 to 3.30)	0.50	1.21 (0.46 to 3.21)	0.70
Privacy problems	0.93 (0.42 to 2.07)	0.86	0.86 (0.35 to 2.10)	0.73
Availability problems with cloud service providers	0.43 (0.19 to 1.00)	0.05	0.38 (0.15 to 0.96)	0.04
Integration problems	0.85 (0.40 to 1.80)	0.67	0.87 (0.38 to 2.02)	0.75
Development problems	0.48 (0.13 to 1.75)	0.27	0.59 (0.15 to 2.40)	0.46
Recovery problems	0.62 (0.26 to 1.49)	0.28	0.67 (0.26 to 1.72)	0.40
Legal problems	0.65 (0.30 to 1.41)	0.27	0.55 (0.24 to 1.27)	0.16
Unsatisfactory Service Level Agreement	1.32 (0.60 to 2.91)	0.49	1.16 (0.49 to 2.74)	0.74
Quality problems	0.93 (0.34 to 2.53)	0.88	1.07 (0.35 to 3.24)	0.90
Organisational and cultural problems	1.15 (0.48 to 2.77)	0.75	0.97 (0.38 to 2.48)	0.96
Loss of control	1.76 (0.83 to 3.73)	0.14	1.71 (0.76 to 3.87)	0.20
Lack of trust with cloud service providers	0.75 (0.35 to 1.63)	0.47	0.82 (0.34 to 1.95)	0.65
Lack of service orientation	0.56 (0.15 to 2.05)	0.38	0.79 (0.19 to 3.23)	0.74
Insufficient skills in your organisation	1.75 (0.67 to 4.53)	0.25	1.69 (0.58 to 4.95)	0.34
Immaturity of technology	0.99 (0.41 to 2.35)	0.98	0.83 (0.33 to 2.05)	0.68
Internet Outages	0.78 (0.35 to 1.71)	0.53	0.79 (0.34 to 1.86)	0.60

* Data analysed using logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including organisation size, industry sector and state.

110 observations in 2012 37 observations in 2013

4.4. Definite Non-Adopters

The fourth and final category of respondents is Definite Non-Adopters who had decided not to adopt CC. The results of both surveys showed that the proportion of this category declined from 7.2% (28 of 390) of respondents in 2012 to 5.3% (9 of 171) in 2013. This decrease may occur because some of this category realised the potential benefits of CC. However, the number of respondents in this category in 2013 is sufficiently small to render any assertions of this kind risky. It may just as easily be the case that organisations which had definitely decided against adopting CC were simply not interested in completing this survey.

The following sub-sections discuss the differences between the Definite Non-Adopters of both surveys in terms of demographic profile, their beliefs and concerns about CC.

4.4.1. Demographic Profile

4.4.1.1. Industry Sectors

Although there were some variations across the two surveys, the survey of 2013 showed that none of the Definite Non-Adopters were from the Government sector, although this sector had been ranked in second place within this group, with 10.7% (3 of 28) in the 2012 survey. This is consistent with the agreement of the Australian Federal Government on the new Commonwealth cloud policy that states agencies "*must adopt cloud where it is fit for purpose, provides adequate protection of data and delivers value for money*" (Department of Finance, 2014b, Cowan, 2014b). The manufacturing sector provided the largest proportion of Definite Non-Adopters in 2012, with 32.1% (9 of 28), but it exchanged position with the finance sector to drop to second place in 2013, with 22.2% (2 of 9) as shown in Figure 4.33. In addition to the finance sector, it was noticeable that the construction, energy and transportation sectors increased their proportion of Definite Non-Adopters in the 2013 survey. All other sectors not mentioned in Figure 4.33 were below 5% in both surveys.

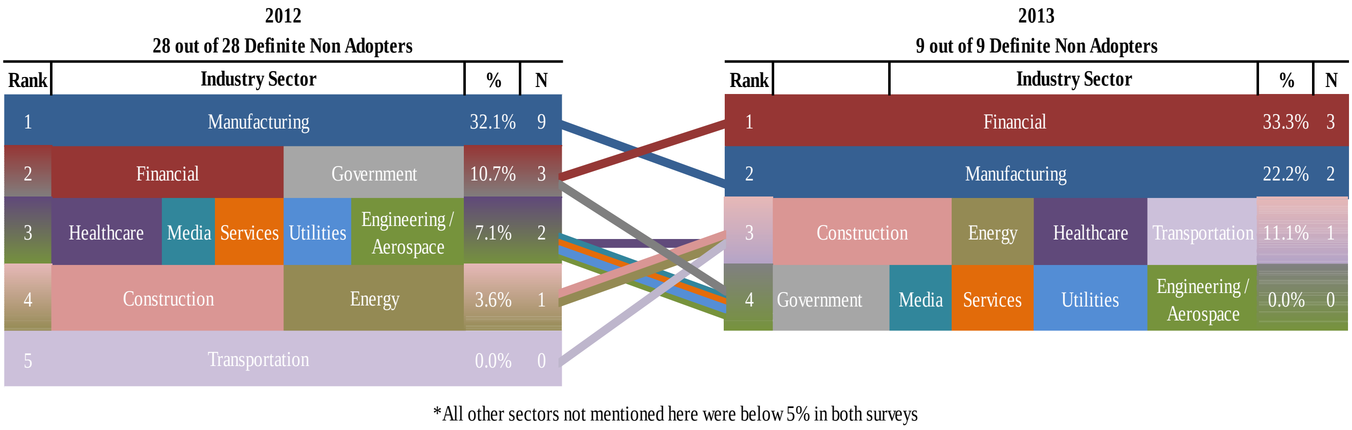


Figure 4.33: Ranking response rate of industry sectors of Definite Non-Adopters in 2012 and 2013

4.4.1.2. Location of Respondents

In 2012, VIC and NSW had the first and second State levels of Definite Non-Adopters, with 46.9% (13 of 28) and 42.9% (12 of 28) respectively and, in 2013, though they exchanged positions with 55.6% (5 of 9) and 44.4% (4 of 9) in the same respective manner, as shown in Figure 4.34, they still made up the two most Non-Adopting group. This may, of course, merely reflect the fact that there were more respondents from these most populous States than from any other State. All States other than NSW and Victoria were below 29% in 2012 and 34% in 2013.

Single State organisations formed 75% (21 of 28) of Definite Non-Adopters in the 2012 survey while the rest 25% (7 of 28) were located in multiple States. However, in 2013, 66.7% (6 of 9) of Definite Non-Adopters were located in a single State. This shift toward multi-State may lie in the types of organisations responding to the two surveys.

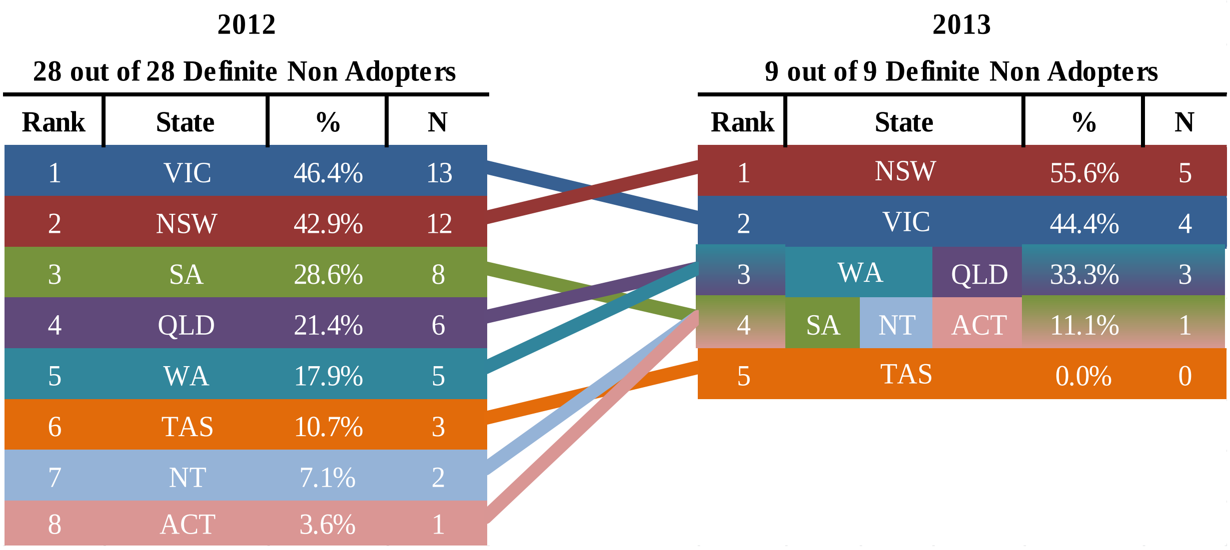


Figure 4.34: Ranking response rate of States of Definite Non-Adopters in 2012 and 2013

4.4.1.3. Size of Responding Organisations

Organisations with 101–499 employees formed the largest organisation size within the Definite Non-Adopters group in the 2012 survey, with 42.9% (12 of 28), as shown in Table 4.26. In 2013 organisations of this size, however, dropped to second position along with organisations with 51–100 employees, together forming 32.1% (9 of 28) of Definite Non-Adopters. It is noticeable that the organisations with 21–50 employees jumped from third place (10.7%; 3 of 28) in 2012 to first place (44.4%; 4 of 9) in 2013, which is not entirely surprising. Organisations with fewer than 21 or more than 10,000 employees rose by one position in 2013, were the least likely to be a member of the Definite Non-Adopters group in either survey – in fact, there were no representatives of this group from organisations of these two sizes in either survey. It is easy to see why the largest companies and organisations would not be likely to form a part of this group – and, in the case of the very smallest organisations, it is not difficult to see why they would be unlikely to respond to a survey of this kind unless they already had an interest in CC. Resources are so scarce in the smallest firms that it can be difficult to find the time to fill in a survey questionnaire which does not have immediate value to the organisation.

Otherwise, the least represented organisation sizes in terms of the decision not to adopt CC, were those with 500–10,000 employees. Together they formed 10.7% (3 of 28) of Definite Non-Adopters in 2012, while in 2013 the least represented organisation sizes, in terms of not to adopt CC, were those with 500–999 employees which formed 11.1% (1 of 9), as illustrated in Table 4.26.

Table 4.29: Ranking response rate of organisation sizes of Definite Non-Adopters in 2012 and 2013

Org. Size	2012			2013		
	28 out of 28 Definite Non Adopters			9 out of 9 Definite Non Adopters		
	Rank	%	N	Rank	%	N
More than 10000	6	0.0%	0	4	0.0%	0
5000-10000	5	3.6%	1	4	0.0%	0
1000-4999	4	7.1%	2	4	0.0%	0
500- 999	5	3.6%	1	3	11.1%	1
101-499	1	42.9%	12	2	22.2%	2
51-100	2	32.1%	9	2	22.2%	2
21-50	3	10.7%	3	1	44.4%	4
11-20	6	0.0%	0	4	0.0%	0
5-10	6	0	0	4	0.0%	0
Under 5	6	0.0%	0	4	0.0%	0

4.4.1.4. Jobs of Respondents

All respondents to the 2013 survey representing the Definite Non-Adopters were employed in IT management, although this group represented only 93% (26 of 28) in 2012, as illustrated in Figure 4.35. Contrary to the situation for Undecided Non-Adopters, where there was a movement away from CIOs and senior management to more technical managers between 2012 and 2013, the proportion of IT managers and network managers responding for the Definite Non-Adopters declined by 23% and 3.6% respectively, while the proportion of CIOs and technical support managers increased by 22.2% and 11.5% in the same respective manner in 2013. It is possible that the decision to definitely exclude CC as a possibility for the organisation in the future had to be taken by a more senior person, but a more thorough qualitative investigation would be needed to truly understand this finding.

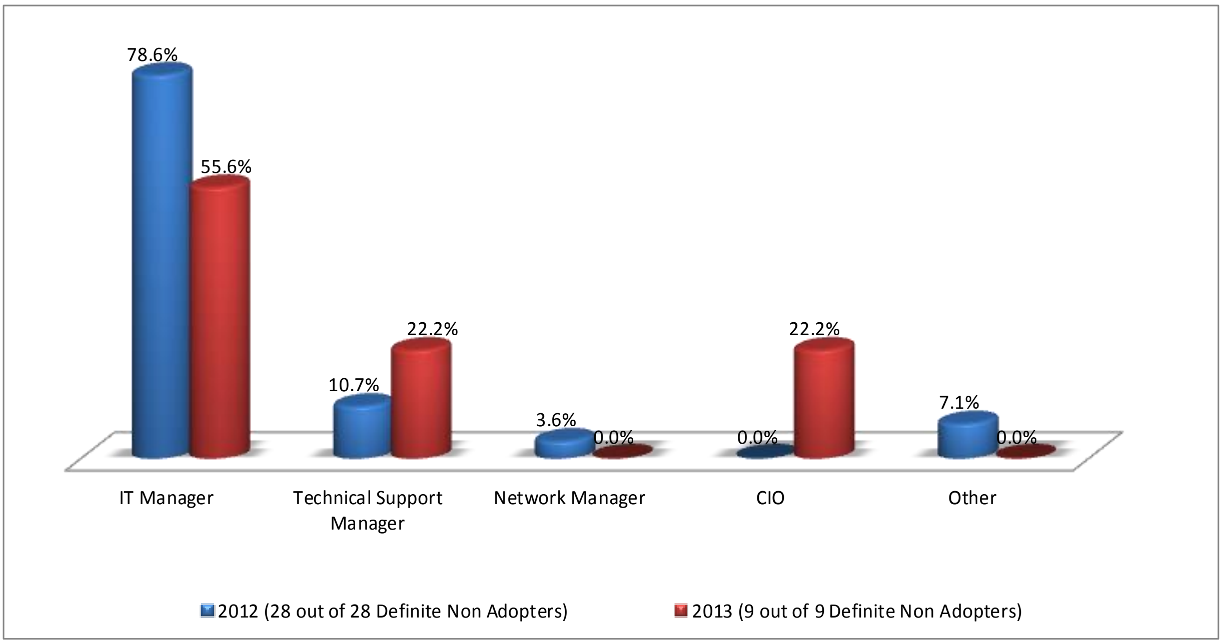


Figure 4.35: Job title of respondents of Definite Non-Adopters in 2012 and 2013

4.4.2. Beliefs

The beliefs of Definite Non-Adopters toward CC in both surveys, after excluding the ‘don’t know’ answers, are shown in Figure 4.36. Almost exactly the same proportion of respondents (between 79% (22 of 28) in 2012 and 78% (7 of 9) in 2013) indicated that they understood the concept of CC, despite the views of the reviewed literature that there was still confusion and uncertainty among Australian CIOs regarding the concept of CC (Kotadia, 2010, Macquarie Telecom, 2011).

The differences between respondents’ agreement with each statement in both surveys varied from 14% to 39% except for agreement with the statements: ‘Cloud Computing will be one of the top ten strategic technologies for the next 5 years’ and ‘Service Oriented Architecture (SOA) is required to enable CC’, which changed by only 1%-2%. These differences must be interpreted with caution, however, because only nine participants represented the Definite Non-Adopters in the 2013 survey.

The greatest agreement in the 2012 survey was on ‘Cloud Computing in Australia is currently immature’, with 75% (21 of 28), while the maximum agreement in the 2013 survey was on ‘the main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery' with 89% (8 of 9). This is consistent with the reviewed literature which states that economics and simplicity of software operation and delivery are the main drivers of CC (Erdogmu, 2009) and indicates CC is still not entirely mature globally (Damshenas et al., 2012, Rimal et al., 2011, Hunter, 2009) and locally (Macquarie Telecom, 2011, Australian Government Information Management Office, 2011, Dearne, 2011).

Only agreement that 'the main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery' and 'Virtualisation is required to enable Cloud Computing' increased dramatically - by 39% and 38% respectively - in 2013 which somewhat surprising, given the apparent lack of agreement with the second of these statements by all other groups of respondents!

Agreement with the statements that 'Cloud Computing in Australia is currently immature', 'Cloud Computing is a tool that enables the organisation to be more productive and cost effective' and 'Cloud Computing is the future of IT' declined by 31%, 21% and 14% respectively, suggesting that even respondents from organisations which have no intention of adopting CC still believe this technology is becoming more mature, provides support for productivity; and is a major area of growth. It would be fascinating to learn why, therefore, these respondents do not wish to participate in something they see as so valuable. Perhaps the answer lies in the fact that the statement 'Cloud Computing is a tool that enables the organisation to be more productive and cost effective' gained the greatest proportion of 'neutral' responses compared with other statements.

The statements 'Virtualisation is required to enable Cloud Computing' and 'Cloud Computing is the future of IT' gained the greatest disagreement, with 36% (10 of 28) of respondents in this group disagreeing in 2012. In 2013 the greatest disagreement was with the statements: 'Cloud Computing is the future of IT' with 56% (5 of 9), followed by 'Virtualisation is required to enable Cloud Computing' and 'Cloud Computing in Australia is currently immature', both with 33% (3 of 9). This appears, at first glance, to suggest that the Non-Adopters group takes an entirely different attitude to the benefits of virtualisation than do respondents from the other groups – but, in fact, the tiny response numbers probably simply means that these responses are not very reliable.

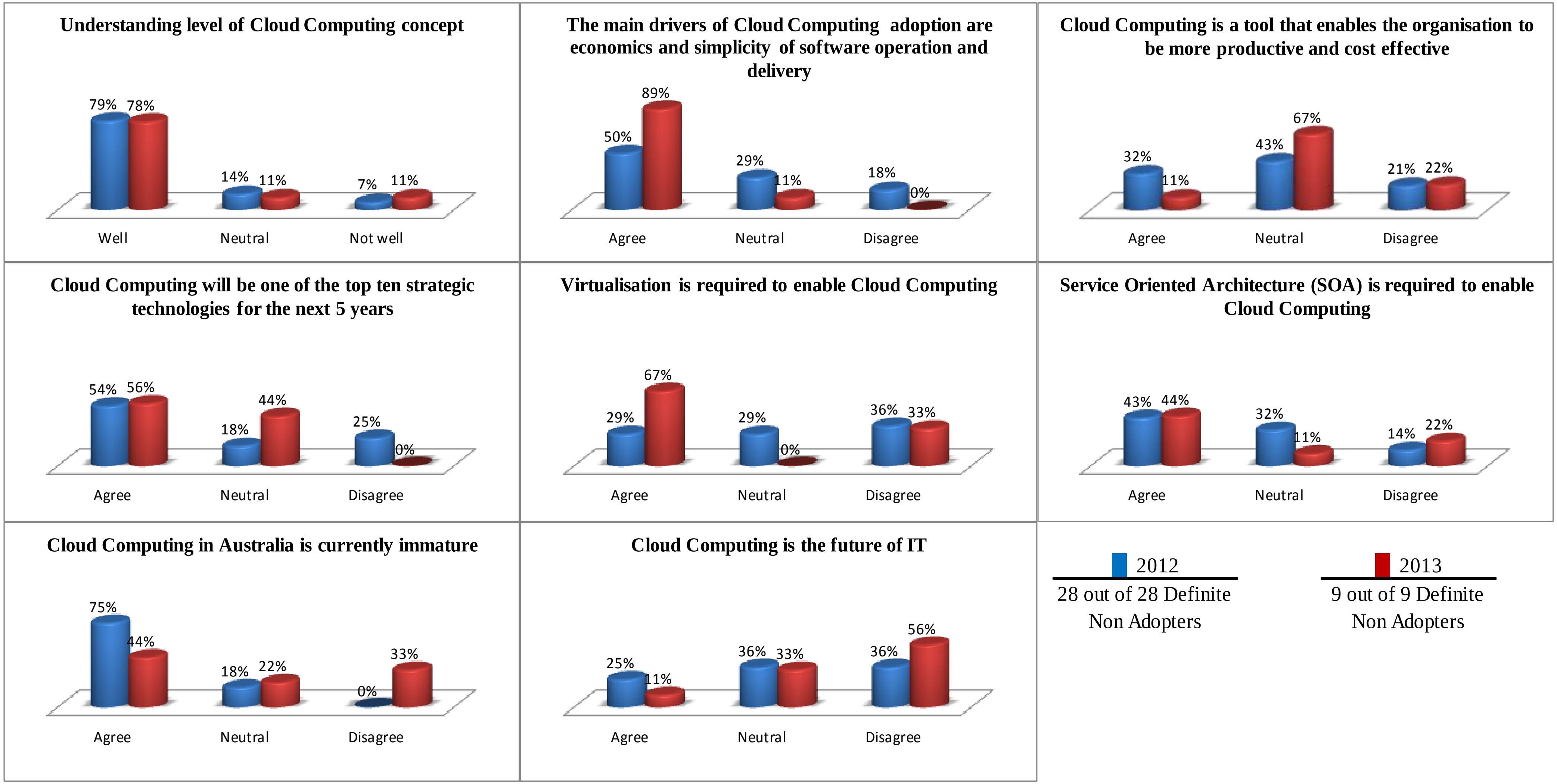


Figure 4.36: Beliefs of Definite Non-Adopters in 2012 and 2013

The results of ordered logistic regression analysis showed that there were only two statistically significant differences in Definite Non-Adopters' beliefs between 2012 and 2013, as shown in Table 4.30. In 2013, the agreement of Definite Non-Adopters in 2013 on that 'main drivers of CC adoption are economics and simplicity' were higher than those in 2012 (p=0.04). This belief increased dramatically from 50% (14 of 28) in 2012 to 89% (8 of 9) in 2013. This might indicate Definite Non-Adopters realised this information, which is consistent the reviewed literature (Erdogmu, 2009), later in 2013. The second difference, respondents of Definite Non-Adopters in 2013 had less belief that 'Cloud Computing in Australia is currently immature' compared with those in 2012 (p=0.04). This belief declined from 75% (21 of 28) in 2012 to 44% (4 of 9) in 2013. This indicated that Definite Non-Adopters believed that CC was becoming more mature over time. Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) cannot be made because there were only nine Definite Non-Adopters participated in the 2013 survey.

Table 4.30: Results of comparing Definite Non-Adopters' beliefs between 2012 and 2013

Belief	2012 vs 2013 (Don't Know were Excluded)				Number of Don't Know
	2012 Mean ± SD	2013 Mean ± SD	OR(95% CI)	p value	
Understanding level of CC	3.89 ± 0.79	4.00 ± 1.00	1.54 (0.34 to 6.96)	0.58	
Main drivers of CC adoption are economics and simplicity	3.33 ± 0.78	4.00 ± 0.50	10.51 (1.12 to 98.58)	0.04	1
CC is a tool to be more productive and cost effective	3.00 ± 0.96	2.89 ± 0.60	0.62 (0.16 to 2.42)	0.49	1
CC will be one of the top ten strategic technologies	3.44 ± 1.15	3.56 ± 0.53	1.04 (0.29 to 3.74)	0.96	1
Virtualisation is required to enable CC	2.88 ± 1.03	3.44 ± 1.13	2.94 (0.66 to 13.16)	0.16	2
SOA is required to enable CC	3.32 ± 0.75	3.29 ± 0.95	1.05 (0.20 to 5.57)	0.96	5
CC in Australia is currently immature	3.92 ± 0.56	3.22 ± 1.09	0.17 (0.03 to 0.89)	0.04	2
CC is the future of IT	2.78 ± 1.09	2.56 ± 0.73	0.63 (0.17 to 2.35)	0.49	1

* Data analysed using ordered logistic regression.
SD: Standard Deviation.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
28 observations in 2012 9 observations in 2013

4.4.3. Concerns

The reviewed literature identified many concerns associated with CC. However, it did not rank or even indicate the proportions of these concerns for Definite Non-Adopters. This study, however, identifies the top five concerns which formed obstacles limiting Definite Non-Adopters from adopting CC in the 2012 and 2013 surveys, as shown in Figure 4.37. The limitation in the number of participants for Definite Non-Adopters in the 2013 survey, however, prevented a statistical analysis of their concerns (see Table 4.31). These concerns varied between 78.6% (22 of 28) and 35.7% (10 of 28) of Definite Non-Adopters in 2012; and between 88.9 (8 of 9) and 33.3% (3 of 9) of the same category in 2013.

The common concerns in both surveys among the top five were security, loss of control, privacy and lack of trust with CSP, with 78.6% (22 of 28), 71.4% (20 of 28), 60.7% (17 of 28) and 60.7% (17 of 28) respectively in 2012; and 88.9 (8 of 9), 77.8% (7 of 9), 66.7% (6 of 9) and 55.6% (5 of 9) in the same respective manner in 2013. Although the rank of the top three concerns (security, loss of control and privacy) did not change, these were the only three concerns that increased in the 2013 survey - by 10.3%, 6.4% and 6% respectively - while all other concerns decreased in terms of both rank and proportion. This is similar to the situation with Cloud and Future Adopters. The only significant difference between this group of top concerns for the Definite Non-Adopters vs. the Cloud or Future Adopters is the inclusion of lack of trust with CSPs. It would be very interesting to discover just how significant this factor really is in dissuading organisations from adopting CC.

Some concerns in the 2013 survey were not originally listed in the 2012 survey. Bandwidth, cross border, usage costs, data sovereignty and performance problems were extracted from the results of the ‘Other’ option in the 2012 survey and occupied the third, fourth and fifth position, 66.7% (6 of 9), 55.6% (5 of 9), 55.6% (5 of 9), 44.4% (4 of 9) and 44.4% (4 of 9) respectively, in the 2013 survey. The small number of participants in this category in 2013 not only highlights the need to interpret their data very carefully, but adds to the case for subsequent qualitative research to enable deeper and more subjective analysis.

2012
28 out of 28 Definite Non Adopters

Rank	Concern	%	N
1	Security problems	78.6%	22
2	Loss of control	71.4%	20
3	Lack of trust with cloud service Providers Privacy problems	60.7%	17
4	Internet Outages Legal problems	39.3%	11
5	Recovery problems	35.7%	10

2013
9 out of 9 Definite Non Adopters

Rank	Concern	%	N
1	Security problems	88.9%	8
2	Loss of control	77.8%	7
3	Bandwidth problems Privacy problems	66.7%	6
4	Cross border problems Usage costs Lack of trust with cloud service Providers	55.6%	5
5	Data sovereignty Performance problems	44.4%	4
6	Internet Outages Legal problems Recovery problems	33.3%	3

Figure 4.37: Ranking response rate of the top 5 concerns of Definite Non-Adopters in 2012 and 2013

Table 4.31: Concerns of Definite Non-Adopters in 2012 and 2013

Concern	**2012** (28 out of 28 Definite Non-Adopters)	**2013** (9 out of 9 Definite Non-Adopters)
Security problems	22	8
Privacy problems	17	6
Availability problems with cloud service providers	4	3
Integration problems	9	2
Development problems	2	1
Recovery problems	10	3
Legal problems	11	3
Unsatisfactory Service Level Agreement	5	2
Quality problems	3	2
Organisational and cultural problems	5	3
Loss of control	20	7
Lack of trust with cloud service providers	17	5
Lack of service orientation	3	1
Insufficient skills in your organisation	2	2
Immaturity of technology	7	2
Internet Outages	11	3
Bandwidth problems	-	6
Cross border problems	-	5
Data sovereignty	-	4
Government legislation	-	2
Performance problems	-	4
Usage costs	-	5

This chapter has focused on *changes occurring within each category* during the study, yet it is also important to investigate the *differences between these categories within each survey* to provide an orthogonal view of the data and offer some analytic triangulation. Chapter 5 will therefore provide this alternative angle of data analysis and will include a third perspective for analysing the data by applying Diffusion of Innovation Theory and Crossing the Chasm Theory to the findings of each survey. These three dimensions of analysis enrich the understanding of CC uptake in Australia.

Chapter 5
Data Analysis

5. Data Analysis

This chapter contains the second empirical component of this Thesis. It analyses the data gathered in both surveys from two different perspectives.

The first analysis dimension compares the four respondent categories (Cloud Adopters[4], Future Adopters, Undecided Non-Adopters and Definite Non-Adopters). This comparison articulates the similarities and differences between these categories *within each survey* where applicable. For example, respondents from all categories were asked about CC adoption, demographic, beliefs and concerns, which will be discussed in Section 5.1, whereas only Cloud Adopters and Future Adopters were asked about adoption date, importance of expected benefits and usage of CC, which will be analysed in Section 5.2. Thus, the comparison will be between responses from participants in each of the categories who answered specific questions. However, questions relating to realised benefits and experiences with CC will not be discussed here because they have already been discussed in Chapter 4.

In the second analysis dimension, the theories which underpinned this study – Diffusion of Innovation Theory and Crossing the Chasm Theory - will be applied in Section 5.3 after taking into the account the proportions of Past Adopters in both surveys. Since these theories are only applicable to those who were adopting or willing to adopt CC, the Current and Future Adopters will be divided into alternative categories according to the theories. Then, a comparison between these theoretical categories in terms of the

[4] Cloud Adopters were formed by combining Current and Past Adopters, since there was insufficient number of Past Adopters to represent their category in the statistical analysis (only four Past Adopters in each survey).

diffusion of CC will be discussed. After that, the attributes of CC as an innovation will be applied followed by the stages of adoption process of all theoretical categories.

5.1. Comparison between Cloud Adopters, Future Adopters, Undecided and Definite Non-Adopters

5.1.1. Adoption

The 2012 survey indicated that 47.9% of all responding organisations (187 of 390 respondents) were using CC (Cloud Adopters) at the time of the survey, while those who expected their organisations to adopt CC in the near future (Future Adopters) formed 16.4% (64 of 390 of respondents), as illustrated in Figure 5.1. Those who had not yet decided whether to adopt CC (Undecided Non-Adopters) made up 28.5% (111 of 390 of respondents) and those who had definitely decided not to adopt CC (Definite Non-Adopters) formed 7.2% (28 of 390 of respondents).

The 2013 survey showed that the proportion of Cloud Adopters had increased by 10% to from 57.9% of all responding organisations (99 of 171 respondents). Future Adopters made up a very similar percentage as in 2012, with 15.2% (26 of 171 of respondents). However, the proportion of Undecided Non-Adopters decreased by 7% to 21.6% (37 of 171 of respondents). This reduction benefitted Cloud and Future Adopters, because Definite Non-Adopters also declined slightly by 1.9% to form only 5.3% (9 of 171of respondents). These changes were consistent with the levels of popularity and rapid growth of CC noted in commercial surveys (Banks, 2011, Dutt, 2012, Barwick, 2013b, Research and Markets, 2013).

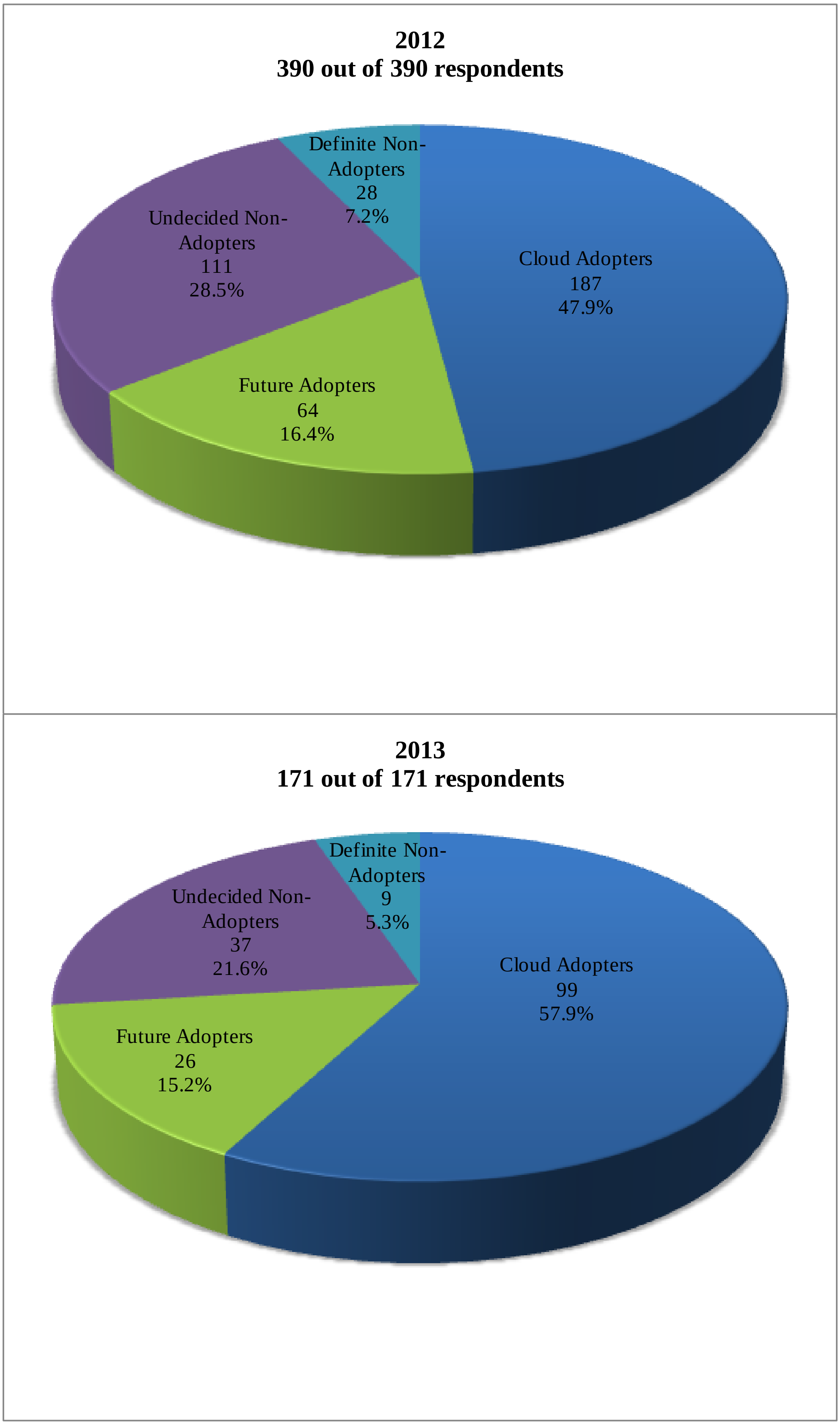


Figure 5.1: Categories of respondents in 2012 and 2013

5.1.2. Demographic Profile

5.1.2.1. Industry Sectors

The participants in both surveys were asked to indicate the industry sector to which their organisation belonged from a range of 24 industry sectors. However, some industry sectors were selected by few or no participants in both surveys. Therefore, these industry sectors were combined into more compact groups – ultimately reduced to seven combined industry sectors to enable the application of logistic regression analysis, as presented in Table 5.1.

Table 5.1: Combined industry sectors

Combined Industry Sector	Individual Industry Sector
Manufacturing & Goods Distribution	Wholesale/Distribution
	Retail
	Manufacturing
Services	Services
	Transportation
	Media
	Tourism
	Research/Consulting
	Utilities
Healthcare & Education	Healthcare
	Education
Finance & ICT	Telecommunication
	Financial
	Information Technology
Government	Government
Resources & Construction	Construction
	Engineering/Aerospace
	Mining
	Energy
Other	Not For Profit
	Real Estate
	Agriculture
	Fishing
	Other

The results of the 2012 survey showed that the healthcare & education, services and finance & ICT sectors were the top three combined industry sectors for Cloud Adopters, with 19.8% (37 of 187), 17.1% (32 of 187) and 16% (30 187) respectively, as shown in Figure 5.2.

This grouping of industry sectors had some effect on sector ranking. Although healthcare & education and finance & ICT continued to hold the same ranking (first and third) of the combined industry sectors for Future Adopters (though with different proportions), manufacturing & goods distribution replaced the services sector and became the second largest combined industry sector, with 20.3% (13 of 64) of Future Adopters.

In addition, this combined industry sector was also the biggest group in both: Undecided and Definite Non-Adopters, with 22.2% (25 of 111) and 35.7% (10 of 28) respectively.

These findings suggest that healthcare & education, services; and finance & ICT were the earliest organisations to adopt CC, followed by manufacturing & goods distribution organisations – although this sector was heavily represented among respondents least likely to adopt CC.

Only qualitative data gathering will clarify why respondents from the manufacturing & distribution sector, well represented in the Future Adopters group, were also so highly ranked among the Undecided Non-Adopters and the Definite Non-Adopters – though a possible explanation might well be the need for rapid data access by companies which run significant numbers of real-time applications and thus hesitated to place data in the (at that time) relatively untested cloud.

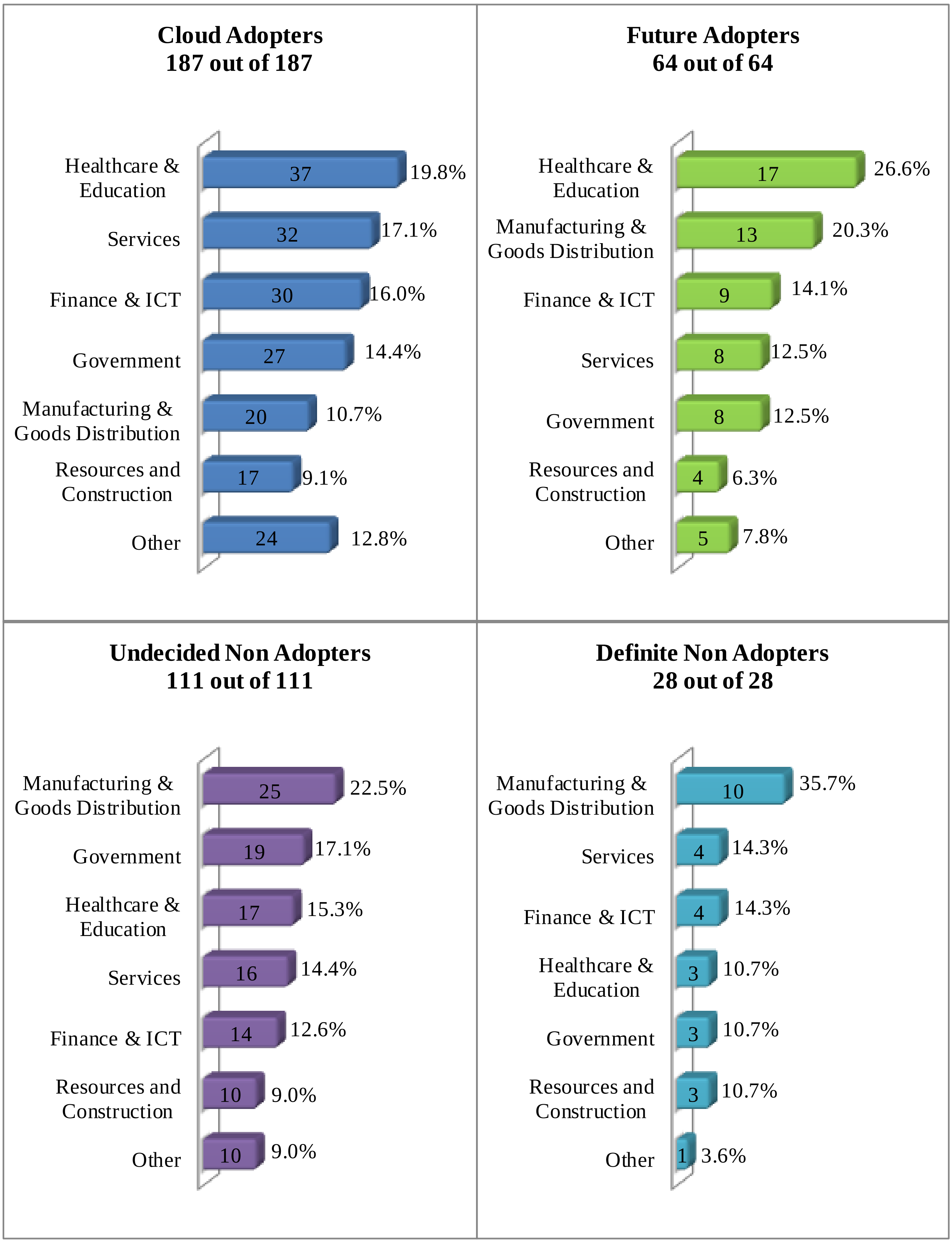


Figure 5.2: Ranking industry sectors of all respondents' categories in 2012

By contrast, most of the Cloud Adopters respondents in 2013 were from the manufacturing & goods distribution combined industry sector, followed by the finance & ICT and government sectors, with 22.2% (22 of 99), 17.2% (17 of 99) and 15.2% (15 of 99) respectively, as illustrated in Figure 5.3.

Almost the same number of respondents from all combined industry sectors expected to adopt CC in the near future. Manufacturing & goods distribution and government were the largest two sectors of the Undecided Non-Adopters, with 24.3% (9 of 37) and 21.6% (8 of 37) respectively.

There was no resistance to adopting CC from the government sector which is consistent with the Australian Federal Government's cloud policy which states that agencies "*must adopt cloud where it is fit for purpose, provides adequate protection of data and delivers value for money*" (Department of Finance, 2014b, Cowan, 2014b). However, there were some government agencies not yet undecided about whether to adopt CC; and this became the second major industry sector in the Undecided Non-Adopters.

Although it is quite possible that respondents from the manufacturing & goods distribution combined industry sector had become more confident about the reliability and response times of CC by 2013, the situation is rendered more complex when we see that finance & ICT was the major combined sector deciding not to adopt CC in 2013! This leads to a further analysis that compares between these categories within each combined industry sector and investigates the situation in more detail.

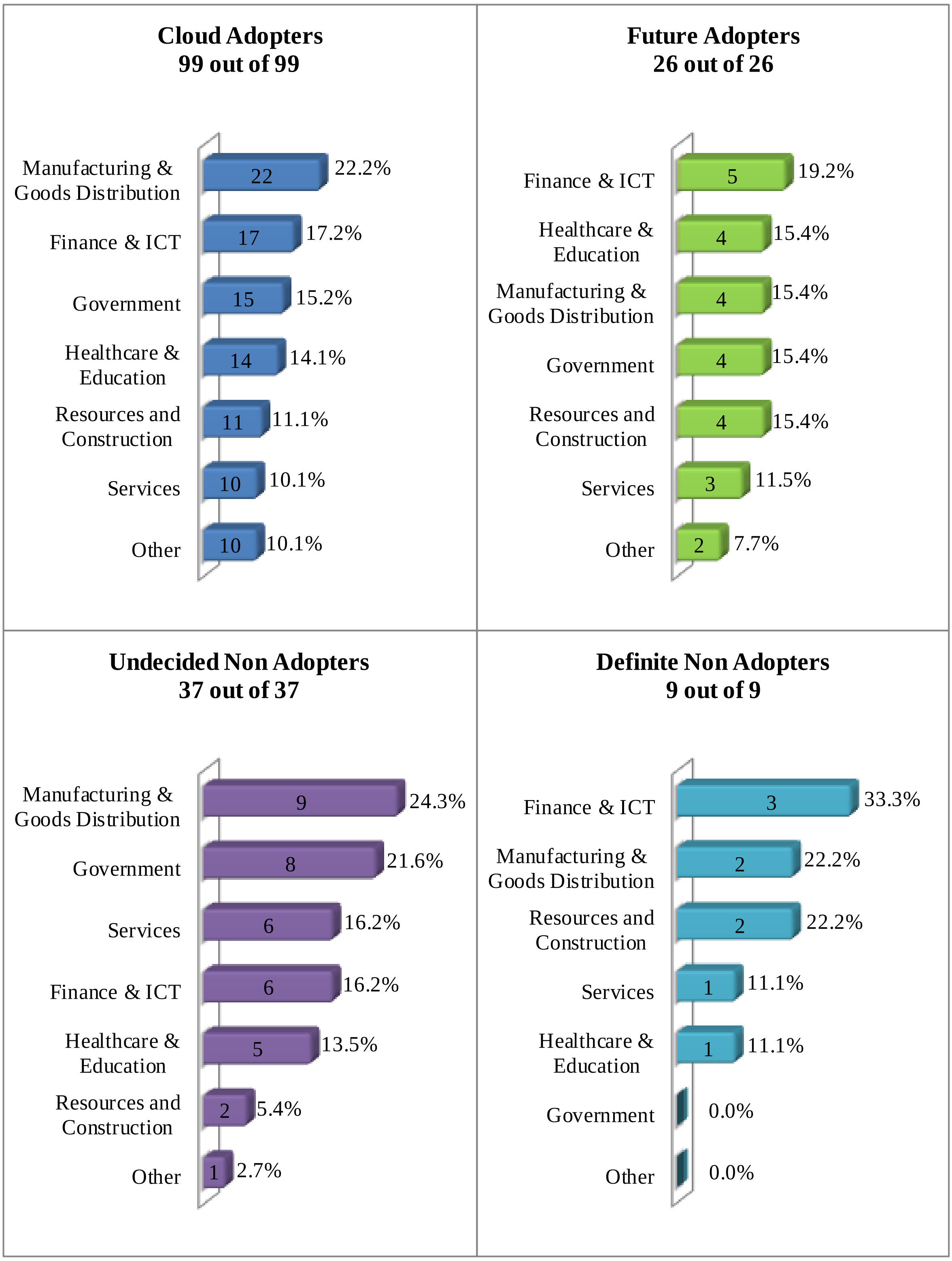


Figure 5.3: Ranking industry sectors of all respondents' categories in 2013

This comparison showed that, in 2012, approximately half the respondents from each combined industry sector indicated they had adopted CC, except for respondents from the manufacturing & goods distribution sector, who indicated that only around 25% of their organisations had adopted CC, as shown in Figure 5.4.

However, in 2013 the adoption of CC by the manufacturing & goods distribution sector increased dramatically compared with the other combined sectors, which increased steadily. This added support to the finding that the manufacturing & goods distribution sector followed the adoption trend of CC after the other combined industry sectors. Since some combined industry sectors (e.g. healthcare & education, services and finance & ICT) are essentially software-based industries, they are likely to be less dependent on real-time systems and thus have less to lose should a move to the cloud slow their Just-in-Time delivery systems down.

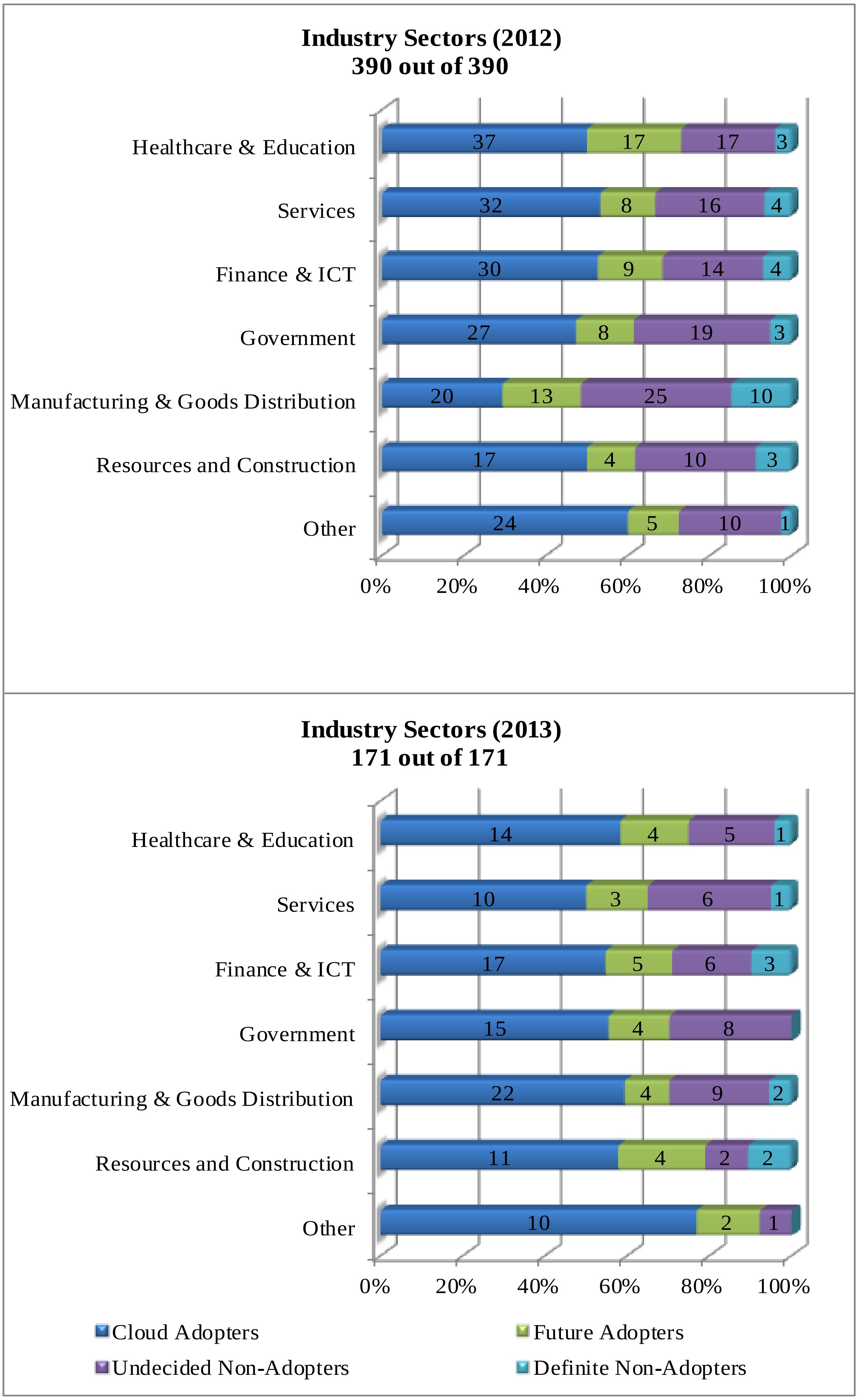


Figure 5.4: Proportions of all respondents' categories within each industry sector

5.1.2.2. Location of Respondents

All respondents in both surveys were asked to identify the States in which their organisation and its branches were located. They were able to select one out of 8 States, or multiple States where this was relevant. Therefore, the responses in terms of State location were grouped into single or multi-State organisations to enable the application of logistic regression analysis.

The results of the 2012 survey showed that participants from both single and multi-State organisations had adopted CC almost equally, as presented in Figure 5.5. Approximately, 58% (37 of 64) of Future Adopters were from single State organisations, while they formed 67% (74 of 111) and 75% (21 of 28) of both Undecided and Definite Non-Adopters, respectively.

In 2013 the proportions of single State organisations among both Cloud and Future Adopters increased slightly whereas they decrease marginally for both types of Non-Adopters. This may indicate that multi-State organisations started to adopt CC before single State which showed resistance from adopting CC. Then, single State organisations followed the CC adoption trend later. Although single State organisations adopted and expected to adopt CC more than multi-State organisations in 2013, single State organisations were still the main resistors of CC adoption. This leads to a further analysis that compare between all categories within each of single and multi-State group.

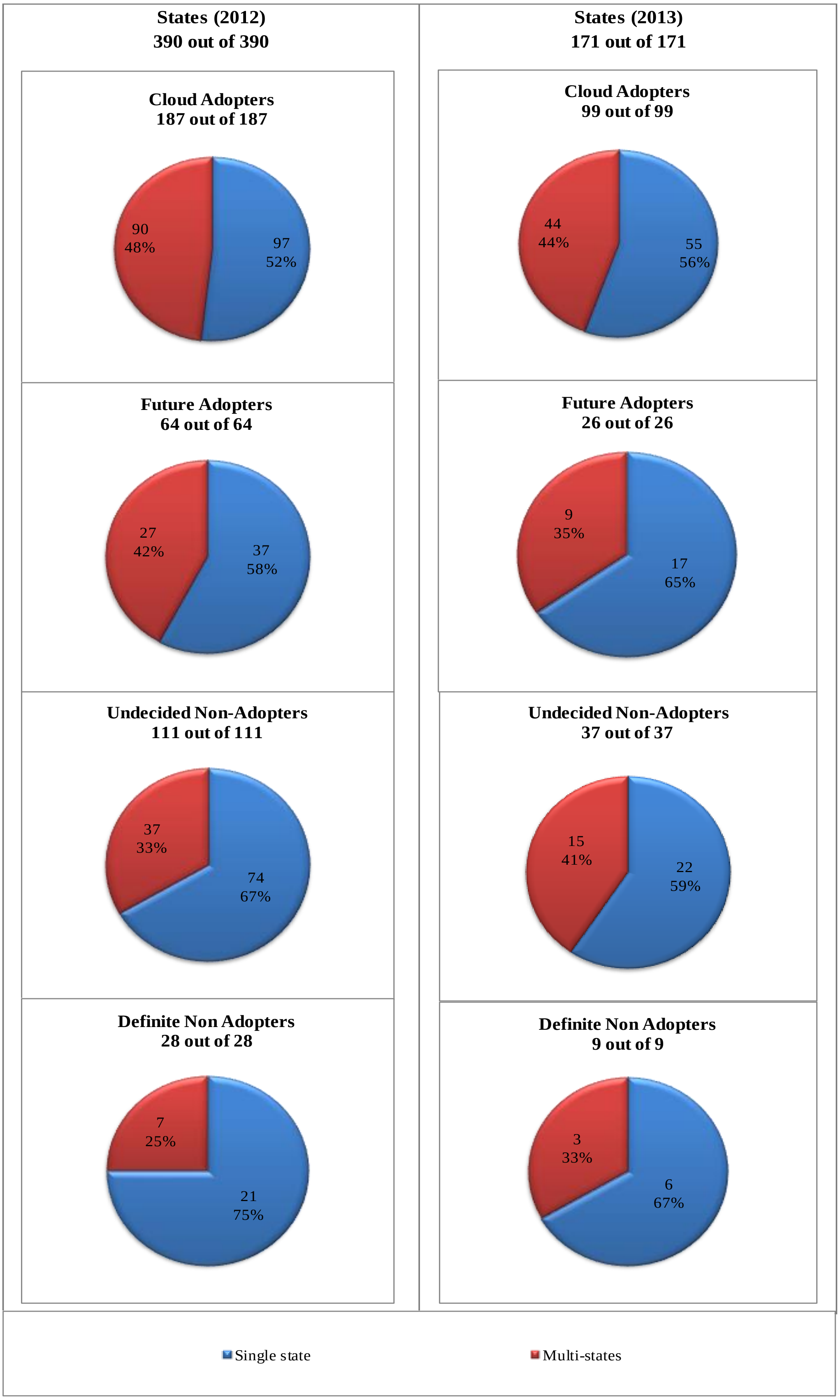


Figure 5.5: Proportions of single and multi-State organisations for all respondents' categories

The comparison showed that multi-State organisations adopted CC more than single State organisations in 2012, as illustrated in Figure 5.6. However, in 2013, single State organisations closed the gap in terms adoption and presented a further expectation to adopt CC. This result supported the assumption that stated multi-State organisations started to adopt CC then followed by single State organisations which showed more resistance at the beginning.

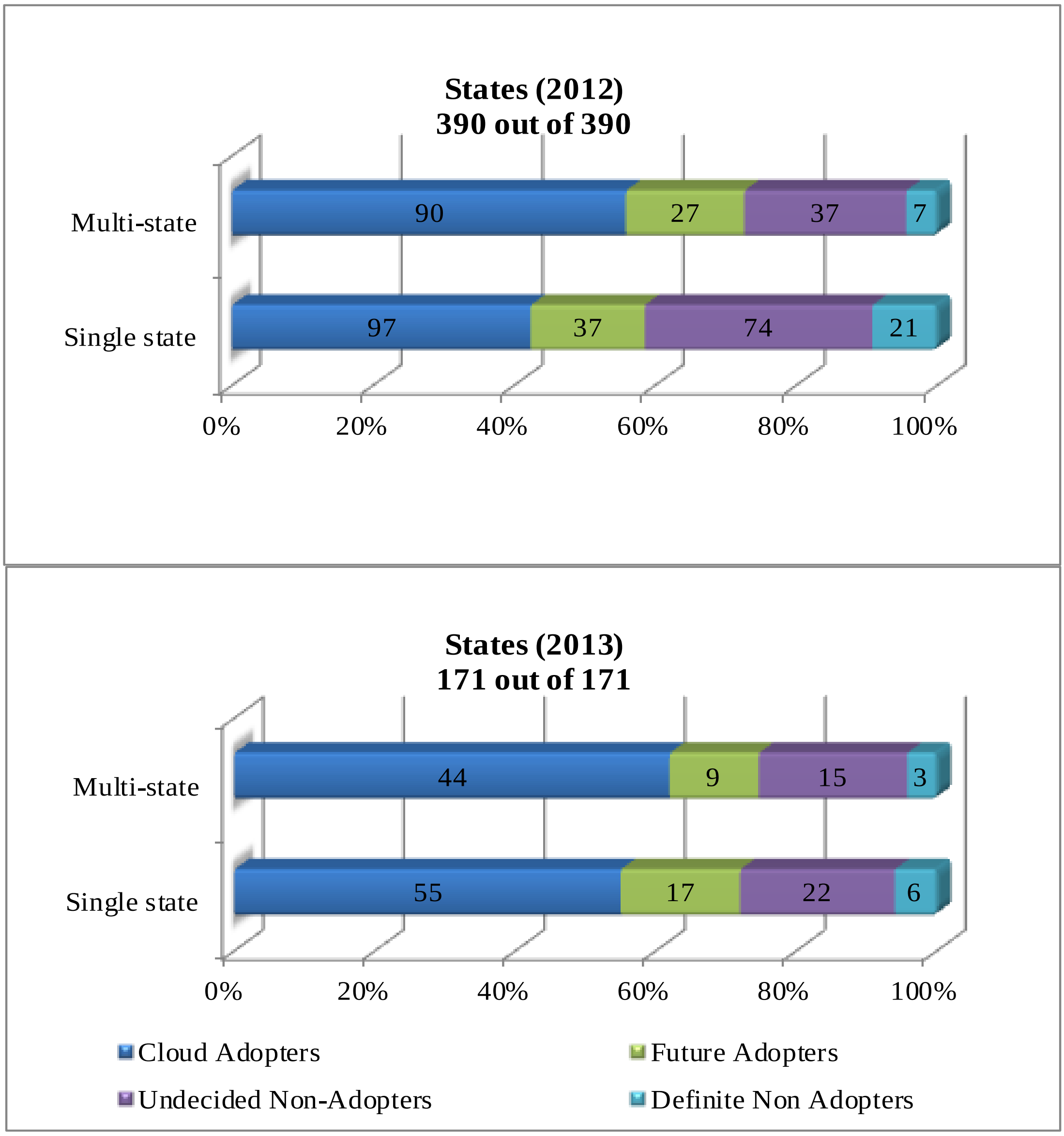


Figure 5.6: Proportions of all respondents' categories within single and multi-State group.

A further analysis was undertaken to rank and identify the proportions of each State within single State organisations. The 2012 participant responses showed that NSW was the major location for single State organisations in all categories, followed by VIC, except in the case of Definite Non-Adopters – as shown in Figure 5.7. The majority of single State Definite Non-Adopters came from VIC, followed by NSW. QLD was the third major single State location for Cloud Adopters, Future Adopters and Undecided Non-Adopters and occupied the fourth place for Definite Non-Adopters. These results match population figures rather neatly, suggesting that single State respondents to the 2012 survey were distributed similarly to the national pattern.

Although single State Cloud Adopters respondents from SA and TAS came fifth and sixth overall, respondents from these States were second in terms of Future Adopters. This may indicate that companies from these States were a little slower to adopt CC than firms from the three most populous States of (NSW, VIC, and QLD) and, again, this finding is consistent with other industry figures (see, for example, Australian Bureau of Statistics (2015b)).

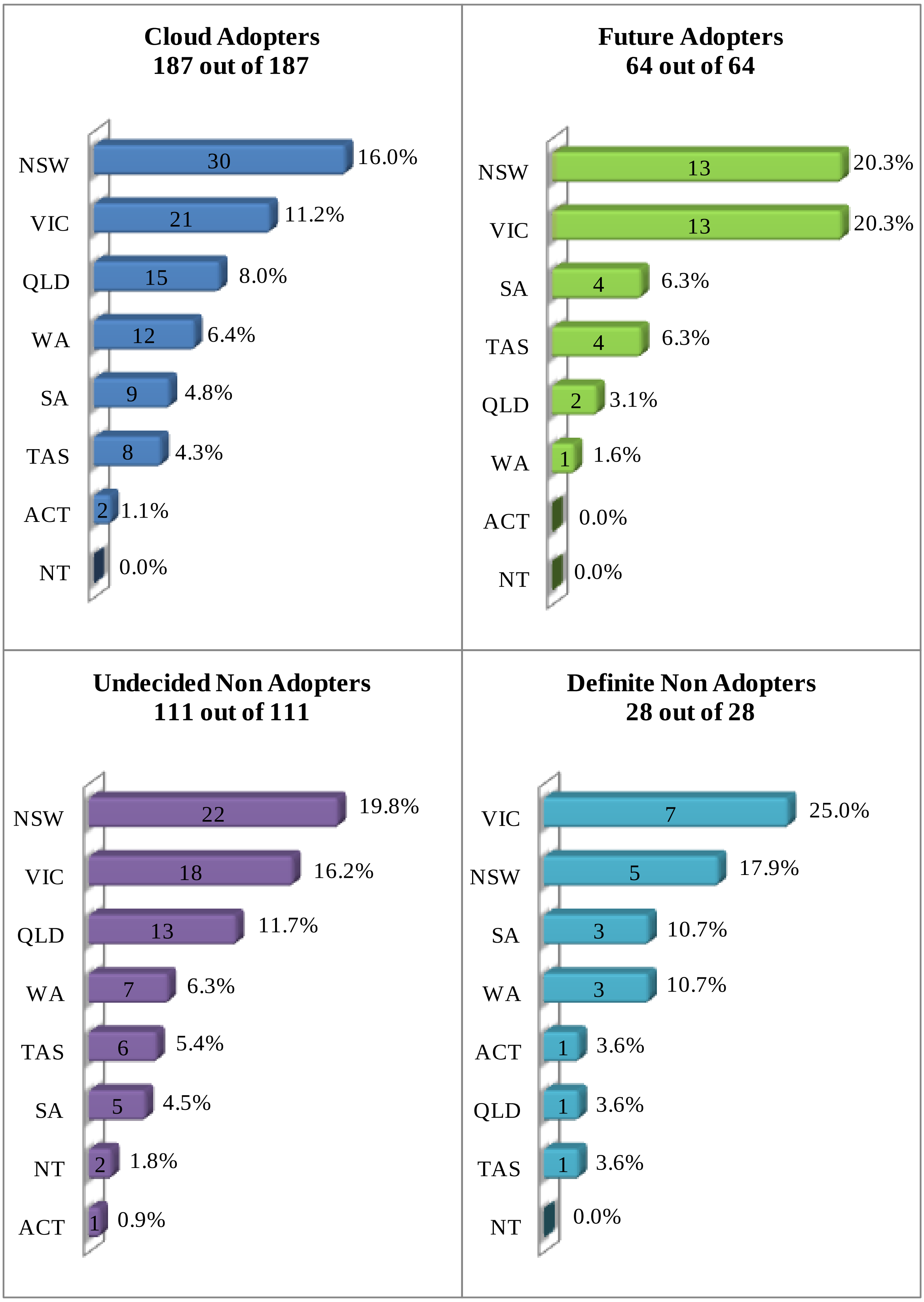


Figure 5.7: Ranking states of single state organisations for all respondents' categories in 2012

In contrast to the 2012 findings, single State NSW respondents in the Future Adopters group were the third highest ranked in 2013, although NSW had, as usual, the highest number of respondents in all other categories of single State respondents, as shown in Figure 5.8. Whether this indicates that many single State NSW firms have already adopted CC (thus limiting the number of those still to adopt), or whether this is merely a statistical anomaly associated with the relatively small number of responses to this survey is not clear.

Interestingly, TAS respondents moved up to third place among single State organisations for Cloud Adopters and WA respondents moved to second place for all categories except that of Cloud Adopters. These results clearly require further analysis to compare all categories within each State of single State organisations to identify the real situation. Possible explanations include: variation in the types or industry sectors of organisations responding to the survey so that more (or less) CC-oriented respondents took the place of less (or more) interested respondents from 2012 or, possibly, simple statistical anomaly associated with respondents numbers.

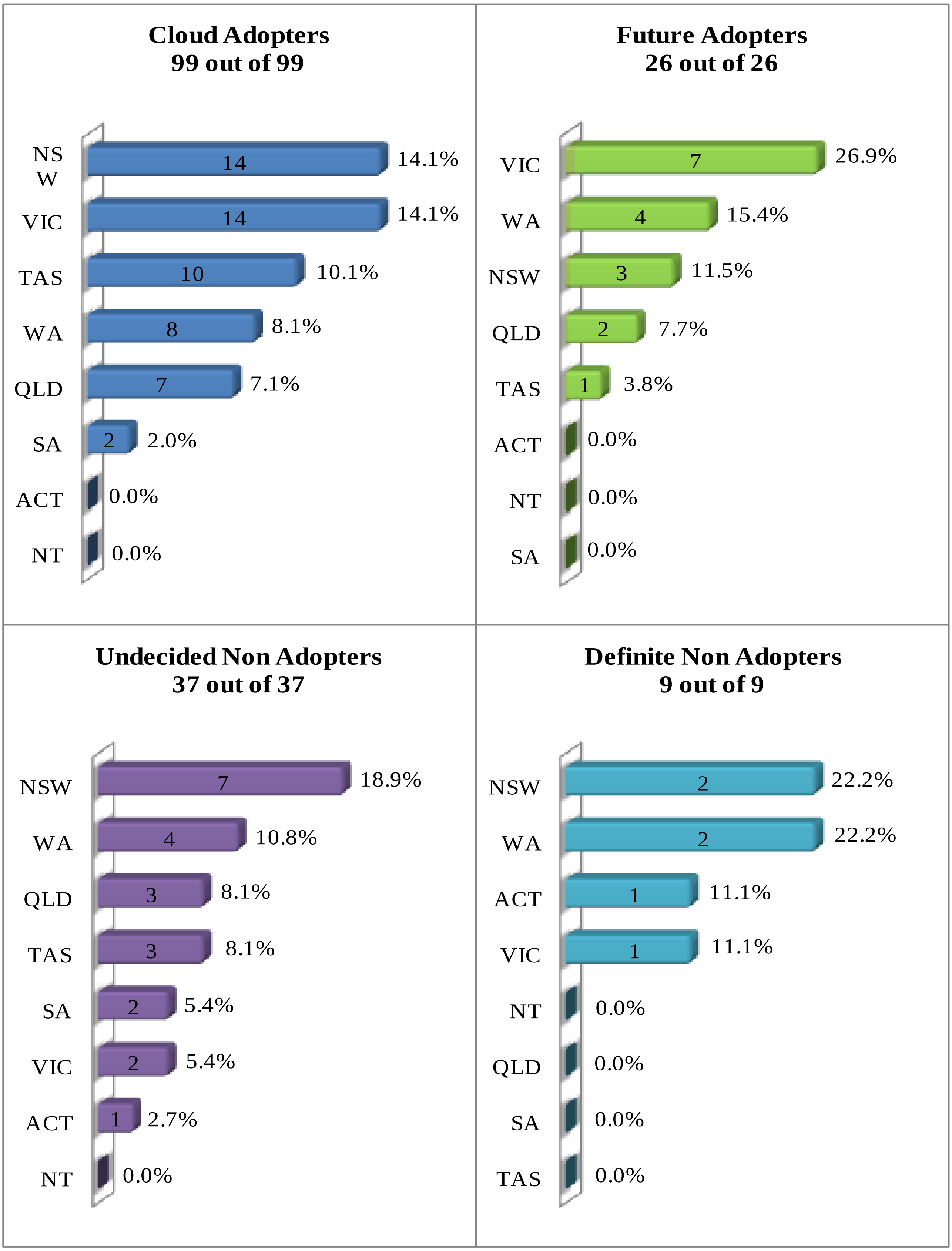
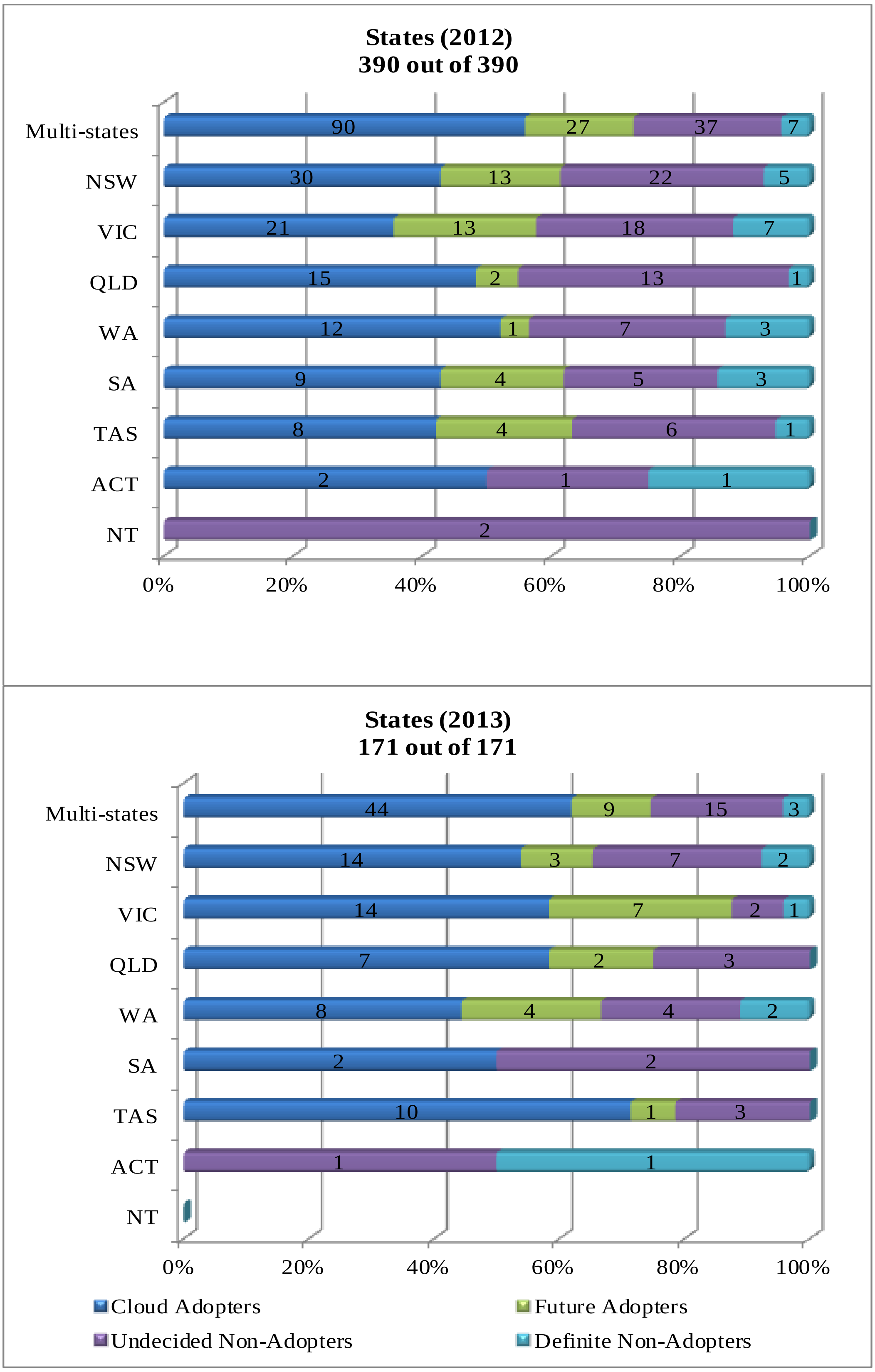


Figure 5.8: Ranking states of single state organisations for all respondents' categories in 2013

If we consider adopters in terms of their interest in adopting CC by State (as shown in Figure 5.9), approximately half of all multi-State respondents and respondents from WA had adopted CC by 2012, with respondents from other States less likely to have already adopted CC. VIC was the location in which single State organisations were least likely to have adopted CC, with only 35.6% (21 of 59) of the single State group being Cloud Adopters. By 2013, however, this situation had changed significantly! Victorian single State organisation respondents now made up 58.3% (14 of 24) of the (considerably smaller) sample.

These results, in fact, suggest an overall increase of uptake among single State respondents – although the decline in response numbers makes it a little more difficult to be sure whether respondents from less populous States (such as Tasmania) were really experiencing the significant increase in CC adoption Figure 5.9 seems to indicate. Industry reports do, indeed, suggest that CC was becoming more popular across the country – but these figures should be seen as indicative, rather than representative, until further investigation can drill down into the experiences of Australia’s smaller States.



* ACT and NT in both years and SA in 2013 were not be taken into account because they had insufficient number of responses (all<5)

Figure 5.9: Proportions of all respondents' categories within each state of single state organisations and multi-states

5.1.2.1. Size of Responding Organisations

The participants in both surveys were asked to indicate the number of employees working in their organisation out of 11 options, but some of these organisation sizes were indicated by few or even no responses in both surveys. Therefore, this number of organisation sizes was reduced to five combined organisation sizes to enable the application of logistic regression analysis, as presented in Table 5.2.

Table 5.2: Combined organisation sizes

Combined Organisation Size	Individual Organisation Size
Less than 101	Under 5
	5-10
	11-20
	21-50
	51-100
101-499	101-200
	201-499
500-999	500-999
1000-4999	1000-4999
More than 4999	5000-10000
	More than 10000

The results of the 2012 survey showed that organisations with 101–499 employees were the biggest group in all categories of Cloud Adopters, as shown in Figure 5.10.

Organisations with fewer than 101 employees came second-last among Cloud Adopters but were first or second in all other categories. At the other end of the scale, organisations with 1000–4999 employees were the second largest group of respondents within Cloud Adopters and Definite Non-Adopters, but came third within Future Adopters and Undecided Non-Adopters.

These findings are consistent with general perceptions: large corporations are generally considered likely to adopt CC well ahead of small (especially very small) firms.

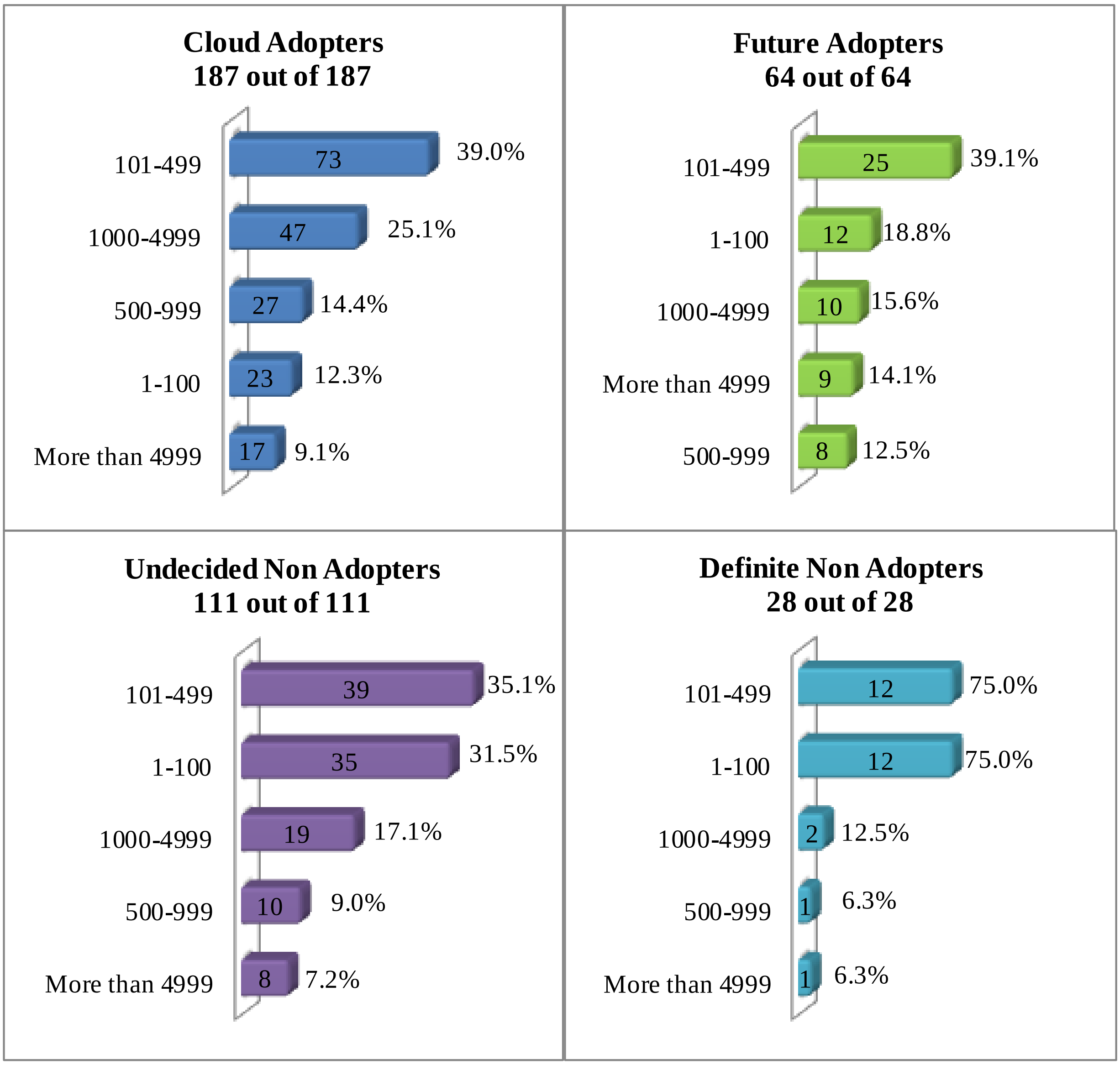


Figure 5.10: Ranking organisation sizes for all respondents' categories in 2012

By 2013 organisations with 101–499 employees were still the largest group of Cloud Adopters and Undecided Non-Adopters, but had dropped to second place among Future Adopters and Definite Non-Adopters as illustrated in Figure 5.11. The largest category within Future Adopters was now organisations with 1000–4999 employees, which might be indicative of increasing corporate acceptance of CC over the period between the surveys.

Organisations with fewer than 101 employees were still the major group of Definite Non-Adopters, which may indicate that medium and large organisations were continuing to lead CC adoption while smaller organisations resisted adopting CC. However, more detailed analysis was required to compare all categories within each organisation size group and investigate the reality of these assumptions.

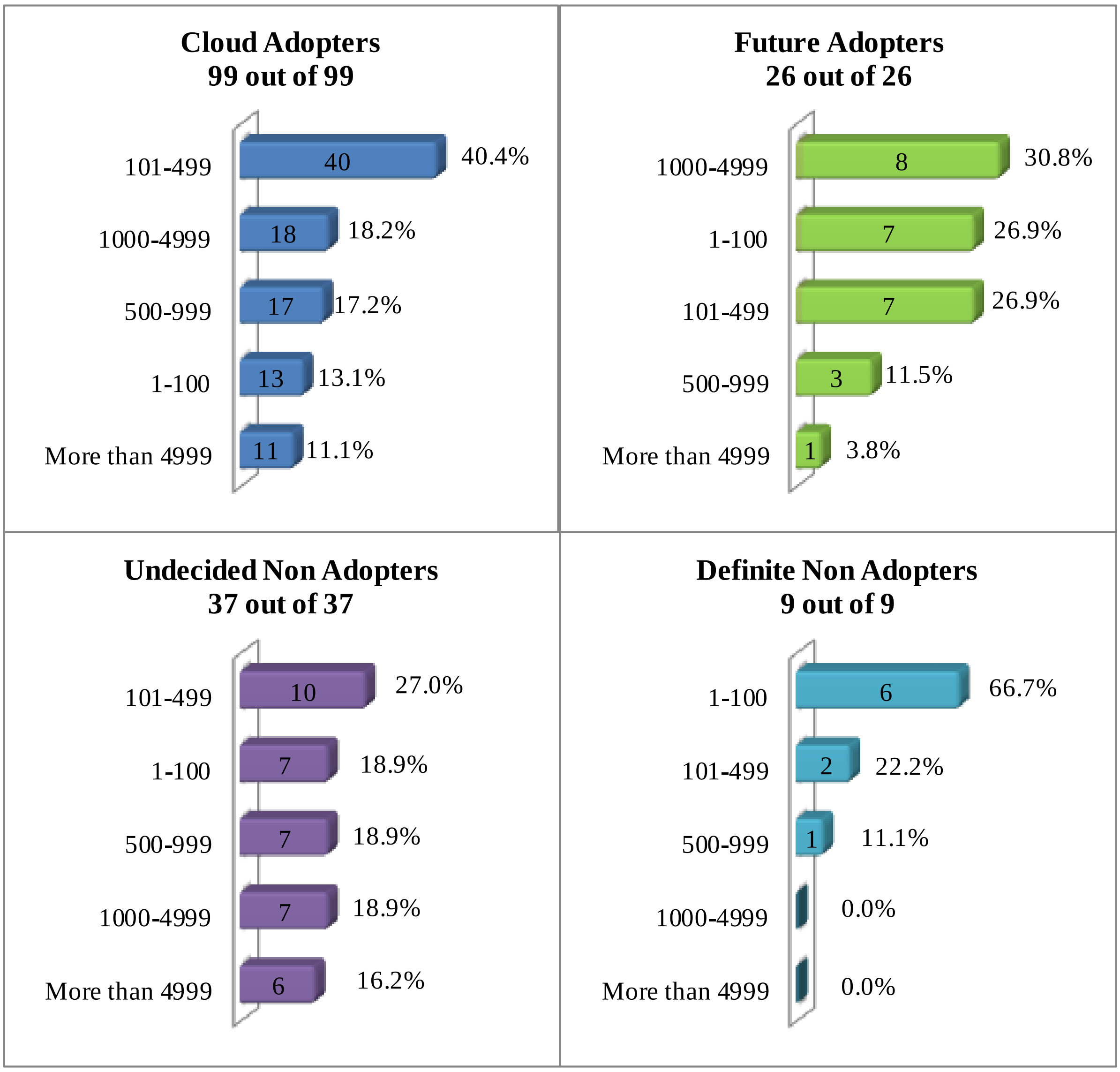


Figure 5.11: Ranking organisation sizes for all respondents' categories in 2013

The results of this comparison showed that medium-to-large organisations with 500–4999 employees were leading the adoption of CC in 2012, as shown in Figure 5.12. By 2013, however, small-to-medium organisations with 101–499 employees were showing significant levels of CC adoption and were, in fact, the group with the highest level of adoption among all respondents.

Organisations with fewer than 101 employees, not surprisingly, had the least proportion of CC adoption. These findings provided further support to the 2012 findings suggesting that medium and big organisation sizes were leading adoption of CC while smaller organisations had the highest resistance from this adoption.

Relatively sound financial status and professional IT teams in big and medium size organisations may well play role in accelerating the adoption of innovative technologies such as CC to meet a firm’s business requirements. It would be interesting to investigate these findings further to discover whether it is purely an organisation’s size which makes it more likely to adopt CC – or whether there are more subtle reasons for this choice.

Figure 5.12: Proportions of all respondents' categories within each organisation size

5.1.2.2. Job of Respondents

Respondents were asked for their job title to validate the responses of participants because these surveys were directed to those employed in IT management: including IT Managers, CIOs, Network Managers and Technical Support Managers. Respondents from these occupations are not only more likely to use CC but are also able to provide more detailed and accurate responses as they have better understanding of the questions included in these surveys. The results of both surveys showed that more than 81% of participants belonged to the target group, as shown in Figure 5.13.

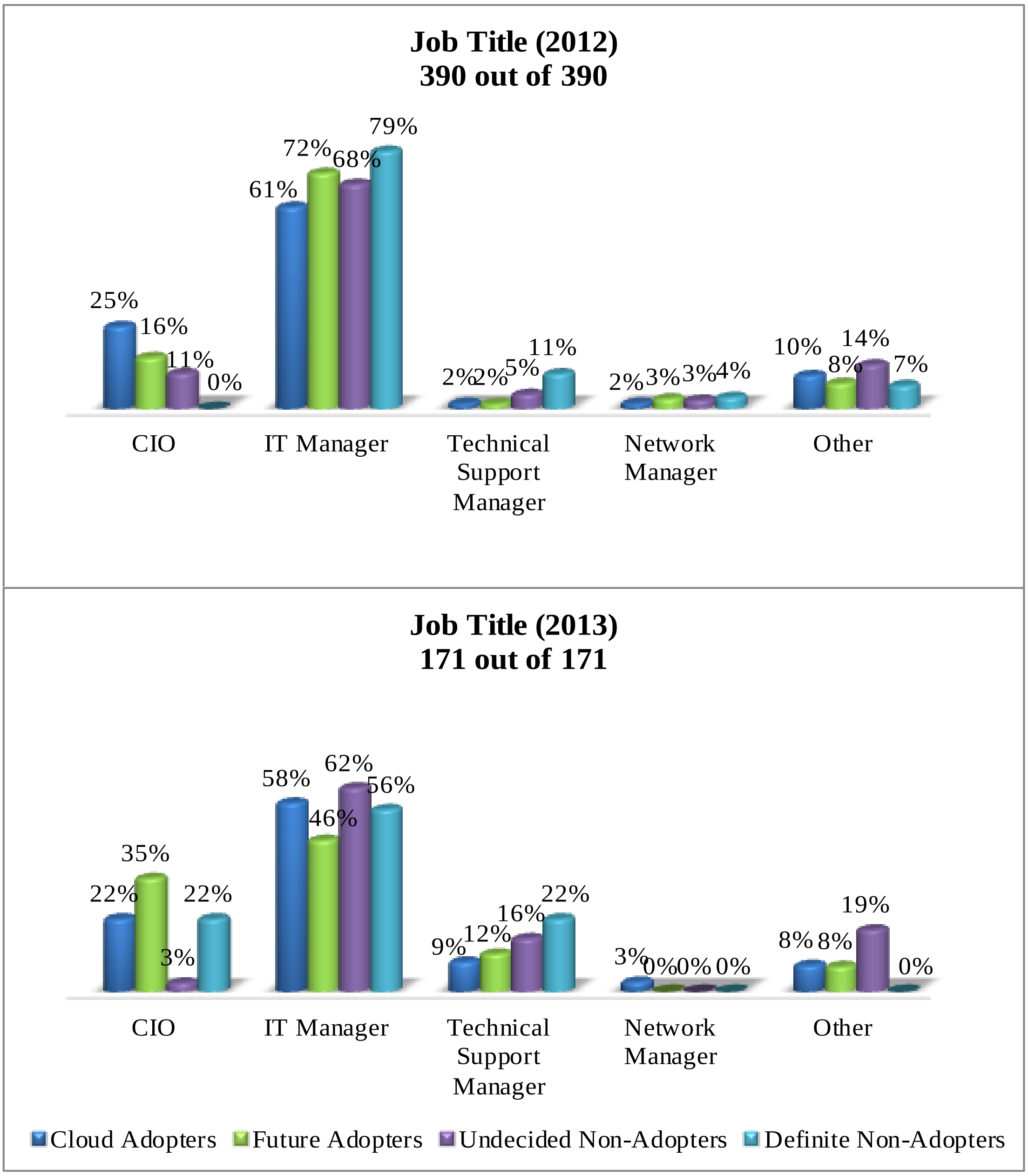


Figure 5.13: Proportions of job tiles for all respondents' categories

5.1.3. Beliefs

The beliefs of respondents from all categories towards CC in 2012, after excluding 'don't know' answers, are illustrated in Figure 5.14. Between 78% and 97% of all categories' respondents indicated that they understood the concept of CC, in contrast to the reviewed literature which had suggested considerable uncertainty and confusion over the concept of CC among Australian CIOs over the past 4-5 years (Kotadia, 2010, Macquarie Telecom, 2011). This finding suggested either that the literature is over-stating confusion about the concept of CC – or that this topic is becoming better understood over time. More than half the respondents in each category agreed that 'the main drivers of CC adoption are economics and simplicity of software operation and delivery', 'Cloud Computing will be one of the top ten strategic technologies for the next 5 years' and 'Cloud Computing in Australia is currently immature'. These beliefs were consistent with the reviewed literature (Linthicum, 2010a, Gartner, 2010, Australian Government Information Management Office, 2011, Motta et al., 2012) although the level of agreement varied across categories.

The most significant difference in agreement levels between categories was 44%, relating to belief that 'Cloud Computing is the future of IT': agreement with this statement varied from 25% to 69% across all categories.

The greatest consistency in agreement between all categories was 15% and related to the statement 'Virtualisation is required to enable Cloud Computing' (although it should be noted that levels of agreement with this statement were relatively low in all cases). Although the reviewed literature indicated two CC enablers: virtualisation (Linthicum, 2010a, O'Driscoll et al., 2013, Rimal and Choi, 2012, Mancini et al., 2009) and SOA (Banerjee et al., 2012, Murah, 2012, Wang et al., 2008, Linthicum, 2010a), the average agreement with each of these was 'neutral' for all categories. This could indicate either genuine disagreement with these statements or that respondents were not sufficiently familiar with the technologies and techniques underlying CC to grasp the importance of virtualisation and SOA for effective deployment of CC. Future qualitative research might provide an answer to this question.

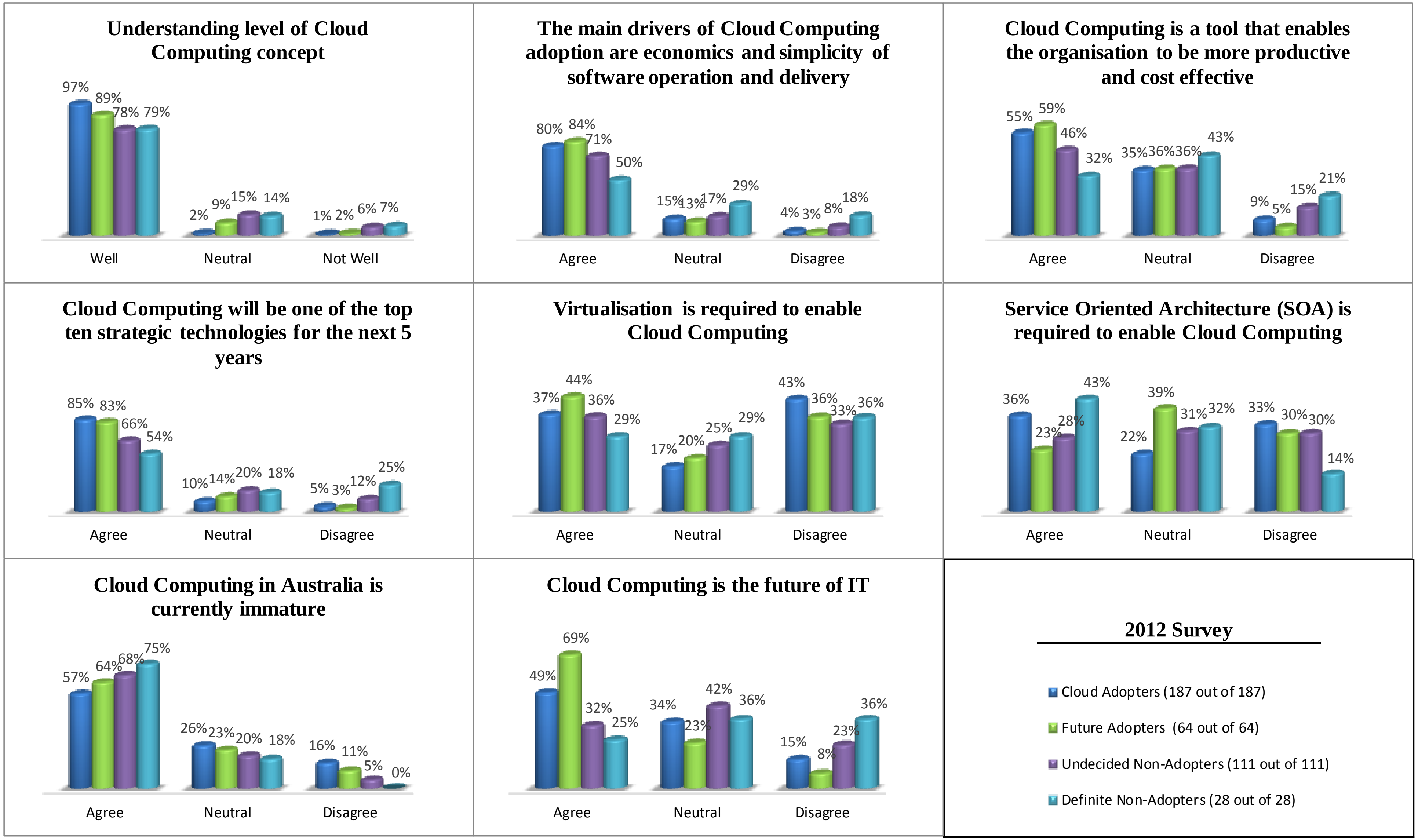


Figure 5.14: Beliefs of all respondents' categories in 2012

Identifying the statistical differences in beliefs across categories of Cloud Adopters requires a comparison between an individual category and all other categories. Cloud Adopters, as the largest group in each survey, was therefore selected for comparison against each category. This approach was applied in all statistical comparisons between all categories in this Chapter.

The results of ordered logistic regression analysis showed statistically significant differences between the beliefs of all categories compared with Cloud Adopters, as shown in Table 5.3. Adjusting the analyses for demographic covariates (industry sectors, State and organisation size) did not change these results.

Respondents from all other categories had lower levels of belief that they 'understood the concept of CC' than did respondents who were Cloud Adopters (all $p<0.045$). Approximately 97% (182 of 187) of Cloud Adopters showed that they understood CC compared with 89% (57 of 64) of Future Adopters, 78% (87 of 111) of Undecided Non-Adopters and 79% (22 of 28) of Definite Non Adopters. The most likely explanation for this finding is that Cloud Adopters had better understanding of CC than other groups because they were the only group that had used and/or were using this technology at the time of the survey.

Participants from the Undecided and Definite Non-Adopters groups had lower levels of belief that 'CC is the future of IT' than did the Cloud Adopters (all $p<0.025$), but were themselves less likely to believe this statement – 49% (92 of 187) ($p<0.025$) – than respondents from Future Adopters. 69% (44 of 64) of Future Adopters, 32% (36 of 111) of Undecided Non-Adopters and 25% (7 of 28) of Definite Non Adopters agreed on that 'CC is the future of IT'. Future Adopters are, of course, likely to be more enthusiastic about CC than non-adopters – but it is interesting that they were even more enthusiastic than Cloud Adopters.

Respondents from the Undecided and Definite Non-Adopters were less inclined to believe that the 'main drivers of CC adoption are economics and simplicity', 'CC is a tool to be more productive and cost effective' or 'CC will be one of the top ten strategic technologies' than respondents from Cloud Adopters (all $p<0.055$).

Undecided Non-Adopters were more likely to believe that 'CC in Australia is currently immature' than Cloud Adopters ($p<0.03$), while Definite Non-Adopters' agreement with this belief statement was close to being statistically significant ($p<0.07$) before adjusting analyses for demographic covariates; and was significant ($p=0.05$) following the adjustment. Although the reviewed literature of the time agreed with this statement, it is not surprising to find that Cloud and Future Adopters were far less likely to agree that CC in Australia was still immature.

There were no statistically significant differences between Cloud Adopters and other categories in terms of their 'neutral' belief regarding the usefulness of virtualisation and/or SOA as CC enablers (as explained on p.257). While agreement that virtualisation was a useful precursor to CC was highest among Future Adopters, it was (oddly) Definite Non-Adopters who agreed most that SOA would be helpful in implementing CC! This counter-intuitive finding is unlikely to be comprehensible without qualitative investigation.

Overall, this comparison showed Cloud Adopters' beliefs were most like those of Future Adopters, followed by Undecided Non-Adopters, then Definite Non-Adopters – as one might expect.

Table 5.3: Results of comparing Cloud Adopters' beliefs against other categories in 2012 (after excluding the answers of 'Don't know' option)

Belief	Future Adopters				Undecided Non Adopters				Definite Non Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Understanding level of CC	0.52 (0.30 to 0.90)	0.02	0.56 (0.32 to 0.98)	0.04	0.28 (0.17 to 0.45)	<0.001	0.31 (0.19 to 0.50)	<0.001	0.21 (0.10 to 0.47)	<0.001	0.27 (0.12 to 0.62)	0.002
Main drivers of CC adoption are economics and simplicity	0.85 (0.48 to 1.49)	0.57	0.89 (0.50 to 1.59)	0.70	0.61 (0.38 to 1.00)	0.05	0.61 (0.37 to 1.01)	0.05	0.21 (0.10 to 0.45)	<0.001	0.20 (0.09 to 0.46)	<0.001
CC is a tool to be more productive and cost effective	1.14 (0.67 to 1.94)	0.64	1.21 (0.70 to 2.09)	0.49	0.60 (0.38 to 0.93)	0.02	0.62 (0.39 to 0.99)	0.05	0.33 (0.15 to 0.71)	0.004	0.34 (0.15 to 0.75)	0.01
CC will be one of the top ten strategic technologies	0.93 (0.54 to 1.59)	0.78	1.05 (0.61 to 1.81)	0.86	0.48 (0.30 to 0.75)	0.002	0.49 (0.30 to 0.80)	0.004	0.27 (0.12 to 0.61)	0.002	0.29 (0.12 to 0.67)	0.004
Virtualisation is required to enable CC	1.35 (0.81 to 2.24)	0.25	1.41 (0.84 to 2.36)	0.19	1.26 (0.82 to 1.95)	0.29	1.36 (0.86 to 2.14)	0.19	0.89 (0.43 to 1.82)	0.75	0.97 (0.45 to 2.08)	0.94
SOA is required to enable CC	0.85 (0.50 to 1.43)	0.54	0.80 (0.47 to 1.36)	0.42	0.96 (0.61 to 1.51)	0.85	0.94 (0.58 to 1.51)	0.80	1.69 (0.81 to 3.52)	0.16	1.54 (0.71 to 3.35)	0.28
CC in Australia is currently immature	1.15 (0.68 to 1.96)	0.60	1.16 (0.67 to 2.00)	0.60	1.68 (1.06 to 2.65)	0.03	1.69 (1.05 to 2.71)	0.03	1.99 (0.94 to 4.22)	0.07	2.19 (0.99 to 4.83)	0.05
CC is the future of IT	1.88 (1.12 to 3.16)	0.02	2.04 (1.19 to 3.47)	0.01	0.54 (0.35 to 0.84)	0.01	0.58 (0.37 to 0.91)	0.02	0.29 (0.14 to 0.62)	0.002	0.30 (0.13 to 0.66)	0.003

* Data analysed using ordered logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

390 observations

The beliefs of all categories towards CC in 2013, after excluding ‘don’t know’ answers, are illustrated in Figure 5.15.

Similarly to 2012, between 78% and 96% of respondents from all categories indicated they understood the concept of CC. More than 80% of each category agreed that the ‘main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery’, where the maximum difference in levels of agreement between all categories was only 8%.

The most significant difference between all categories in response to any statement of belief was 66% which occurred (as in 2012) in responses to the statement ‘Cloud Computing is the future of IT’; followed by ‘CC is a tool to be more productive and cost effective’ with a difference of 54%.

Again as in 2012, the average agreement on the requirement of SOA as CC enabler was ‘neutral’ for all categories. However, the situation was not clear regarding the requirement for virtualisation as a CC enabler. This will be clarified later on in this Section in the statistical analyses for the beliefs. The reason behind the disagreements with these statements may lie in the prior assumption which suggested respondents were not sufficiently familiar with the technologies and techniques leading to effective deployment of CC. Follow-up qualitative investigation would assist in checking the validity of this assumption.

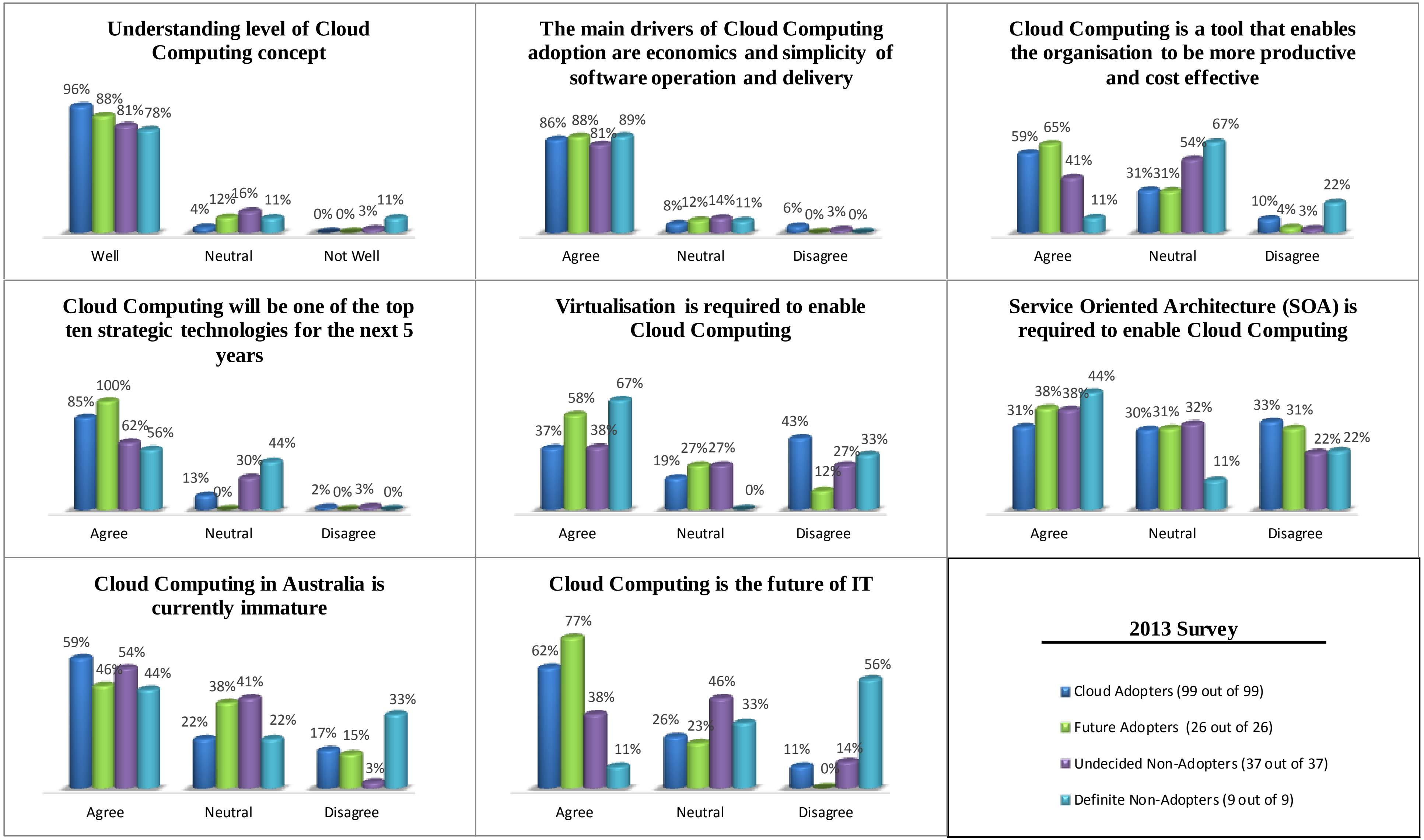


Figure 5.15: Beliefs of all respondents' categories in 2013

The ordered logistic regression analysis indicated that there were statistically significant differences between the beliefs of all categories against Cloud Adopters, as presented in Table 5.4. The results did not change after adjusting the analyses for demographic covariates (industry sectors, state and organisation size).

Respondents from Future Adopters and Undecided Non-Adopters were less inclined to believe they ‘understood the concept of CC’ than those from Cloud Adopters (all $p<0.025$). Approximately, 96% (95 of 99) of Cloud Adopters showed that they understood CC compared with 88% (23 of 26) of Future Adopters and 78% (30 of 37) of Undecided Non-Adopters. Although 78% (7 of 9) of Definite Non-Adopters indicated that they ‘understood the concept of CC’ (which was lower than the proportion for Future Adopters and Undecided Non-Adopters), there was no statistically significant difference between responses from this category and Cloud Adopters, because the understanding level of CC towards ‘very well’ for Definite Non-Adopters was higher than for Future Adopters and Undecided Non-Adopters (Table 5.5).

Participants from Future Adopters were more strongly in agreement with the statement that ‘CC will be one of the top ten strategic technologies’ compared with those from Cloud Adopters ($p=0.02$). In contrast, respondents from Undecided and Definite Non-Adopters had less belief in that statement compared with those from Cloud Adopters (all $p<0.025$). Almost two-thirds of Cloud Adopters (62%; 61 of 99) agreed that ‘CC will be one of the top ten strategic technologies’ while 77% (20 of 26) of Future Adopters, 38% (14 of 37) of Undecided Non-Adopters and 11% (1 of 9) of Definite Non-Adopters agreed on that.

Again, as in 2012, respondents of both types of Non-Adopters had lower belief in that ‘CC is the future of IT’ than those from Cloud Adopters (all $p<0.025$). In addition, participants from Definite Non-Adopters were less inclined to believe that ‘CC is a tool to be more productive and cost effective’ compared with those from Cloud Adopters ($p=0.01$). Approximately, 59% (58 of 99) of Cloud Adopters against only 11% (1 of 9) of Definite Non-Adopters believed in that. Although respondents from both types of Non-Adopters did not agree with the reviewed literature for these statements, this disagreement may clarify why their organisations did not adopt CC or expect the adoption in the near future.

There were no statistically significant differences between all categories compared with Cloud Adopters in their agreement with the beliefs that: SOA was an effective CC enabler; CC in Australia was still immature; and the ‘main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery’.

However, participants from Future Adopters were more convinced that ‘Virtualisation is required to enable CC’ than Cloud Adopters. Almost 58% (15 of 26) of Future Adopters agreed with this statement, compared with 37% (37 of 99) of Cloud Adopters. Interestingly, there was no statistically significant difference between Definite Non-Adopters and Cloud Adopters in believing that ‘Virtualisation is required to enable CC’ (once again, as with 2012), although this view was held by 67% (6 of 9) of Definite Non-Adopters, which was greater than the proportion of Future Adopters. To explain this difference more clearly, Table 5.6, shows that the proportion of Future Adopters who *strongly agreed* that ‘Virtualisation is required to enable CC’ was higher than the proportion of Definite Non-Adopters.

The ‘don’t know’ responses indicated that major uncertainty in both surveys occurred in relation to the need for SOA as an enabler for CC (Table 5.7). The second major uncertainty occurred in relation to a need for virtualisation as an enabler for CC in 2012. These uncertainties may indicate why agreement for all categories was ‘neutral’ regarding the requirement for both SOA and virtualisation as CC enablers in 2012; and on the requirement for SOA in 2013. These findings support the assumption that respondents were not sufficiently familiar with the technologies and techniques required for effective deployment of CC to truly understand which additional technologies would assist in making CC more effective. To really understand whether SOA and virtualisation are as important for CC, as authors such as Linthicum (Linthicum, 2010a) believe, will require more detailed qualitative research.

Table 5.4: Results of comparing Cloud Adopters' beliefs against other categories in 2013 (after excluding the answers of 'Don't know' option)

Belief	Future Adopters				Undecided Non Adopters				Definite Non Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Understanding level of CC	0.36 (0.15 to 0.87)	0.02	0.32 (0.13 to 0.80)	0.02	0.14 (0.06 to 0.32)	<0.001	0.12 (0.05 to 0.30)	<0.001	0.31 (0.07 to 1.41)	0.13	0.30 (0.06 to 1.63)	0.16
Main drivers of CC adoption are economics and simplicity	1.11 (0.46 to 2.68)	0.81	0.98 (0.39 to 2.43)	0.96	0.67 (0.31 to 1.48)	0.32	0.73 (0.33 to 1.63)	0.45	0.75 (0.19 to 2.90)	0.67	0.66 (0.15 to 2.87)	0.58
CC is a tool to be more productive and cost effective	1.55 (0.68 to 3.58)	0.30	1.37 (0.57 to 3.30)	0.48	0.65 (0.32 to 1.31)	0.23	0.69 (0.33 to 1.45)	0.33	0.18 (0.05 to 0.63)	0.01	0.12 (0.03 to 0.50)	0.003
CC will be one of the top ten strategic technologies	2.84 (1.22 to 6.64)	0.02	2.75 (1.10 to 6.88)	0.03	0.24 (0.11 to 0.53)	<0.001	0.22 (0.10 to 0.49)	<0.001	0.16 (0.05 to 0.60)	0.01	0.10 (0.02 to 0.39)	0.001
Virtualisation is required to enable CC	2.77 (1.27 to 6.05)	0.01	3.01 (1.34 to 6.76)	0.01	1.47 (0.74 to 2.91)	0.27	1.27 (0.63 to 2.57)	0.51	2.11 (0.62 to 7.16)	0.23	1.85 (0.47 to 7.29)	0.38
SOA is required to enable CC	1.22 (0.56 to 2.66)	0.61	1.15 (0.52 to 2.56)	0.73	1.49 (0.75 to 2.98)	0.26	1.32 (0.64 to 2.73)	0.45	1.84 (0.46 to 7.32)	0.39	1.14 (0.26 to 4.97)	0.86
CC in Australia is currently immature	0.88 (0.39 to 1.99)	0.76	0.78 (0.34 to 1.82)	0.57	1.14 (0.58 to 2.27)	0.70	1.01 (0.50 to 2.06)	0.97	0.51 (0.14 to 1.94)	0.33	0.52 (0.12 to 2.16)	0.37
CC is the future of IT	1.74 (0.78 to 3.89)	0.18	1.69 (0.73 to 3.94)	0.22	0.43 (0.21 to 0.88)	0.02	0.40 (0.19 to 0.84)	0.02	0.10 (0.03 to 0.34)	<0.001	0.08 (0.02 to 0.32)	<0.001

* Data analysed using ordered logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

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Table 5.5: Proportions of understanding level of CC for all categories

Belief	Category	Very Well	Reasonably Well	Neutral	Not very well	I really don't understand it at all
Understanding level of CC	Cloud Adopters	49 49%	46 46%	4 4%	0 0%	0 0%
	Future Adopters	7 27%	16 62%	3 12%	0 0%	0 0%
	Undecided Non-Adopters	3 8%	27 73%	6 16%	0 0%	1 3%
	Definite Non-Adopters	3 33%	4 44%	1 11%	1 11%	0 0%

Table 5.6: Proportions of the agreement on 'virtualisation is required to enable CC' for all categories

Belief	Category	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Virtualisation is required to enable CC	Cloud Adopters	13 13%	24 24%	19 19%	34 34%	9 9%
	Future Adopters	5 19%	10 38%	7 27%	2 8%	1 4%
	Undecided Non-Adopters	4 11%	10 27%	10 27%	10 27%	0 0%
	Definite Non-Adopters	1 11%	5 56%	0 0%	3 33%	0 0%

Table 5.7: Number of Don't Know of all respondents' categories beliefs in 2012 and 2013

Belief	2012				2013			
	Cloud Adopters	Future Adopters	Undecided Non-Adopters	Definite Non-Adopters	Cloud Adopters	Future Adopters	Undecided Non-Adopters	Definite Non-Adopters
Main drivers of CC adoption are economics and simplicity	1	0	4	1	0	0	1	0
CC is a tool to be more productive and cost effective	2	0	3	1	0	0	1	0
CC will be one of the top ten strategic technologies	1	0	3	1	0	0	2	0
Virtualisation is required to enable CC	6	0	6	2	0	1	3	0
SOA is required to enable CC	16	5	13	3	5	0	3	2
CC in Australia is currently immature	2	1	7	2	2	0	1	0
CC is the future of IT	3	0	3	1	1	0	1	0

5.1.4. Concerns

The reviewed literature identified many concerns associated with CC, but without indicating their proportions or ranking them for either Cloud Adopters or Non-Adopters. This study has highlighted these proportions and ranked the top five concerns for all categories of Cloud Adopters/Non-Adopters, as shown in Figure 5.16. 'Security problems' concerned between 69.8% and 78.6% of respondents from each category and was ranked as the major concern for all adopters categories in 2012. The second major concern was 'privacy problems' for participants from all categories except Definite Non-Adopters for whom it was nonetheless the third major concern and ranged between 59.5% and 69.1% for each category. For Definite Non-Adopters, the second most serious concern was 'loss of control', followed by 'lack of trust with cloud service providers' and 'privacy problems' – with 71.4% (20 of 28) and 60.7% (17 of 28) respectively. All other concerns for all categories were below 46.5%. These responses help to clarify why Definite Non-Adopters have resisted adopting CC.

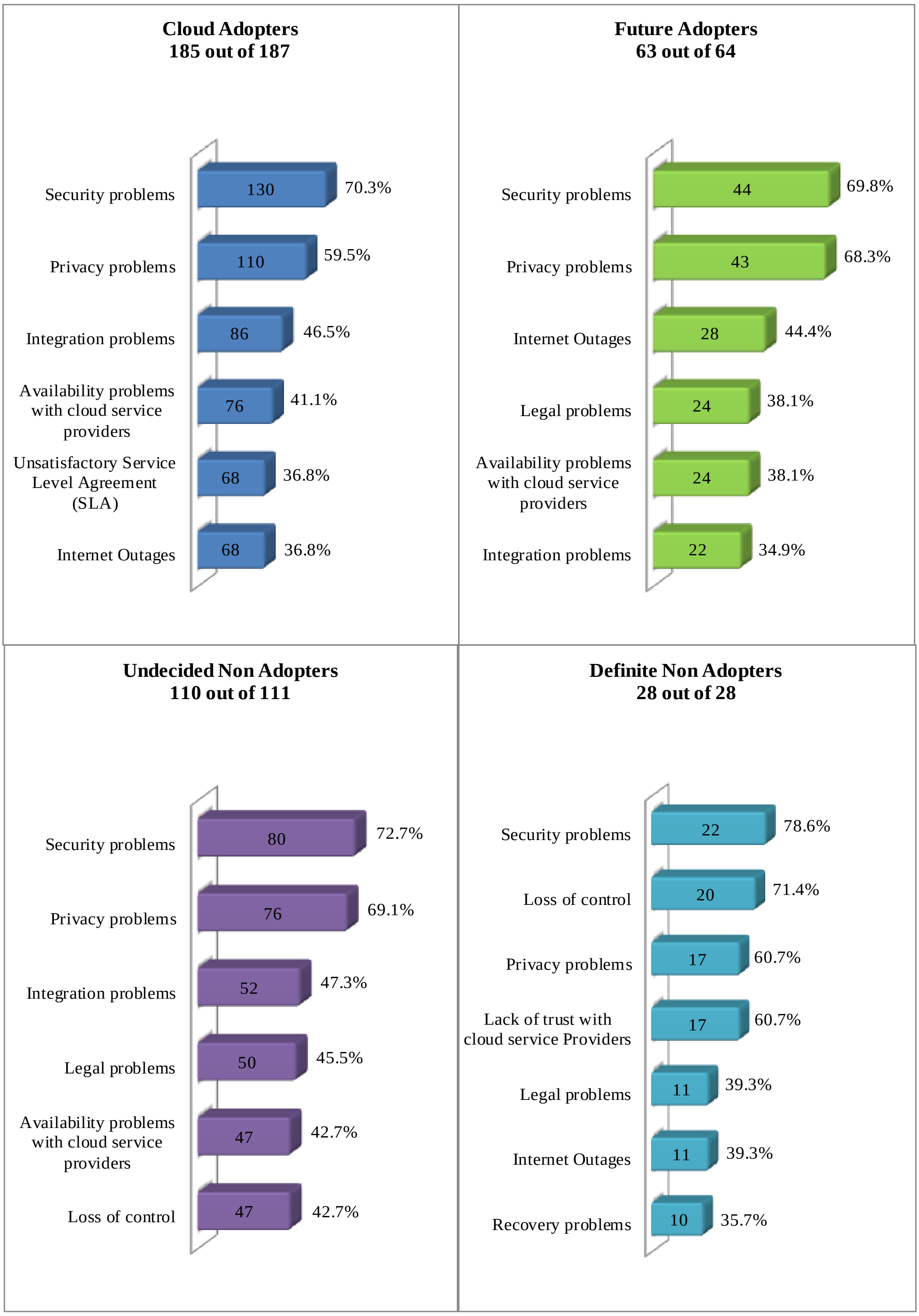


Figure 5.16: Top five concerns for all categories in 2012

The results of logistic regression analysis showed some statistically significant differences in the concerns of all categories vs. Cloud Adopters, as presented in Table 5.8. After adjusting the analyses for demographic covariates (industry sectors, State and organisation size), the results did not change except for ‘privacy problems’ for Undecided Non-Adopters. Respondents form this category were more concerned about ‘privacy problems’ than were Cloud Adopters after the adjustment ($p=0.04$).

‘Lack of trust with cloud service providers’ concerned participants from both types of Non-Adopters more than it did Cloud Adopters ($p<0.001$): 41.8% (46 of 110) of Undecided Non-Adopters and 60.7% (17 of 28) of Definite Non-Adopters were worried about this issue, yet it concerned only 20% (37 of 185) of Cloud Adopters. ‘Loss of control’ was another issue of concern for respondents from Definite Non-Adopters vis-à-vis those from Cloud Adopters ($p<0.001$). This issue worried 71.4% (20 of 28) of Definite Non-Adopters whereas it concerned only 33% (61 of 185) of Cloud Adopters. Clearly, trust (or lack of trust) in CSPs is a major factor in the decision whether or not to adopt CC.

Surprisingly, however, the Definite Non-Adopters were less concerned about ‘availability problems with cloud service providers’ than were those from Cloud Adopters ($p=0.01$). This issue concerned 41.1% (76 of 185) of Cloud Adopters while it concerned only 14.3% (4 of 28) of Definite Non-Adopters. These differing responses might indicate that Definite Non-Adopters are more concerned about the integrity of CSPs than they are about their capability – although this assumption would benefit from further investigation using qualitative research approaches.

These concerns were the only statistically significant differences between Cloud Adopters against other categories, suggesting that all categories of Cloud Adopters shared most concerns, apart from those mentioned above. This analysis also identified no differences between the concerns of Current and Future Adopters – and, as one might expect, that the closest category for these two groups was Undecided Non-Adopters.

Table 5.8: Results of comparing Cloud Adopters' concerns against other categories in 2012

Concern	Future Adopters				Undecided Non Adopters				Definite Non Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Security problems	0.98 (0.53 to 1.83)	0.95	0.99 (0.52 to 1.88)	0.97	1.13 (0.67 to 1.91)	0.65	1.12 (0.65 to 1.96)	0.68	1.55 (0.60 to 4.04)	0.37	1.60 (0.58 to 4.38)	0.36
Privacy problems	1.47 (0.80 to 2.69)	0.22	1.51 (0.80 to 2.85)	0.21	1.52 (0.92 to 2.51)	0.10	1.77 (1.02 to 3.05)	0.04	1.05 (0.47 to 2.38)	0.90	1.43 (0.59 to 3.45)	0.43
Availability problems with cloud service providers	0.88 (0.49 to 1.59)	0.68	0.89 (0.49 to 1.64)	0.72	1.07 (0.66 to 1.73)	0.78	1.12 (0.67 to 1.85)	0.67	0.24 (0.08 to 0.72)	0.01	0.22 (0.07 to 0.70)	0.01
Integration problems	0.62 (0.34 to 1.12)	0.11	0.72 (0.39 to 1.32)	0.29	1.03 (0.64 to 1.66)	0.90	1.20 (0.72 to 1.99)	0.48	0.55 (0.23 to 1.27)	0.16	0.71 (0.29 to 1.75)	0.46
Development problems	0.50 (0.19 to 1.37)	0.18	0.51 (0.18 to 1.40)	0.19	1.07 (0.55 to 2.07)	0.84	1.11 (0.56 to 2.22)	0.76	0.45 (0.10 to 2.01)	0.30	0.48 (0.10 to 2.22)	0.35
Recovery problems	0.53 (0.24 to 1.17)	0.12	0.51 (0.23 to 1.13)	0.10	1.43 (0.85 to 2.43)	0.18	1.41 (0.81 to 2.46)	0.22	1.78 (0.77 to 4.14)	0.18	1.64 (0.67 to 4.03)	0.28
Legal problems	1.11 (0.61 to 2.00)	0.73	1.15 (0.62 to 2.13)	0.67	1.50 (0.93 to 2.43)	0.10	1.65 (0.98 to 2.77)	0.06	1.17 (0.52 to 2.64)	0.71	1.52 (0.63 to 3.65)	0.35
Unsatisfactory Service Level Agreement	0.74 (0.40 to 1.37)	0.34	0.82 (0.44 to 1.54)	0.54	0.71 (0.42 to 1.17)	0.18	0.78 (0.46 to 1.33)	0.37	0.37 (0.14 to 1.03)	0.06	0.46 (0.16 to 1.33)	0.15
Quality problems	1.00 (0.52 to 1.93)	1.00	0.99 (0.50 to 1.95)	0.98	0.61 (0.34 to 1.11)	0.11	0.60 (0.32 to 1.13)	0.11	0.35 (0.10 to 1.22)	0.10	0.34 (0.09 to 1.22)	0.10
Organisational and cultural problems	1.11 (0.55 to 2.21)	0.78	1.13 (0.56 to 2.31)	0.73	1.08 (0.61 to 1.92)	0.80	1.16 (0.64 to 2.13)	0.62	0.84 (0.30 to 2.36)	0.74	0.92 (0.31 to 2.74)	0.89
Loss of control	0.95 (0.51 to 1.74)	0.86	0.86 (0.46 to 1.61)	0.63	1.52 (0.93 to 2.47)	0.09	1.31 (0.79 to 2.19)	0.30	5.08 (2.12 to 12.20)	<0.001	4.36 (1.74 to 10.94)	0.002
Lack of trust with cloud service providers	1.48 (0.76 to 2.87)	0.25	1.41 (0.71 to 2.79)	0.33	2.88 (1.70 to 4.85)	<0.001	3.07 (1.77 to 5.34)	<0.001	6.18 (2.67 to 14.31)	<0.001	7.40 (3.01 to 18.18)	<0.001
Lack of service orientation	0.78 (0.30 to 2.02)	0.61	0.83 (0.31 to 2.20)	0.71	1.17 (0.58 to 2.36)	0.66	1.23 (0.59 to 2.59)	0.58	0.89 (0.25 to 3.19)	0.86	1.03 (0.27 to 3.94)	0.97
Insufficient skills in your organisation	0.84 (0.39 to 1.81)	0.65	0.81 (0.36 to 1.82)	0.62	0.70 (0.36 to 1.36)	0.29	0.79 (0.39 to 1.58)	0.50	0.34 (0.08 to 1.51)	0.16	0.42 (0.09 to 1.96)	0.27
Immaturity of technology	1.37 (0.73 to 2.55)	0.33	1.39 (0.73 to 2.64)	0.32	0.96 (0.55 to 1.65)	0.87	0.92 (0.51 to 1.63)	0.77	0.98 (0.39 to 2.45)	0.96	0.87 (0.33 to 2.30)	0.78
Internet Outages	1.38 (0.77 to 2.46)	0.28	1.41 (0.77 to 2.59)	0.26	1.06 (0.65 to 1.73)	0.81	0.98 (0.59 to 1.65)	0.95	1.11 (0.49 to 2.52)	0.80	0.90 (0.38 to 2.14)	0.81

* Data analysed using logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

386 observations

Analysis of the top five concerns for all categories in 2013 showed that, as in 2012, ‘security problems’ was the most significant concern for all categories – apart from Future Adopters, where it was nonetheless the second most significant concern (see Figure 5.17). CC security issues concerned between 62.2% and 88.9% of all categories excluding Future Adopters, where it was still a concern for 53.8% (14 of 26) of respondents.

Concern over ‘privacy problems’ varied far more widely, ranking between 50% and 67.6% for all categories. It was the major concern for Future Adopters; the second most important concern for Cloud Adopters and Undecided Non-Adopters; and the third most important concern for Definite Non-Adopters.

Again as in 2012, the second most serious concern for Definite Non-Adopters was ‘loss of control’ with 77.8% (7 of 9). This concern was the third major concern for Undecided Non-Adopters along with ‘bandwidth problems’ with 56.8% (21 of 37). ‘Bandwidth problem’ was also the third major concern for Definite Non-Adopters followed by ‘lack of trust with cloud service providers’, ‘cross border problems’ and ‘usage costs’ with 66.7% (6 of 9) and 55.6% (5 of 9) respectively. However, these proportions must be interpreted with caution because only nine participants represented the Definite Non-Adopters in the 2013 survey. All of the other concerns for all categories were below 48.6%.

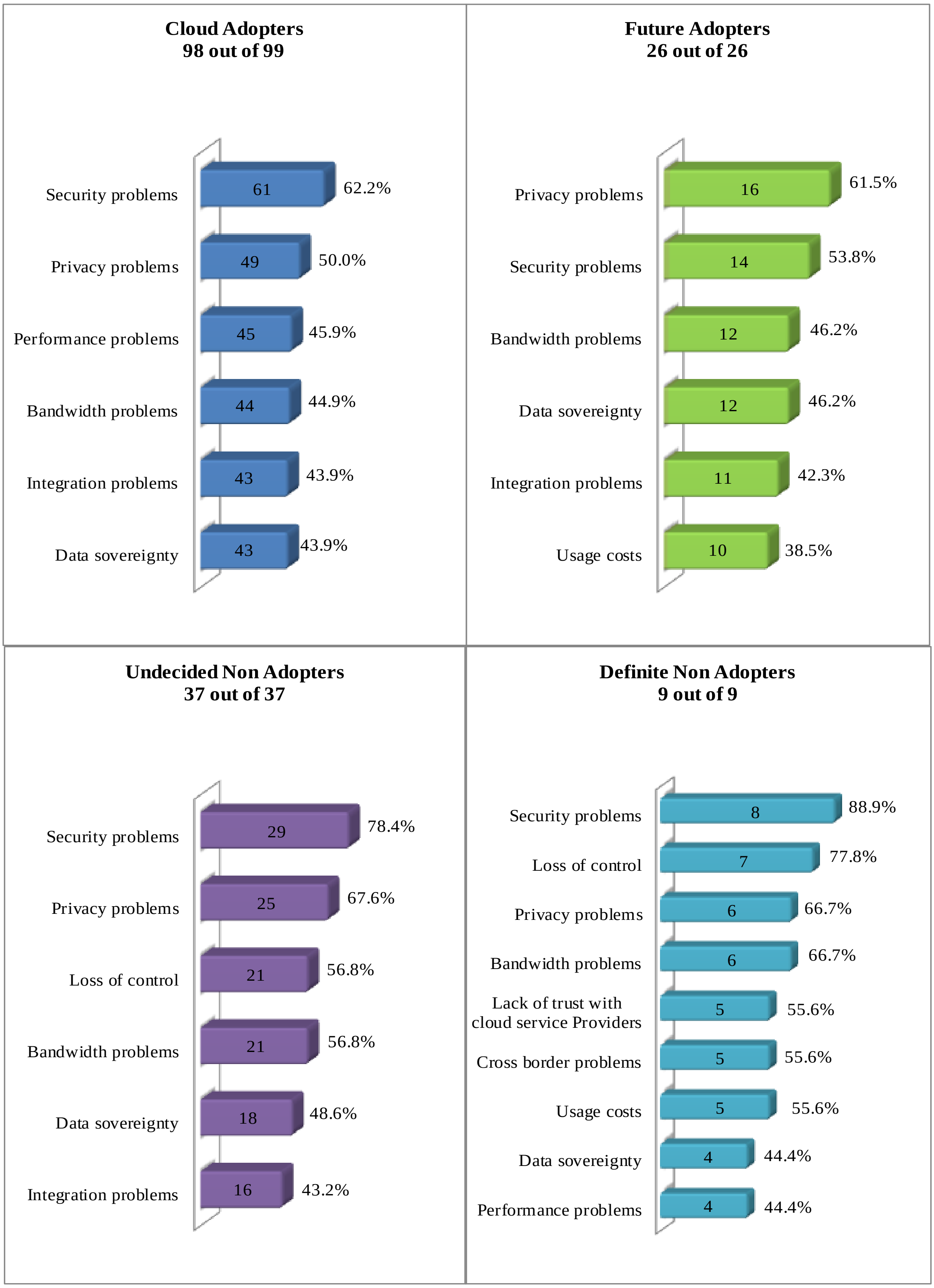


Figure 5.17: Top five concerns for all categories in 2012

The results of logistic regression analysis showed there were few statistically significant differences between the concerns of all categories compared with Cloud Adopters, as shown in Table 5.9. The results did not change after adjusting the analyses for demographic covariates (industry sectors, State and organisation size) except for 'Lack of trust with cloud service providers' for Undecided Non-Adopters.

Respondents from this category were more inclined to believe that 'Lack of trust with cloud service providers' was a concern compared with Cloud Adopters after the adjustment ($p=0.04$). This issue also concerned Definite Non-Adopters more than Cloud Adopters ($p=0.03$), with 35.1% (13 of 37) of Undecided Non-Adopters and 55.6% (5 of 9) of Definite Non-Adopters being worried, whereas it concerned only 21.4% (21 of 98) of Cloud Adopters.

In addition, 'loss of control' concerned the respondents from both types of Non-Adopters more than those from Cloud Adopters (all $p<0.025$), being a matter of concern for 77.8% (7 of 9) of Definite Non-Adopters and 56.8% (21 of 37) of Undecided Non-Adopters, compared with only 33.7% (33 of 98) of Cloud Adopters. The third difference was in 'Cross border problems' which, again, concerned 55.6% (5 of 9) of Definite Non-Adopters compared with only 18.4% (18 of 98) of Cloud Adopters. As with the 2012 survey, these concerns appear to relate more to the non-adopting respondents' views of CSP probity than capability.

These concerns were the only statistically significant differences between Cloud Adopters against other categories. This analysis showed that all categories shared most of the concerns except for these concerns indicated above. It also supported the finding that there were no differences between the concerns of Cloud and Future Adopters and the closest category for them was Undecided Non-Adopters, as in 2012.

Table 5.9: Results of comparing Cloud Adopters' concerns against other categories in 2013

Concern	Future Adopters				Undecided Non Adopters				Definite Non Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
Security problems	0.71 (0.30 to 1.69)	0.44	0.63 (0.24 to 1.63)	0.34	2.20 (0.91 to 5.32)	0.08	2.35 (0.90 to 6.15)	0.08	4.85 (0.58 to 40.37)	0.14	3.31 (0.35 to 31.01)	0.30
Privacy problems	1.60 (0.66 to 3.87)	0.30	1.46 (0.57 to 3.77)	0.43	2.08 (0.94 to 4.61)	0.07	1.95 (0.83 to 4.60)	0.13	2.00 (0.47 to 8.45)	0.35	1.50 (0.30 to 7.57)	0.62
Availability problems with cloud service providers	0.80 (0.32 to 2.03)	0.64	0.79 (0.29 to 2.14)	0.64	0.58 (0.25 to 1.36)	0.21	0.51 (0.20 to 1.25)	0.14	0.90 (0.21 to 3.82)	0.89	0.58 (0.12 to 2.95)	0.51
Integration problems	0.94 (0.39 to 2.25)	0.89	1.11 (0.43 to 2.86)	0.83	0.97 (0.45 to 2.09)	0.95	0.80 (0.35 to 1.81)	0.59	0.37 (0.07 to 1.85)	0.22	0.47 (0.08 to 2.92)	0.42
Development problems	0.37 (0.08 to 1.71)	0.20	0.40 (0.08 to 1.98)	0.26	0.39 (0.11 to 1.42)	0.15	0.34 (0.09 to 1.30)	0.12	0.56 (0.07 to 4.73)	0.59	0.47 (0.05 to 4.63)	0.52
Recovery problems	1.14 (0.43 to 3.03)	0.80	1.43 (0.48 to 4.27)	0.53	0.85 (0.34 to 2.11)	0.73	0.88 (0.33 to 2.37)	0.80	1.54 (0.36 to 6.64)	0.56	0.95 (0.19 to 4.90)	0.95
Legal problems	1.26 (0.50 to 3.15)	0.62	1.53 (0.54 to 4.30)	0.42	1.29 (0.58 to 2.87)	0.54	1.39 (0.57 to 3.44)	0.47	1.19 (0.28 to 5.08)	0.82	1.20 (0.23 to 6.19)	0.83
Unsatisfactory Service Level Agreement	0.62 (0.23 to 1.69)	0.35	0.68 (0.24 to 1.95)	0.48	1.12 (0.50 to 2.48)	0.79	1.18 (0.51 to 2.71)	0.70	0.59 (0.12 to 3.00)	0.52	0.81 (0.14 to 4.61)	0.81
Quality problems	0.93 (0.24 to 3.59)	0.92	1.04 (0.25 to 4.31)	0.96	1.39 (0.48 to 4.01)	0.55	1.22 (0.40 to 3.75)	0.73	2.05 (0.38 to 11.03)	0.40	1.37 (0.21 to 8.78)	0.74
Organisational and cultural problems	1.06 (0.35 to 3.18)	0.92	1.40 (0.43 to 4.52)	0.58	1.43 (0.58 to 3.54)	0.44	1.45 (0.56 to 3.79)	0.44	2.22 (0.51 to 9.73)	0.29	3.87 (0.71 to 21.19)	0.12
Loss of control	0.73 (0.28 to 1.90)	0.51	0.73 (0.27 to 1.97)	0.53	2.59 (1.19 to 5.60)	0.02	2.57 (1.14 to 5.79)	0.02	6.89 (1.36 to 35.06)	0.02	5.42 (0.98 to 30.06)	0.05
Lack of trust with cloud service providers	0.67 (0.21 to 2.15)	0.50	0.74 (0.21 to 2.66)	0.65	1.99 (0.87 to 4.55)	0.11	2.76 (1.03 to 7.39)	0.04	4.58 (1.13 to 18.60)	0.03	5.18 (0.97 to 27.73)	0.06
Lack of service orientation	2.43 (0.54 to 10.90)	0.25	3.30 (0.63 to 17.28)	0.16	1.64 (0.37 to 7.24)	0.51	1.69 (0.35 to 8.17)	0.51	2.33 (0.24 to 22.40)	0.47	4.37 (0.32 to 59.29)	0.27
Insufficient skills in your organisation	1.25 (0.44 to 3.53)	0.68	1.57 (0.51 to 4.85)	0.44	1.15 (0.45 to 2.90)	0.77	0.99 (0.37 to 2.65)	0.99	1.19 (0.23 to 6.18)	0.84	1.39 (0.23 to 8.44)	0.72
Immaturity of technology	0.24 (0.05 to 1.10)	0.07	0.31 (0.07 to 1.46)	0.14	0.94 (0.39 to 2.26)	0.89	0.96 (0.38 to 2.41)	0.93	0.83 (0.16 to 4.28)	0.83	1.32 (0.22 to 8.03)	0.76
Internet Outages	0.67 (0.27 to 1.70)	0.40	0.69 (0.26 to 1.87)	0.47	0.73 (0.33 to 1.61)	0.43	0.67 (0.29 to 1.55)	0.35	0.76 (0.18 to 3.20)	0.71	0.61 (0.13 to 2.94)	0.54
Bandwidth problems	1.05 (0.44 to 2.51)	0.91	1.00 (0.39 to 2.59)	1.00	1.61 (0.75 to 3.45)	0.22	1.60 (0.69 to 3.70)	0.28	2.45 (0.58 to 10.38)	0.22	1.93 (0.37 to 10.13)	0.44
Cross border problems	1.64 (0.60 to 4.48)	0.34	1.80 (0.59 to 5.49)	0.30	1.65 (0.68 to 4.00)	0.27	1.68 (0.63 to 4.51)	0.30	5.56 (1.36 to 22.77)	0.02	6.28 (1.12 to 35.38)	0.04
Data sovereignty	1.10 (0.46 to 2.61)	0.84	1.21 (0.48 to 3.08)	0.69	1.21 (0.57 to 2.59)	0.62	1.20 (0.53 to 2.73)	0.67	1.02 (0.26 to 4.04)	0.97	1.37 (0.30 to 6.19)	0.69
Government legislation	1.45 (0.56 to 3.77)	0.45	1.55 (0.54 to 4.43)	0.42	1.57 (0.68 to 3.60)	0.29	1.34 (0.54 to 3.34)	0.53	0.93 (0.18 to 4.80)	0.93	1.57 (0.25 to 9.82)	0.63
Performance problems	0.62 (0.25 to 1.53)	0.30	0.64 (0.25 to 1.65)	0.35	0.80 (0.37 to 1.73)	0.58	0.80 (0.35 to 1.81)	0.59	0.94 (0.24 to 3.72)	0.93	0.85 (0.18 to 4.01)	0.84
Usage costs	1.49 (0.60 to 3.66)	0.39	1.71 (0.66 to 4.45)	0.27	1.62 (0.74 to 3.56)	0.23	1.54 (0.67 to 3.57)	0.31	2.97 (0.74 to 11.88)	0.12	2.37 (0.51 to 11.00)	0.27

* Data analysed using ordered logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

170 observations

5.2. Comparison between Cloud and Future Adopters

The adoption date, importance of expected benefits and usage of CC questions were common questions only between Cloud and Future Adopters. Each of these grouped questions will be explained and their results will be analysed for each survey.

5.2.1. Adoption Date

Analysing the adoption date for Cloud and Future Adopters, which has not occurred thus far in the reviewed literature, was important to investigate the continuity of CC Adoption. The results of the adoption date question in both surveys showed that Australian organisations started to adopt CC from 2006 onward, as shown in Figure 5.18 and Figure 5.19[5]. The proportions of the adoption dates in these figures were calculated on the basis of the total number of respondents in each survey (390 in the 2012 survey and 171 in the 2013 survey) to show the real annual adoption proportion of CC in Australia.

The adoption date in 2012 in Figure 5.18 included both Cloud and Future Adopters because the 2012 survey was conducted in the middle of 2012. Similarly, the adoption date in 2013 in Figure 5.19 consists of both Cloud and Future Adopters because the 2013 survey was conducted in the last quarter of 2013.

The 2012 survey showed that adoption of CC increased gently but steadily between 2006 and 2008, as illustrated in Figure 5.18. It then rose sharply from 3.1% (12 of 390) of all respondents in 2008 to 14.4% (56 of 390) in 2011, which was the maximum proportion of CC adoption.

Although this adoption process was expected to decline starting from 2012 (Figure 5.18), in conjunction with the assumptions based on Rogers' model (see Section 5.3), the 2013 survey showed that 2012 also achieved very high rates of CC

[5] It should be noted that four respondents from both surveys indicated their organisations had adopted CC before 2006, *viz.* in 1999, 2000, 2004 and 2003 – these respondents were thus referring to some other form of hosted computing.

adoption equivalent to those achieved in 2011, with 13.5% (23 of 171) in each of these years (Figure 5.19).

One possible explanation for this very rapid rate of CC uptake might be the fact that some organisations adopted CC earlier than they had stated they would in the 2012 survey, i.e. the expectations of respondents to the 2012 survey may have been overtaken by real-world events, leading to faster than anticipated uptake of CC.

Other potential factors affecting this acceleration of CC adoption in 2012 might include: increased awareness of the CC concept (as shown in the results of the 2012 survey); the enforcing of the Privacy Amendment (Enhancing Privacy Protection) Act 2012 (Goldenfein, 2013) which made many firms more aware of the need for secure data storage; and Australia's development as the second most friendly environment for CSPs after Japan (Corbin, 2013, Osman, 2013) which attracted a number of giant international CSPs such as AWS Inc. to open global CC datacentres in Australia in 2012 (Amazon Web Services Inc., 2012). A qualitative follow-up to this study would provide a better opportunity to analyse the real impact of these factors on accelerating the adoption of CC.

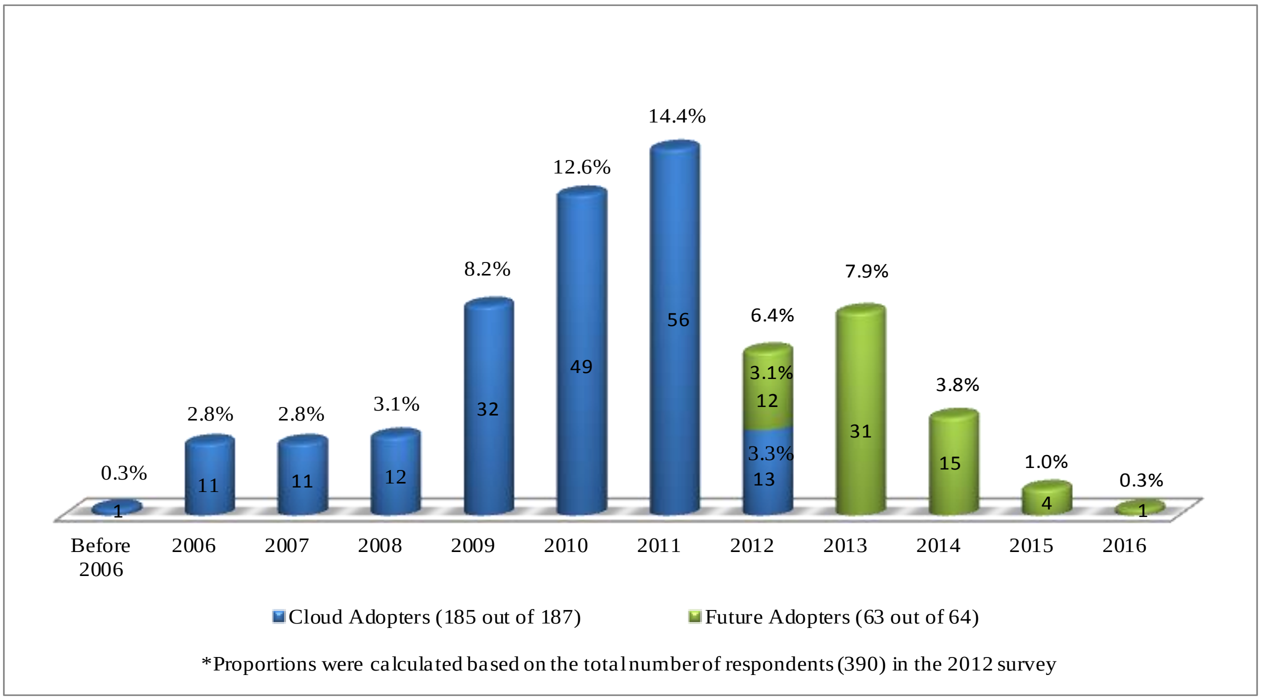


Figure 5.18: Adoption date for Cloud & Future Adopters according to the 2012 survey

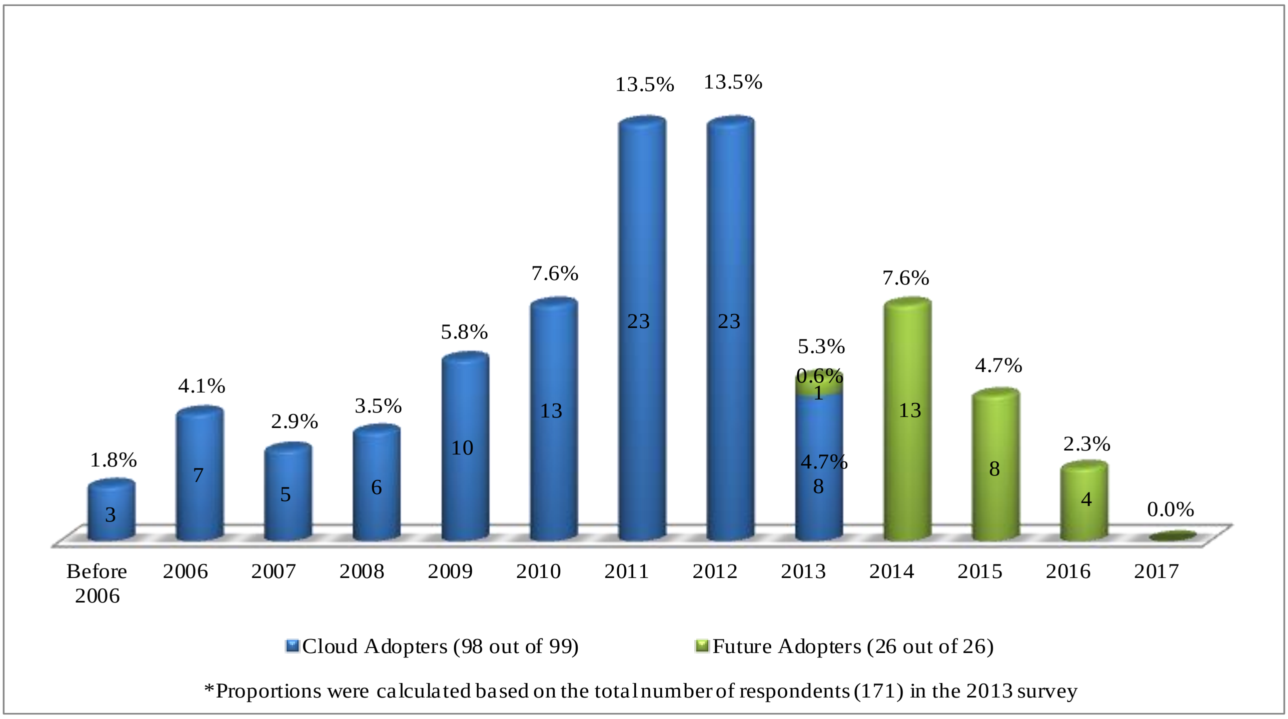


Figure 5.19: Adoption date for Cloud & Future Adopters according to the 2013 survey

5.2.2. Importance of Expected Benefits

The reviewed literature identified many expected benefits from adopting CC, but without indicating their importance level or ranking them. This study has therefore investigated the proportion of the importance of these benefits for Cloud and Future Adopters, as shown in Figure 5.20.

The results of the 2012 survey showed that the importance of all expected benefits varied between the quite significant levels of 73% and 97% for Cloud and Future Adopters. Only four expected benefits – 'improving security', 'facilitating internal communication', 'avoiding expense of buying licenses' and 'green IT' – differed. These benefits were considered important by only 43% to 66% of Cloud and Future Adopters – and the last three of these expected benefits, together with 'reducing costs', were more important for Future Adopters than for Cloud Adopters by 9% to 17%.

Ranking the top five expected benefits for Cloud and Future Adopters highlighted the priorities of each category, as shown in Figure 5.21. 'Improving business performance significantly', 'maintaining the systems more effectively', 'enabling introducing new systems more easily', 'quickness of implementation', 'reducing costs', 'increasing productivity' and 'adding or removing services as needed' were among the top five expected benefits for both of Cloud and Future Adopters (though with different proportions).

'Reducing costs' was the most important expected benefit for Future Adopters in 2012, however, while it took only fourth place for Cloud Adopters in the same year. In addition, 'accessibility via any internet-connected device' was among the top five important expected benefits for Cloud Adopters only; while 'needless of implementation or administration of IT infrastructure' was among the top five important expected benefits for Future Adopters only.

The most likely explanation for these differences would seem to be the greater genuine understanding of benefits held by actual users of CC, compared with firms not yet actively involved who were still drawing at least some of their opinions from industry literature rather than practical experience.

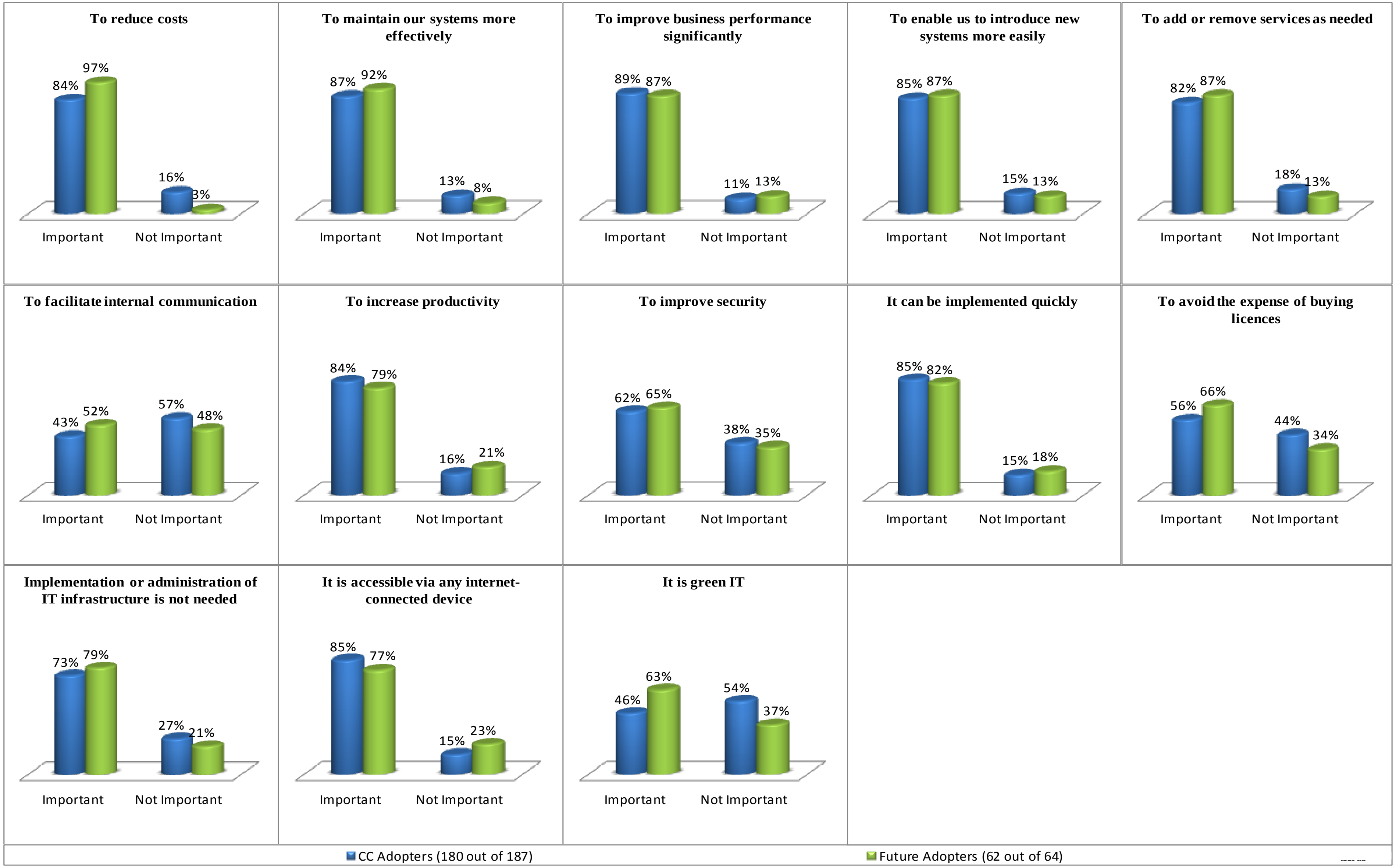


Figure 5.20: Importance of expected benefits for Cloud & Future Adopters in 2012

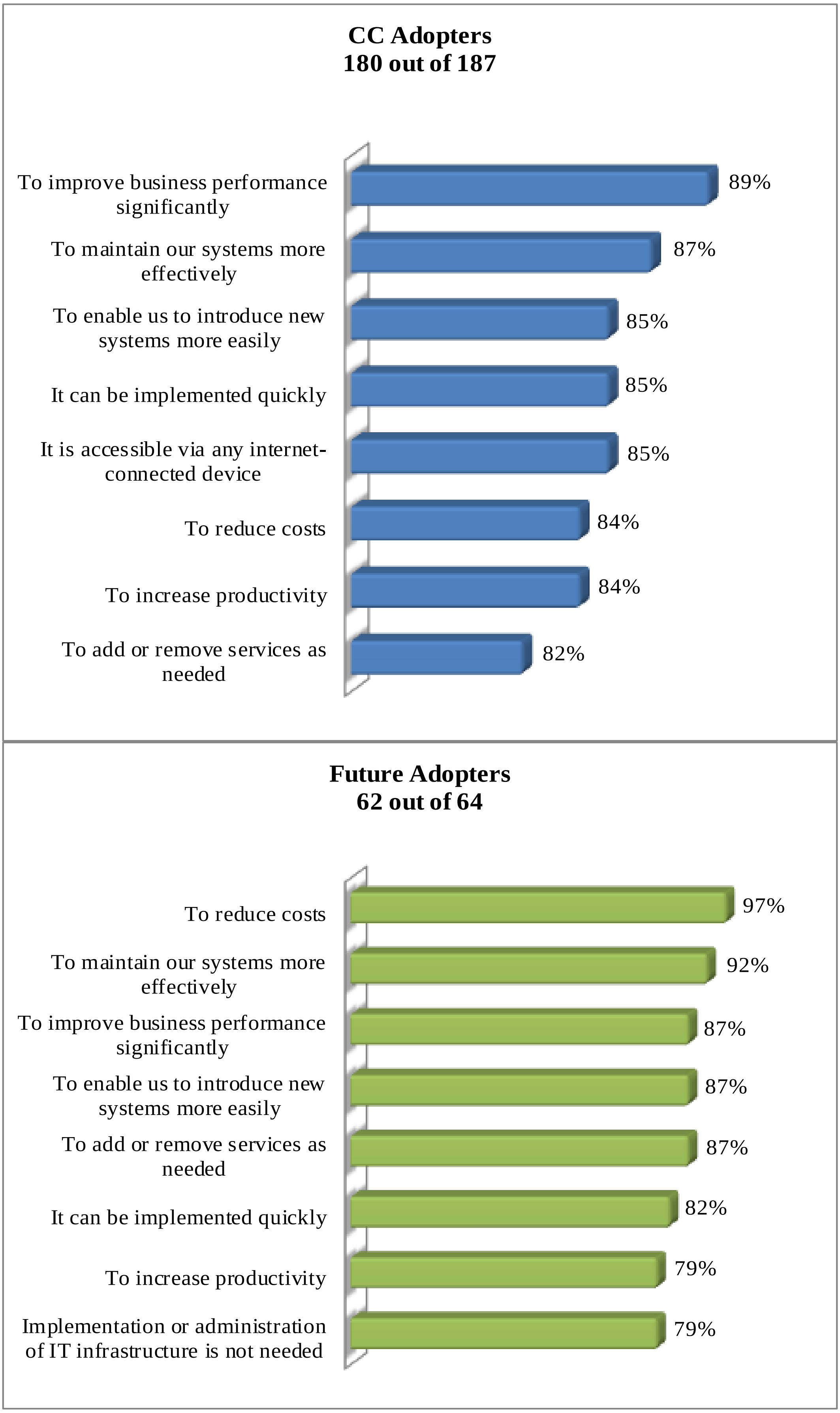


Figure 5.21: Top five expected benefits for Cloud & Future Adopters in 2012

In order to investigate the statistical differences between Cloud and Future Adopters in terms of the importance of the expected benefits, ordered logistic regression analysis was used. The results showed three statistically significant differences between the importance of the expected benefits for Future Adopters vs. Cloud Adopters, as illustrated in Table 5.10. The results did not change even after adjusting the analyses for demographic covariates (industry sectors, State and organisation size).

Future Adopters believed that ‘reducing costs’ and ‘green IT’ were more important compared with respondents from Cloud Adopters (all $p<0.035$), with approximately 97% (60 out of 62) of Future Adopters indicating that ‘reducing costs’ was important vs. only 84% (151 out of 180) of Cloud Adopters. The most likely explanation for this difference is that users of CC had discovered for themselves that cost savings are not only less likely than they had hoped (Bersin, 2009), but that the most important benefits tend to be strategic issues, such as improving business efficiency.

Another difference, ‘quickness of implementation’ was less important for Future Adopters than for Current Adopters ($p=0.02$). This may be due to the fact that most of the Future Adopters were located in a single State, so that importance of speed of implementation would be less than for Cloud Adopters, almost half of whom were multi-State organisations.

Table 5.10: Results of comparing importance of expected benefits for Future Adopters against Cloud Adopters in 2012

Importance of Expected Benefit	Future Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
To reduce costs	2.26 (1.34 to 3.80)	0.002	2.14 (1.25 to 3.67)	0.01
To maintain our systems more effectively	1.63 (0.96 to 2.76)	0.07	1.64 (0.95 to 2.83)	0.07
To improve business performance significantly	1.07 (0.64 to 1.80)	0.79	1.04 (0.61 to 1.77)	0.90
To enable us to introduce new systems more easily	1.02 (0.60 to 1.71)	0.95	0.99 (0.58 to 1.71)	0.99
To add or remove services as needed	1.14 (0.68 to 1.91)	0.61	1.24 (0.73 to 2.12)	0.43
To facilitate internal communication	1.42 (0.84 to 2.39)	0.19	1.53 (0.89 to 2.64)	0.12
To increase productivity	0.79 (0.47 to 1.33)	0.38	0.80 (0.47 to 1.38)	0.43
To improve security	1.16 (0.68 to 1.95)	0.59	1.11 (0.65 to 1.90)	0.71
It can be implemented quickly	0.55 (0.33 to 0.92)	0.02	0.53 (0.31 to 0.90)	0.02
To avoid the expense of buying licences	1.21 (0.73 to 2.01)	0.46	1.03 (0.61 to 1.75)	0.90
Implementation or administration of IT infrastructure is not needed	1.10 (0.66 to 1.83)	0.72	1.09 (0.65 to 1.84)	0.74
It is accessible via any internet connected device	0.84 (0.49 to 1.41)	0.50	0.85 (0.49 to 1.45)	0.54
It is green IT	1.80 (1.07 to 3.03)	0.03	1.85 (1.08 to 3.15)	0.03

* Data analysed using ordered logistic regression.

OR: Odds Ratio. 95% CI: 95% Confidence Interval.

[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.

242 observations

The 2013 survey showed that for both Cloud and Future Adopters the importance of all expected benefits varied between 62% and 96%, as illustrated in Figure 5.22.

As with 2012, however, there were some differences between these two groups of adopters in terms of anticipated benefits. ‘Facilitating internal communication’, ‘avoiding expense of buying licenses’ and ‘green IT’ were important for 40% to 58% of Cloud and Future Adopters, but ‘improving security’ and ‘green IT’ were more important for Future Adopters than for Cloud Adopters by 15% to 18%. This finding is fairly similar to the situation in the 2012 survey and, as then, might well indicate the differences in real-world experience between the two groups.

The top five expected benefits for Cloud and Future Adopters in 2013 are ranked in Figure 5.23. Eleven expected benefits of fifteen were among the top five expected benefits for Future Adopters, however, which makes distinguishing between Cloud and Future Adopters more difficult because all of the top five expected benefits for Cloud Adopters were also among the top five expected benefits for Future Adopters.

These top five expected benefits include: ‘maintaining the systems more effectively’, ‘improving business performance significantly’, ‘enabling introducing new systems more easily’, ‘accessibility via any internet-connected device’, ‘quickness of implementation’ and ‘increasing productivity’. However, ‘increasing productivity’ was the most important expected benefit for Future Adopters in addition to ‘improving business performance significantly’, but only held fifth place for Cloud Adopters. This might indicate that the Future Adopters was moving towards more strategic objectives. A further qualitative investigation would provide more detail concerning this issue.

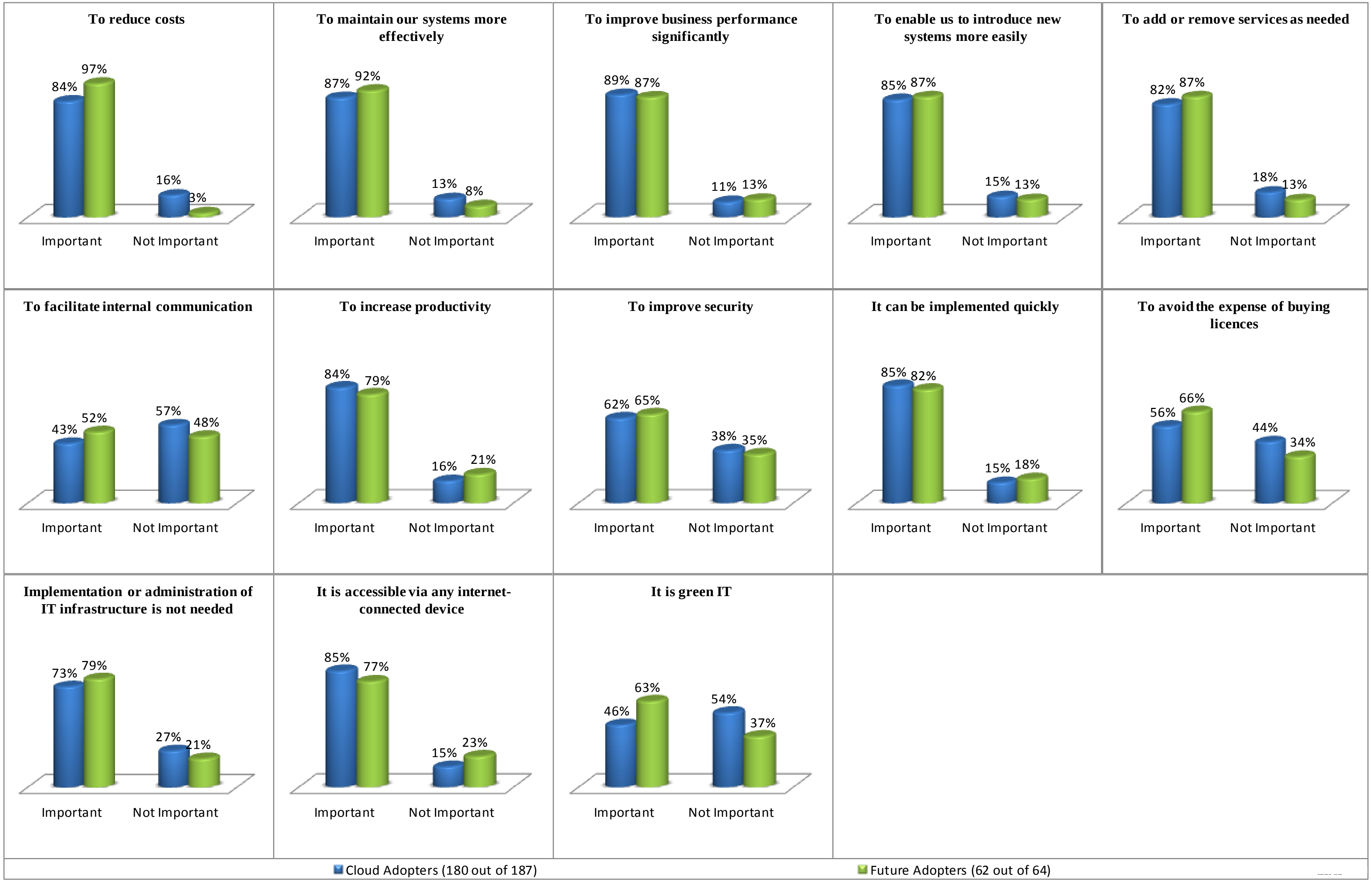
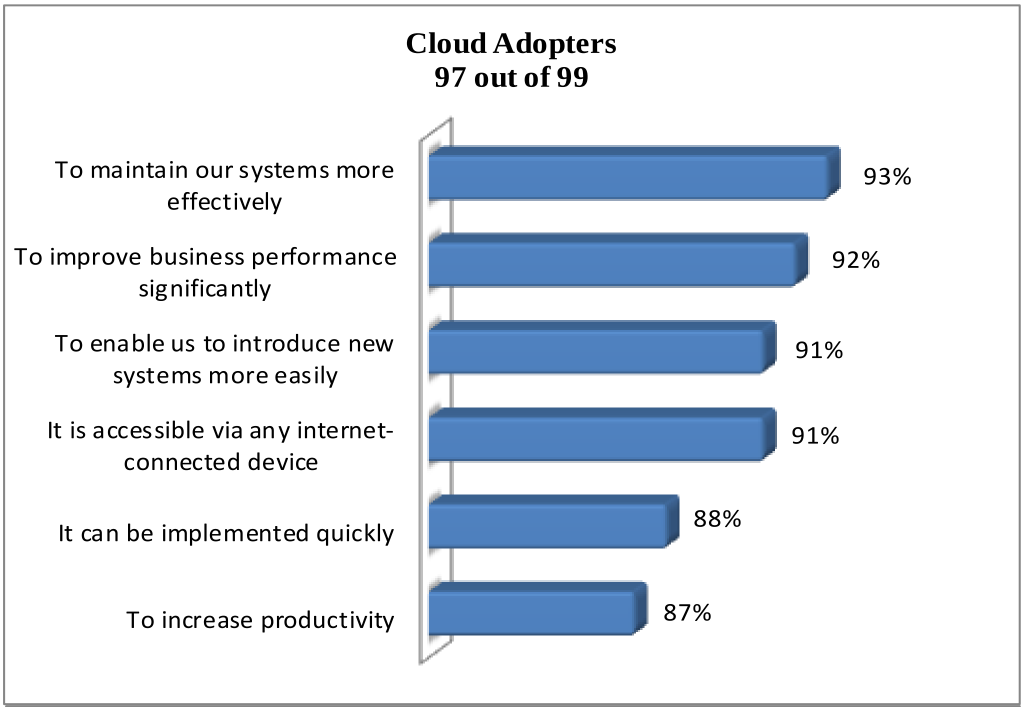


Figure 5.22: Importance of expected benefits for Cloud & Future Adopters in 2013



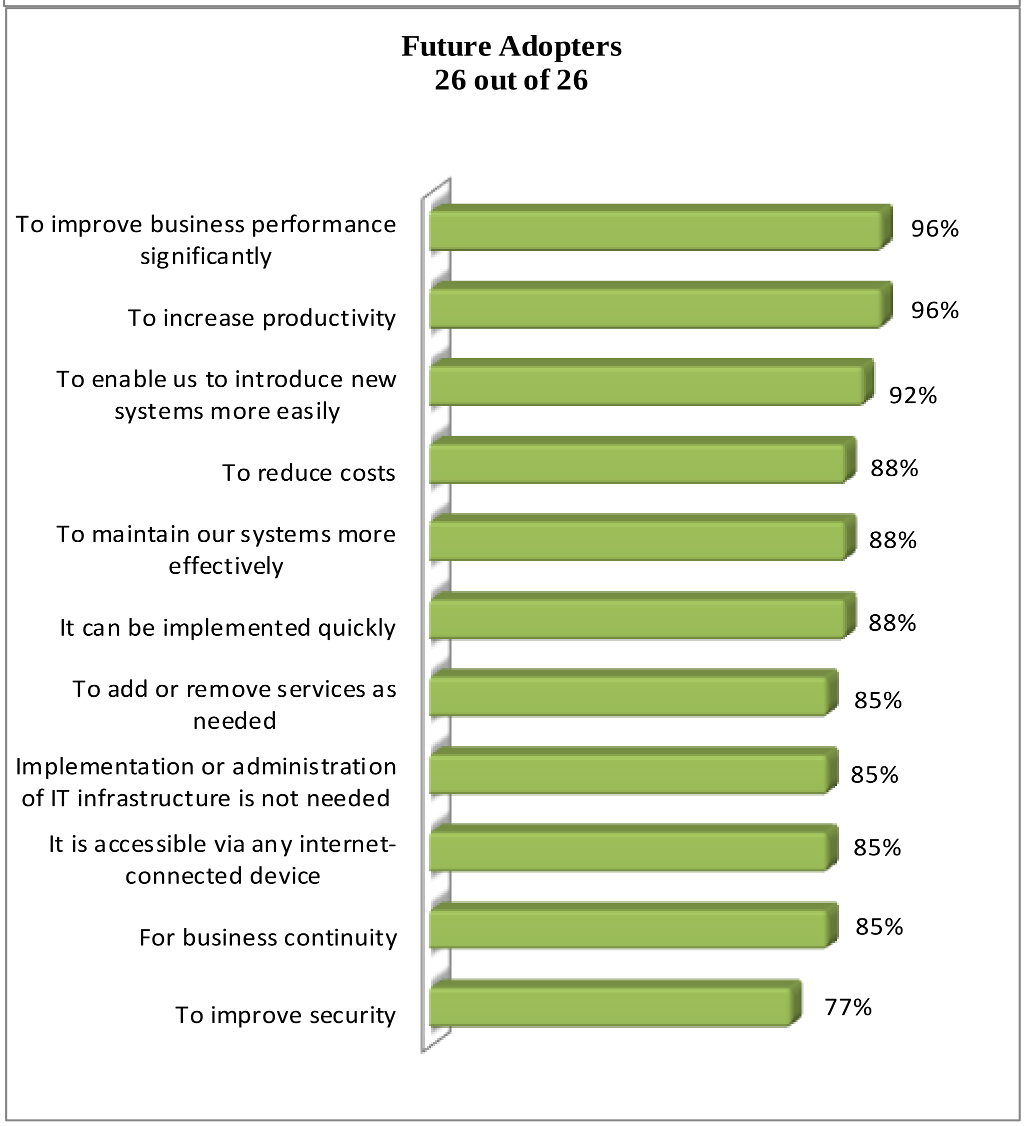


Figure 5.23: Top five expected benefits for Cloud & Future Adopters in 2013

The results of ordered logistic regression analysis showed there were few statistically significant differences between the importance levels of expected benefits for Future Adopters compared with Cloud Adopters, as shown in Table 5.11.

After adjusting the analyses for demographic covariates (industry sectors, State and organisation size), the results did not change, except for the ‘needless of implementation or administration of IT infrastructure’ which was more important for Future Adopters than for Cloud Adopters ($p=0.03$). This might be because Future Adopters were considering a move to the cloud because of a lack of internal IT professional staff and, thus, hoped to move the responsibility for implementation and administration of IT infrastructure to CSPs. Follow-up qualitative research will investigate the reality of this assumption.

Respondents from Future Adopters also believed that ‘improving business performance significantly’, ‘increasing productivity’ and ‘green IT’ were more important than did Cloud Adopters ($p>0.035$). These findings supported the view which emerged from the 2013 survey that the objectives of the Future Adopters who expected to become Cloud Adopters in the near future were starting to think more strategically. However, a follow-up qualitative study will provide more details regarding this issue.

Table 5.11: Results of comparing importance of expected benefits for Future Adopters against Cloud Adopters in 2013

Importance of Expected Benefit	Future Adopters			
	OR[1](95% CI)	p value[1]	OR[2](95% CI)	p value[2]
To reduce costs	1.88 (0.85 to 4.18)	0.12	2.23 (0.94 to 5.29)	0.07
To maintain our systems more effectively	1.59 (0.71 to 3.60)	0.26	1.85 (0.78 to 4.35)	0.16
To improve business performance significantly	2.43 (1.11 to 5.33)	0.03	2.40 (1.04 to 5.55)	0.04
To enable us to introduce new systems more easily	1.05 (0.47 to 2.31)	0.91	1.01 (0.44 to 2.34)	0.97
To add or remove services as needed	1.80 (0.79 to 4.09)	0.16	2.03 (0.84 to 4.91)	0.12
To facilitate internal communication	1.00 (0.45 to 2.20)	1.00	1.14 (0.49 to 2.66)	0.76
To increase productivity	2.88 (1.26 to 6.58)	0.01	2.64 (1.11 to 6.31)	0.03
To improve security	2.06 (0.93 to 4.54)	0.07	2.10 (0.91 to 4.81)	0.08
It can be implemented quickly	0.88 (0.41 to 1.90)	0.74	0.83 (0.38 to 1.85)	0.66
To avoid the expense of buying licences	0.96 (0.44 to 2.09)	0.92	1.07 (0.47 to 2.42)	0.88
Implementation or administration of IT infrastructure is not needed	1.94 (0.86 to 4.36)	0.11	2.55 (1.08 to 6.01)	0.03
It is accessible via any internet connected device	1.38 (0.61 to 3.14)	0.44	1.39 (0.59 to 3.30)	0.45
It is green IT	2.48 (1.07 to 5.77)	0.03	2.54 (1.07 to 6.03)	0.03
To mitigate risks	1.38 (0.63 to 2.99)	0.42	1.07 (0.47 to 2.46)	0.87
For business continuity	1.22 (0.57 to 2.63)	0.61	1.08 (0.48 to 2.43)	0.85

* Data analysed using ordered logistic regression.
OR: Odds Ratio. 95% CI: 95% Confidence Interval.
[1] Not adjusted for covariates. [2] adjusted for covariates including industry sector, state and organisation size.
123 observations

5.2.3. Usage of Cloud Computing

This Section investigates the ways in which Cloud Adopters were using Cloud and how Future Adopters were planning to use it in both surveys. This usage involves the service delivery models and the type of CSPs being selected; as well as their deployment models. The types of cloud systems and their deployment models are also included in this Section.

5.2.3.1. Service Delivery Models and their Cloud Service Providers

All the service delivery models which have been discussed in the reviewed literature were also identified by both Cloud and Future Adopters in both surveys. Not only were the usage proportions of these models and the type of CSP identified, but the association between them, as well, which is not found in the literature. However, because the number of responses to some options in both surveys was small (Table 5.12 & Table 5.13), logistic regression analysis could not be applied to identify whether any statistically significant difference existed between Cloud and Future Adopters in terms of service delivery models and CSPs.

The results of the 2012 survey indicated that SaaS was the most popular service delivery model used by Cloud Adopters, followed by IaaS and PaaS (in that order), as illustrated in Figure 5.24. Future Adopters expected to use these in the same order – but with different proportions. The ranking of these models was expected, since: using packaged software is relatively easy for companies of all sizes leading to the popularity of SaaS; access to space on a ‘raw machine’ for storage or to run statistical analyses is also relatively easy to achieve, making IaaS fairly attractive; but the need for development environments depends upon the existence of in-house IT specialists capable of building their own software, so that PaaS is the least popular of the three ‘standard’ types of CC environments.

Future Adopters expected to use IaaS and PaaS much more than did Cloud Adopters, possibly because existing SaaS solutions did not meet the requirements of some organisations since customisation in SaaS is very limited (Kepes, 2011, Padhy and Patra, 2012, Xiaoqi, 2012), or possibly because companies which have not yet made use of CC are not truly aware of the relative levels of difficulty involved in the three basic CC types.

International CSPs were the major providers of SaaS and PaaS for Cloud Adopters. However, Australian CSPs were not only the major providers for Cloud Adopters' IaaS solutions, but were also expected by Future Adopters to be the major providers for all types of cloud service delivery models.

As a result, a move towards contracting with Australian CSPs was expected. This occurred because the International CSPs were the initiators of Cloud and they were the most experienced providers at that time compared with Australian ones. However, Cloud Adopters are more likely to use IaaS with Australian CSPs because: they would like to gain instantaneous HPC access, provided by an ideal CSP's infrastructure (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010) without the delay or interruption common with International CSPs; or possibly because of their awareness of the imminent changes to the federal Privacy Act which has made offshore CSPs considerably less attractive to Australian firms. Both these justifications apply to Future Adopters who would prefer to use Australian CSPs with all service delivery models as well as to Cloud Adopters.

Table 5.12: Number of responses for service delivery models and the type of CSPs for Cloud and Future Adopters in 2012

Service Delivery Model	**Cloud Adopters** (168 out of 187 Cloud Adopters)			**Future Adopters** (58 out of 64 Future Adopters)		
	International CSP	**Both Australian & International CSPs**	**Australian CSP**	**International CSP**	**Both Australian & International CSPs**	**Australian CSP**
SaaS	76	24	49	7	15	27
PaaS	25	2	20	2	4	29
IaaS	26	13	45	1	6	38

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

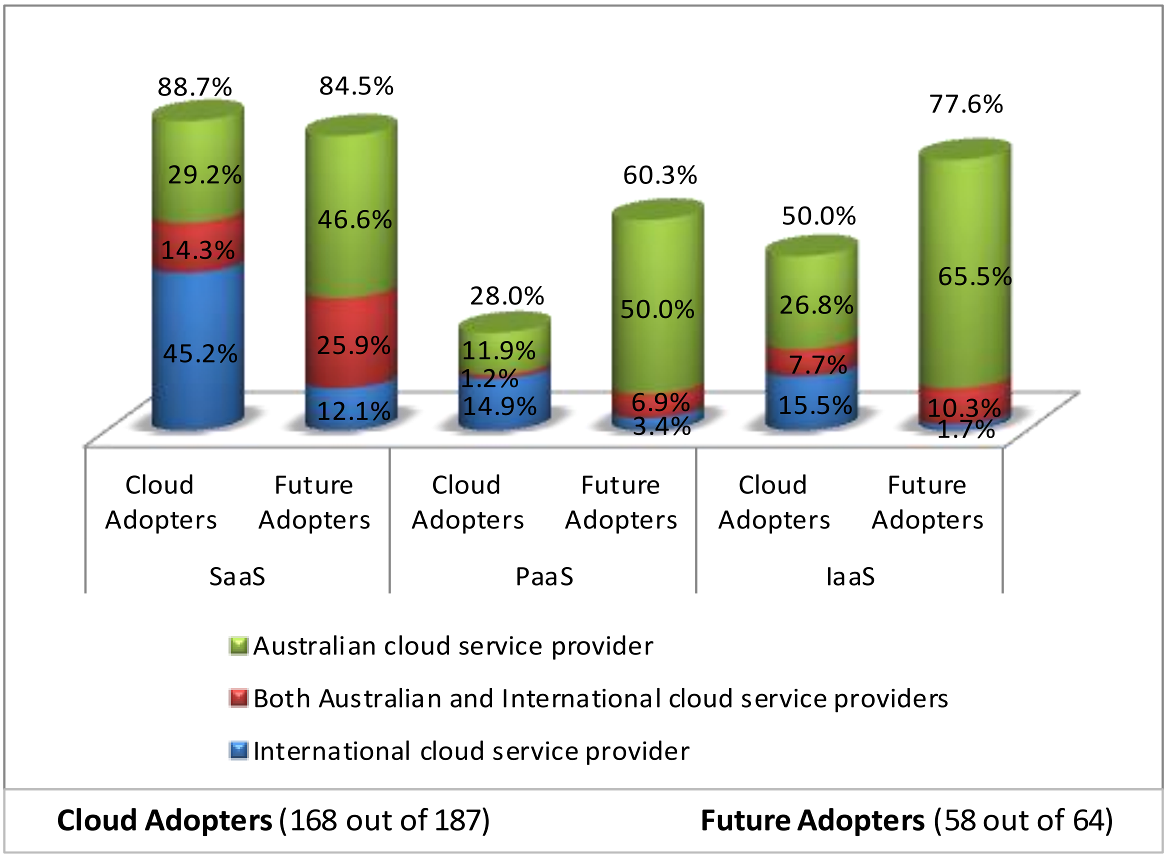


Figure 5.24: Service delivery models and their CSPs for Cloud & Future Adopters in 2012

The 2013 survey showed no change in the usage rank of service delivery models against the 2012 survey findings for either Cloud or Future Adopters. Although the 2012 survey indicated a likely increase in the usage of IaaS and PaaS in the near future (Figure 5.24), such an increase occurred only for SaaS and PaaS usage by Cloud Adopters (Figure 5.25).

It was also expected that Cloud Adopters would be more likely to use Australian CSPs for all service delivery models as a result of the 2012 survey (Figure 5.24). However, the proportions of Australian CSP usage declined for all types of service delivery models of Cloud Adopters in 2013. While at first sight this might seem counter-intuitive, given the up-coming changes to the federal Privacy Act, the explanation may well be found in the opening in 2012 of Australian datacentres by giant international CSPs such as AWS, Inc. (Amazon Web Services Inc., 2012). This enabled Australian CC users to take advantage of the greater experience and expertise of global CSPs while still keeping their data physically within Australia – a potential win-win for organisations subject to the Privacy Act.

Table 5.13: Number of responses for service delivery models and the type of CSPs for Cloud and Future Adopters in 2013

Service Delivery Model	Cloud Adopters (97 out of 99 Cloud Adopters)			Future Adopters (25 out of 26 Future Adopters)		
	International CSP	Both Australian & International CSPs	Australian CSP	International CSP	Both Australian & International CSPs	Australian CSP
SaaS	48	21	19	5	3	14
PaaS	23	3	8	1	2	9
IaaS	20	4	23	2	2	15

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

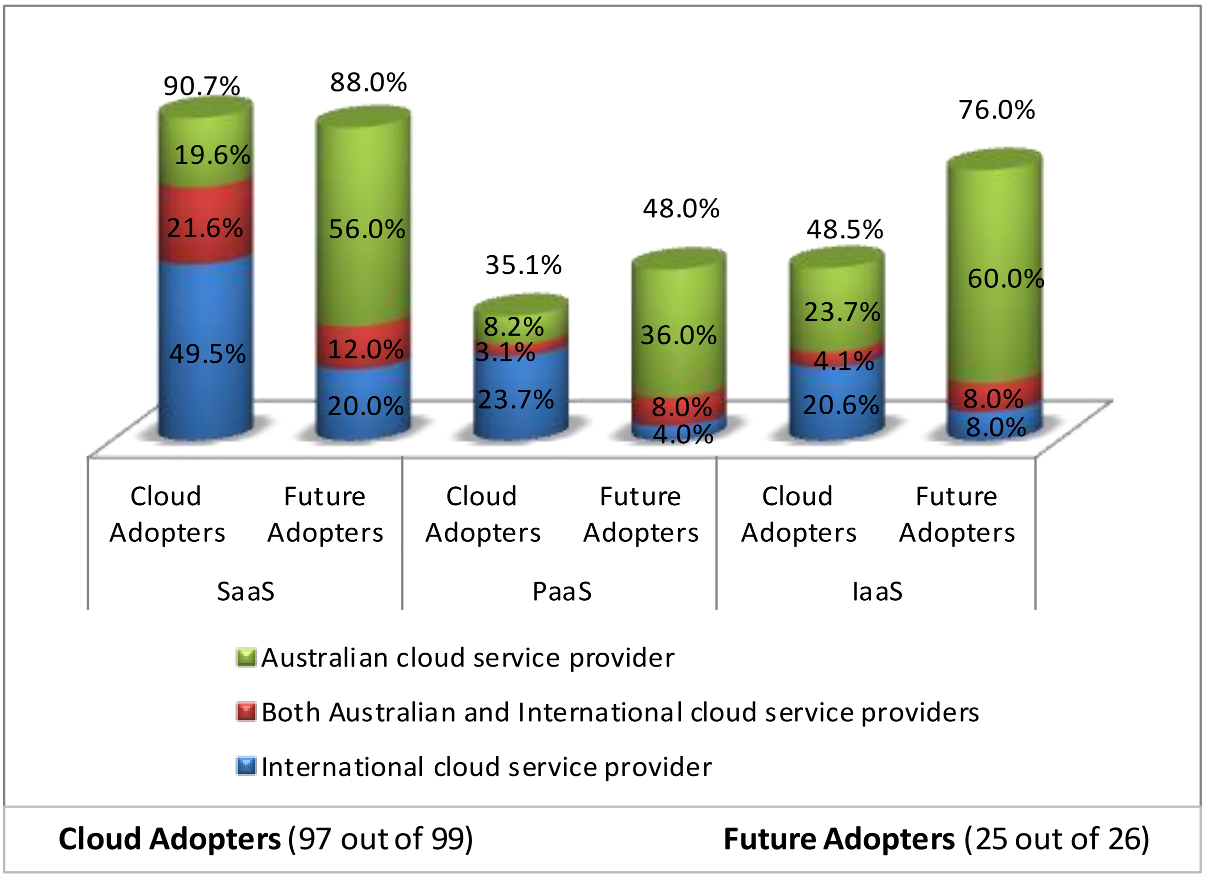


Figure 5.25: Service delivery models and their CSPs for Cloud & Future Adopters in 2013

5.2.3.2. Deployment Models and their Service Delivery Models

Respondents to both surveys indicated that all types of deployment and service delivery models identified in the reviewed literature were being used (or would be used) by Cloud and Future Adopters. Both the usage proportions of the deployment models and their relationship with service delivery models, which was not found in the reviewed literature, were identified in this study (Table 5.14 and Table 5.15).

The results of the 2012 survey showed that Public Cloud was the major deployment model for 64.95% of Cloud Adopters, followed by Out-sourced and On-site Private Clouds with ~44%, as illustrated in Figure 5.26. Hybrid Cloud was used by 23.8% of Cloud Adopters while both types of Community Cloud were the least favoured deployment models in terms of usage (below 17%).

Future Adopters, by contrast, expected to use both types of Private Cloud as their preferred deployment model with ~61%, followed by Hybrid Cloud with 53.4%. Public Cloud occupied the fourth place in terms of usage for Future Adopters with 44.8%, with both types of Community Cloud falling below 30%. Whether this enthusiasm for Private Cloud on the part of Future Adopters is indicative of a change in corporate policies towards CC, or whether it merely reflects lack of hands-on experience in using the cloud is difficult to tell – without the opportunity to interview representatives of both experienced and future users.

SaaS was the preferred service delivery model for both Cloud and Future Adopters in all deployment models, except for those Future Adopters expecting to use Out-sourced Private Cloud and Hybrid Cloud, where SaaS ranked second after IaaS.

IaaS was the second major service delivery model in all deployment models except for those Cloud Adopters using either type of Community Cloud where it came in third after PaaS, suggesting that these respondents were involved in more cloud-based development projects.

IaaS was the most popular service delivery model for those Future Adopters planning to use Out-sourced Private Cloud and Hybrid Cloud; and the second most popular deployment model for Cloud Adopters, either because their IT infrastructure was not sufficiently up-to-date for their CSP's infrastructure (Orfano, 2009, Schaffer, 2009, O'Driscoll et al., 2013, Schadt et al., 2010); or because they were increasingly taking advantage of the opportunity to use cloud-based analysis tools such as Hadoop, Cloudera or MapR.

Table 5.14: Number of responses for deployment models and their service delivery models for Cloud and Future Adopters in 2012

Deployment Model	Cloud Adopters (168 out of 187 Cloud Adopters)			Future Adopters (58 out of 64 Future Adopters)		
	SaaS	PaaS	IaaS	SaaS	PaaS	IaaS
Hybrid Cloud	26	13	24	18	15	21
Out-sourced Community Cloud	21	7	6	9	5	7
On-site Community Cloud	7	5	4	6	4	6
Out-sourced Private Cloud	52	13	38	24	16	26
On-site Private Cloud	47	29	42	23	22	22
Public Cloud	92	17	30	20	5	10

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

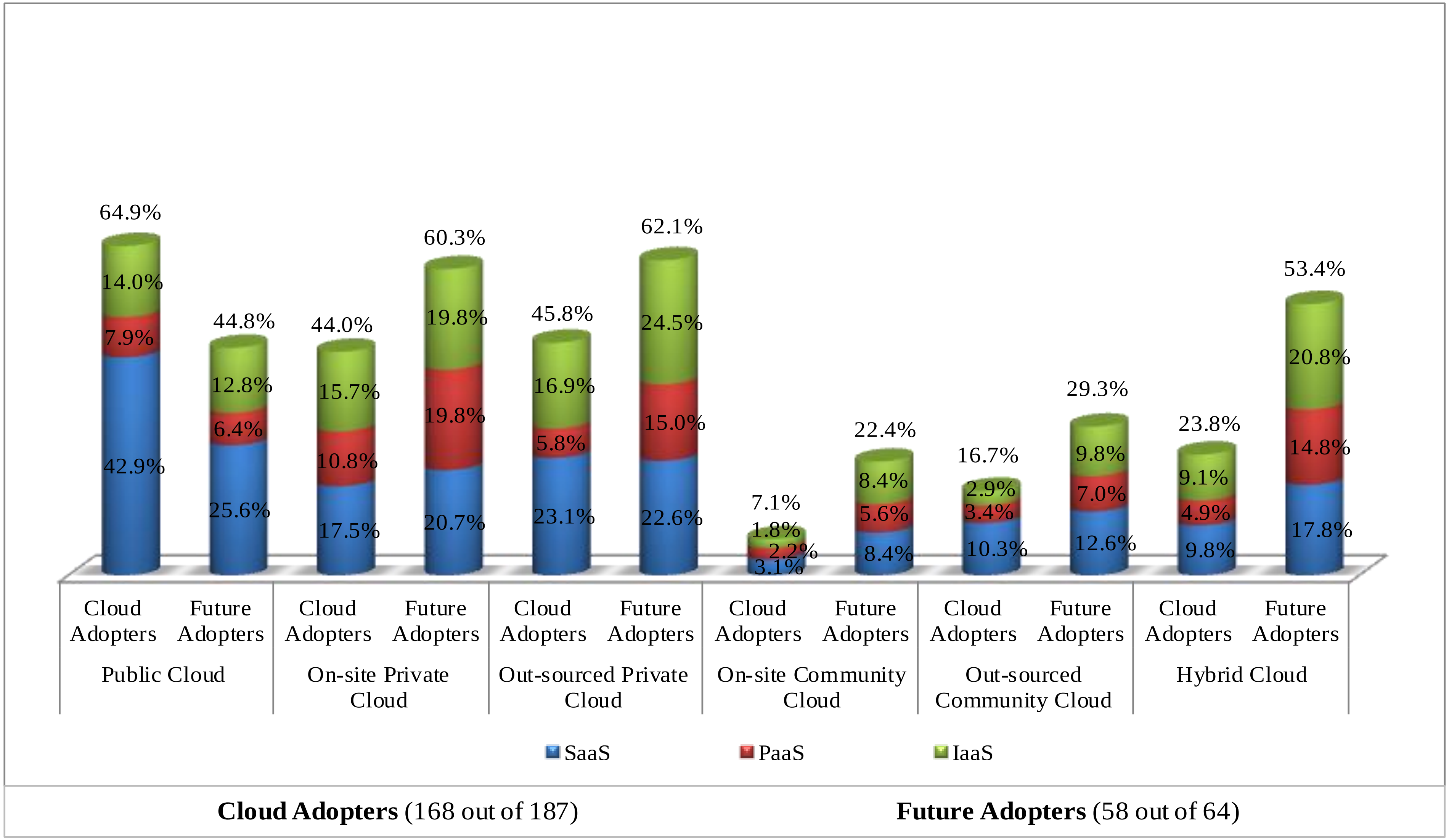


Figure 5.26: Deployment models and their service delivery models for Cloud & Future Adopters in 2012

The 2013 survey showed that the rank of deployment models of Cloud Adopters was the same as in 2012, although this order changed slightly for Future Adopters, as shown in Figure 5.27. Hybrid Cloud became the second most popular deployment model for Future Adopters between Out-sourced and On-site Private Cloud.

The usage proportions of all deployment models for Cloud and Future Adopters (Figure 5.27) declined, except for Out-sourced Private Cloud for Cloud Adopters and Hybrid Cloud for both Cloud and Future Adopters which increased by between 2.6% and 6%. Whether this was the result of genuine changes in cloud usage, or merely reflected the make-up of the rather smaller respondent group in 2013 is difficult to determine.

SaaS was the most popular service delivery model in all deployment models for Cloud and Future Adopters, except for On-site Private Cloud for Cloud Adopters where it became the second most popular model after IaaS. The second major service delivery model in all deployment models was IaaS, except for Out-sourced Community Cloud for Cloud Adopters where it came in third after PaaS. The popularity rankings of the service delivery models described in Section 5.2.3.1 did not change significantly between the two surveys.

Table 5.15: Number of responses for deployment models and their service delivery models for Cloud and Future Adopters in 2013

Deployment Model	**Cloud Adopters** (97 out of 99 Cloud Adopters)			**Future Adopters** (25 out of 26 Future Adopters)		
	SaaS	**PaaS**	**IaaS**	**SaaS**	**PaaS**	**IaaS**
Hybrid Cloud	16	10	13	9	4	9
Out-sourced Community Cloud	7	3	2	4	2	4
On-site Community Cloud	3	1	3	2	0	1
Out-sourced Private Cloud	32	11	25	11	5	11
On-site Private Cloud	15	16	24	8	3	7
Public Cloud	53	14	17	9	2	3

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

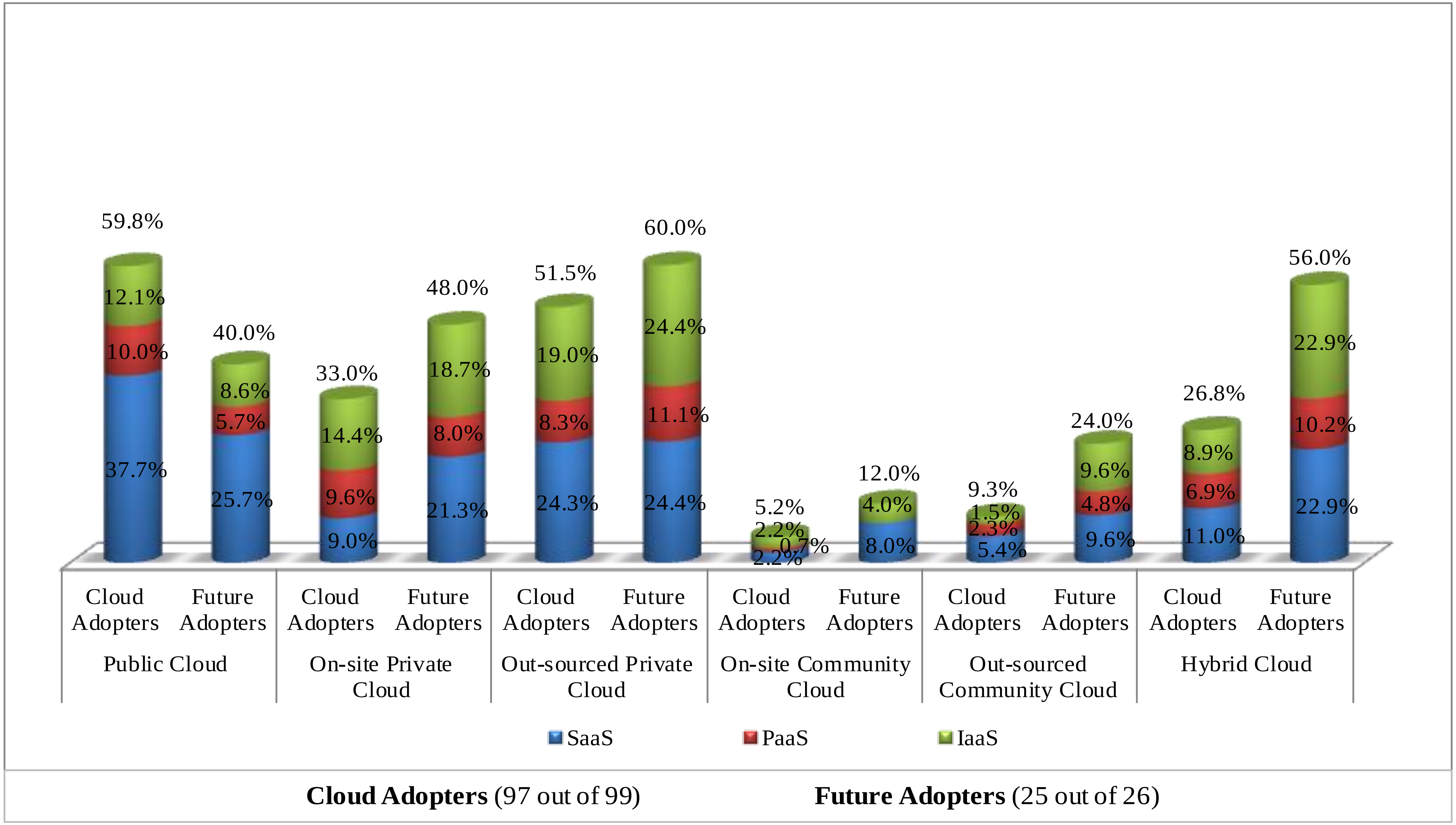


Figure 5.27: Deployment models and their service delivery models for Cloud & Future Adopters in 2013

5.2.3.3. Cloud Systems and their Deployment Models

Many cloud systems were identified in the reviewed literature but without ranking or indicating the usage proportions of these systems for Cloud and Future Adopters. Thus, ranking the top five cloud systems and identifying their deployment models for Cloud and Future Adopters highlighted the priorities of each category (Table 5.16 for the 2012 survey and Table 5.19 for the 2013 survey).

The results of the 2012 survey showed that email, storage/archiving, database and backup were among the top five cloud systems for both Cloud and Future Adopters, as illustrated in Figure 5.28. The usage proportions anticipated by Future Adopters for all these cloud systems were higher than was seen with Cloud Adopters.

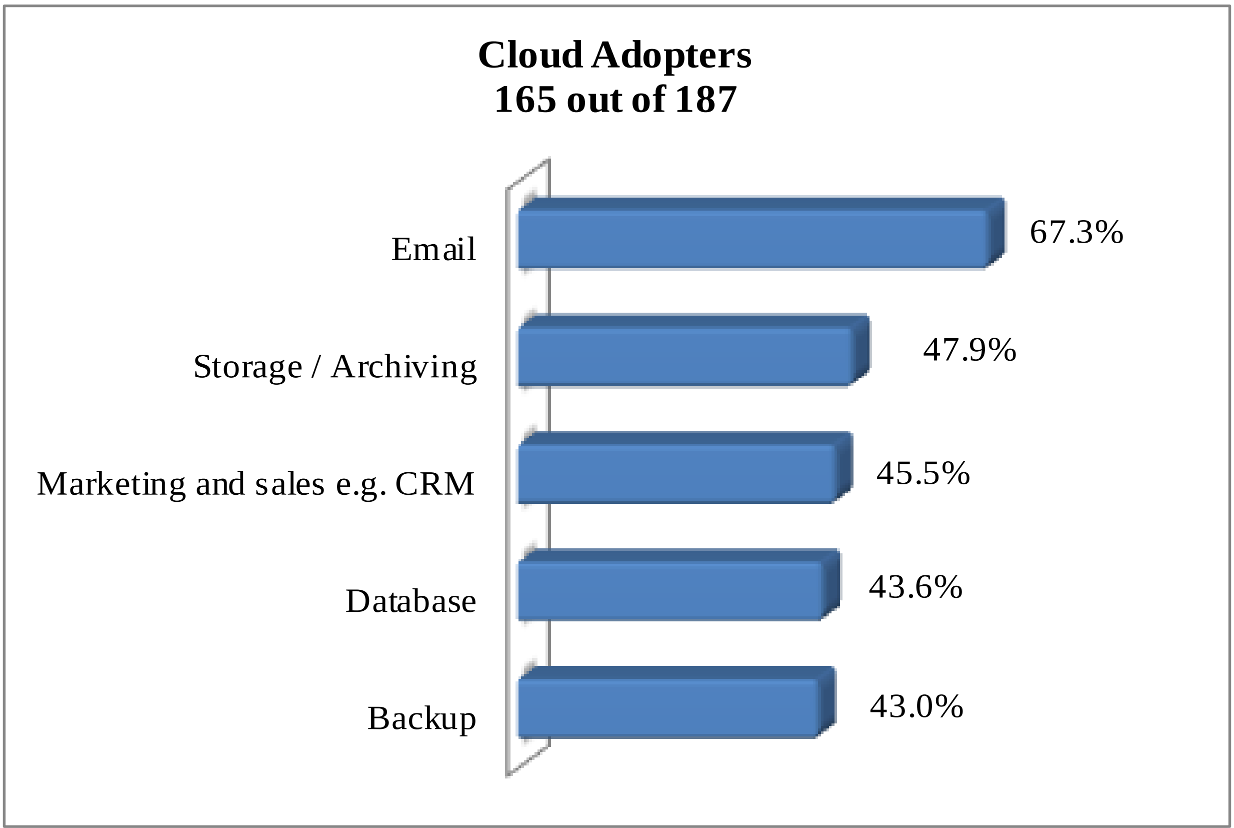
Backup was the most important expected cloud system for Future Adopters in 2012, while it occupied only fifth place for Cloud Adopters in the same year, suggesting that this application might well prove less important in practice.

Marketing and sales was among the top five cloud systems for Cloud Adopters but not for Future Adopters (who might not yet have had the opportunity to appreciate just how useful the cloud could be in this area), while financial and accounting and critical business systems were among the top five important expected cloud system for Future Adopters but not for Cloud Adopters. Such differences highlighted the development continuity of CC based on the business requirements of each category.

Table 5.16: Number of responses for cloud systems and their deployment models for Cloud and Future Adopters in 2012

Cloud System	Cloud Adopters 165 out of 187 Cloud Adopters)						Future Adopters (57 out of 64 Future Adopters)					
	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	12	38	16	0	3	4	3	16	13	0	2	4
Manufacturing	0	12	4	0	0	1	1	6	2	0	0	1
Real time	4	19	8	0	0	4	2	11	5	0	1	4
Marketing and sales e.g. CRM	46	18	17	0	3	8	5	11	13	0	2	6
Human resource management	21	27	19	0	2	1	6	12	13	0	1	3
Database	14	46	20	0	3	4	2	20	11	0	2	4
Storage / Archiving	23	45	18	2	3	4	5	19	18	1	4	5
Backup	15	40	20	0	3	6	7	19	21	0	4	5
Email	55	42	25	1	4	5	13	14	17	1	5	6
Critical business systems	9	42	21	0	3	5	2	18	13	0	2	4
Processing	6	22	8	1	0	1	3	13	14	0	2	6
Test and development	19	36	14	1	5	9	9	12	14	0	3	7
Project Management	21	20	11	2	1	1	5	13	14	0	2	4

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.



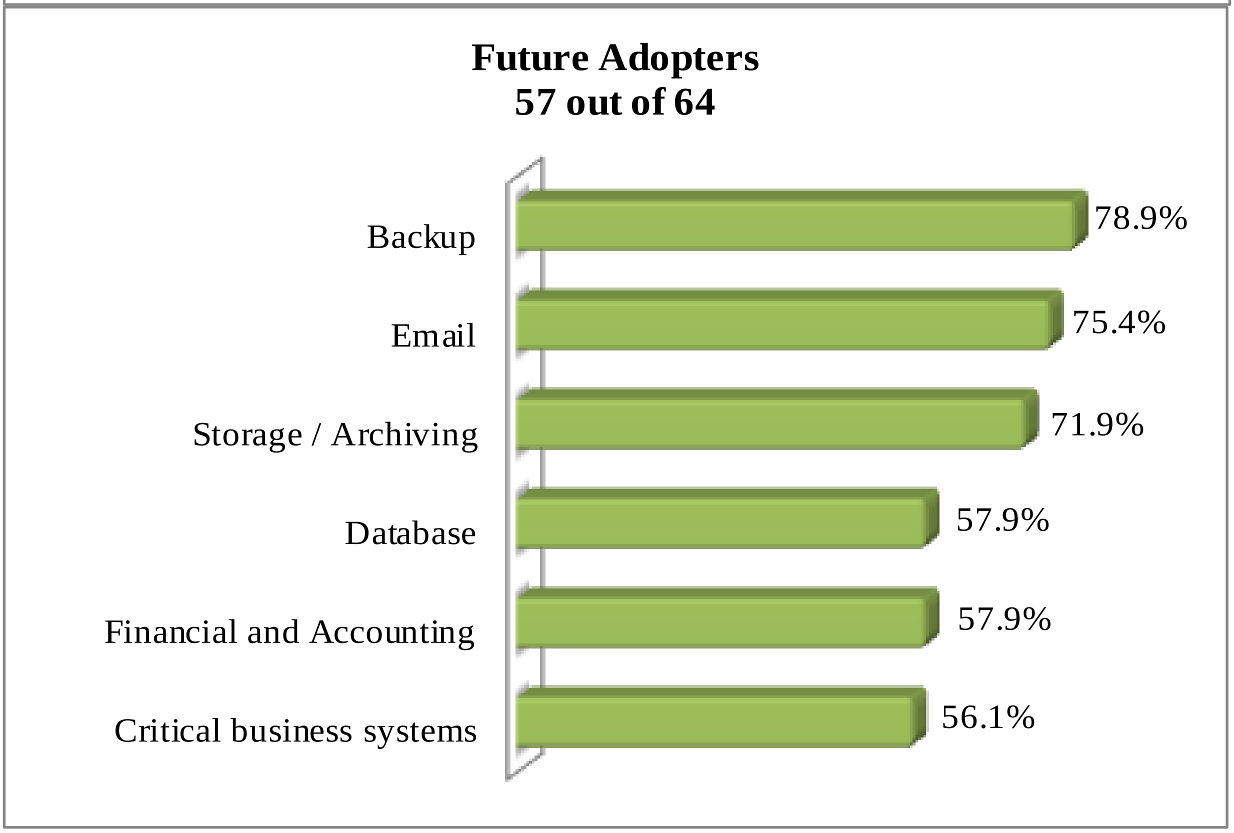


Figure 5.28: Top five cloud systems for Cloud & Future Adopters in 2012

Most major systems were (or would be) located in On-site Private Clouds for both Cloud and Future Adopters in 2012, as shown in Table 5.17. The main cloud systems for Cloud Adopters were located in either Public Cloud or On-site Private Cloud. However, Out-sourced Private Cloud was expected by Future Adopters to replace Public Cloud and On-site Private Cloud. This shift towards Out-sourced Private Cloud could not be tested because of the anonymous nature of the surveys.

Table 5.17: Top cloud systems and their deployment models for Cloud & Future Adopters in 2012

Cloud System	Cloud Adopters (165 out of 187)	Futuer Adopters (57 out of 64)
Email	Public Cloud	Out-sourced Private Cloud
Storage / Archiving	On-site Private Cloud	On-site Private Cloud
Marketing and sales e.g. CRM	Public Cloud	Out-sourced Private Cloud
Database	On-site Private Cloud	On-site Private Cloud
Backup	On-site Private Cloud	Out-sourced Private Cloud
Financial and Accounting	On-site Private Cloud	On-site Private Cloud
Critical business systems	On-site Private Cloud	On-site Private Cloud

Investigating the primary cloud system for each deployment model showed that Email was the most popular cloud system of Public Cloud for both Cloud and Future Adopters in 2012, as presented in Table 5.18. Testing and development was also the major cloud system of Hybrid Cloud for both Cloud and Future Adopters. The main cloud systems for all of the other deployment models for Cloud and Future Adopters differed widely. This displacement presents the dynamic changes of CC usage within most of the deployment models.

Table 5.18: Main cloud system for each deployment model for Cloud & Future Adopters in 2012

Cloud System	Cloud Adopters (165 out of 187)			Futuer Adopters (57 out of 64)		
Public Cloud	Email		23%	Email		21%
On-site Private Cloud	Storage / Archiving	Database	11%	Database		11%
Out-sourced Private Cloud	Email		12%	Backup		13%
On-site Community Cloud	Storage / Archiving	Project Management	29%	Email	Storage / Archiving	50%
Out-sourced Community Cloud	Test and development		17%	Email		17%
Hybrid Cloud	Test and development		17%	Test and development		12%

The results of the 2013 survey showed that email, web hosting, storage/archiving and financial and accounting were among the top five cloud systems for both Cloud and Future Adopters, as illustrated in Figure 5.29. The anticipated usage proportions of all these cloud systems by Future Adopters were higher than for Cloud Adopters. Although web hosting was added only in the 2013 survey as a result of 4 out of 27 respondents' comments in 2012 it, together with Email, became the top-ranked cloud system used by Cloud Adopters and the fifth most popular option for Future Adopters. In addition collaboration systems, also not originally listed in the 2012 survey and identified by only 2 out of 27 who selected the option 'Other' in the 2012 survey, took fourth place for Cloud Adopters in 2013. Database and backup cloud systems dropped out of the top five cloud systems for Cloud Adopters in 2013 but remained among the top five cloud systems for Future Adopters. Marketing and sales, human resource management; and test and development were among the top five cloud systems for Cloud Adopters only, whereas critical business systems were among the top five expected cloud systems for Future Adopters only.

These differences indicated the variation in business requirements between Cloud and Future Adopters. It would be fascinating to follow the Future Adopters group up.

Table 5.19: Number of responses for cloud systems and their deployment models for Cloud and Future Adopters in 2013

Cloud System	**Cloud Adopters** (96 out of 99 Cloud Adopters)						**Future Adopters** (23 out of 26 Future Adopters)					
	Public Cloud	**On-site Private Cloud**	**Out-sourced Private Cloud**	**On-site Community Cloud**	**Out-sourced Community Cloud**	**Hybrid Cloud**	**Public Cloud**	**On-site Private Cloud**	**Out-sourced Private Cloud**	**On-site Community Cloud**	**Out-sourced Community Cloud**	**Hybrid Cloud**
Financial and Accounting	4	20	16	0	2	2	2	7	6	0	1	1
Manufacturing	0	7	0	0	0	0	0	1	2	0	0	0
Real time	2	7	4	0	0	1	0	1	2	0	0	1
Marketing and sales e.g. CRM	24	8	9	0	1	1	6	3	3	0	1	1
Human resource management	14	12	14	0	4	0	2	4	8	0	1	0
Database	6	15	18	1	1	3	1	8	7	0	0	2
Storage / Archiving	15	15	16	1	3	2	4	7	9	0	0	2
Backup	5	16	14	1	2	1	2	5	10	1	0	1
Email	22	15	15	0	2	6	8	5	8	0	0	1
Critical business systems	4	17	14	0	1	1	0	6	6	0	1	2
Processing	2	10	3	0	1	1	0	2	3	0	0	2
Test and development	12	19	9	0	1	3	2	4	2	0	0	4
Project Management	10	10	8	0	2	0	2	4	4	0	0	0
Collaboration	17	10	9	1	3	2	7	3	2	0	0	0
Content Filtering	15	7	9	0	1	1	5	2	3	0	1	0
E-Learning	17	11	9	1	1	0	6	1	5	1	1	2
Library Services	4	8	5	2	1	0	2	2	2	1	0	1
Phone System	2	13	8	1	1	2	3	5	4	0	0	0
Web Hosting	29	9	21	2	1	5	5	3	3	1	1	2

* Participants were allowed to choose more than one answer in a matrix form question. Thus, the total numbers of respondents are not added up.

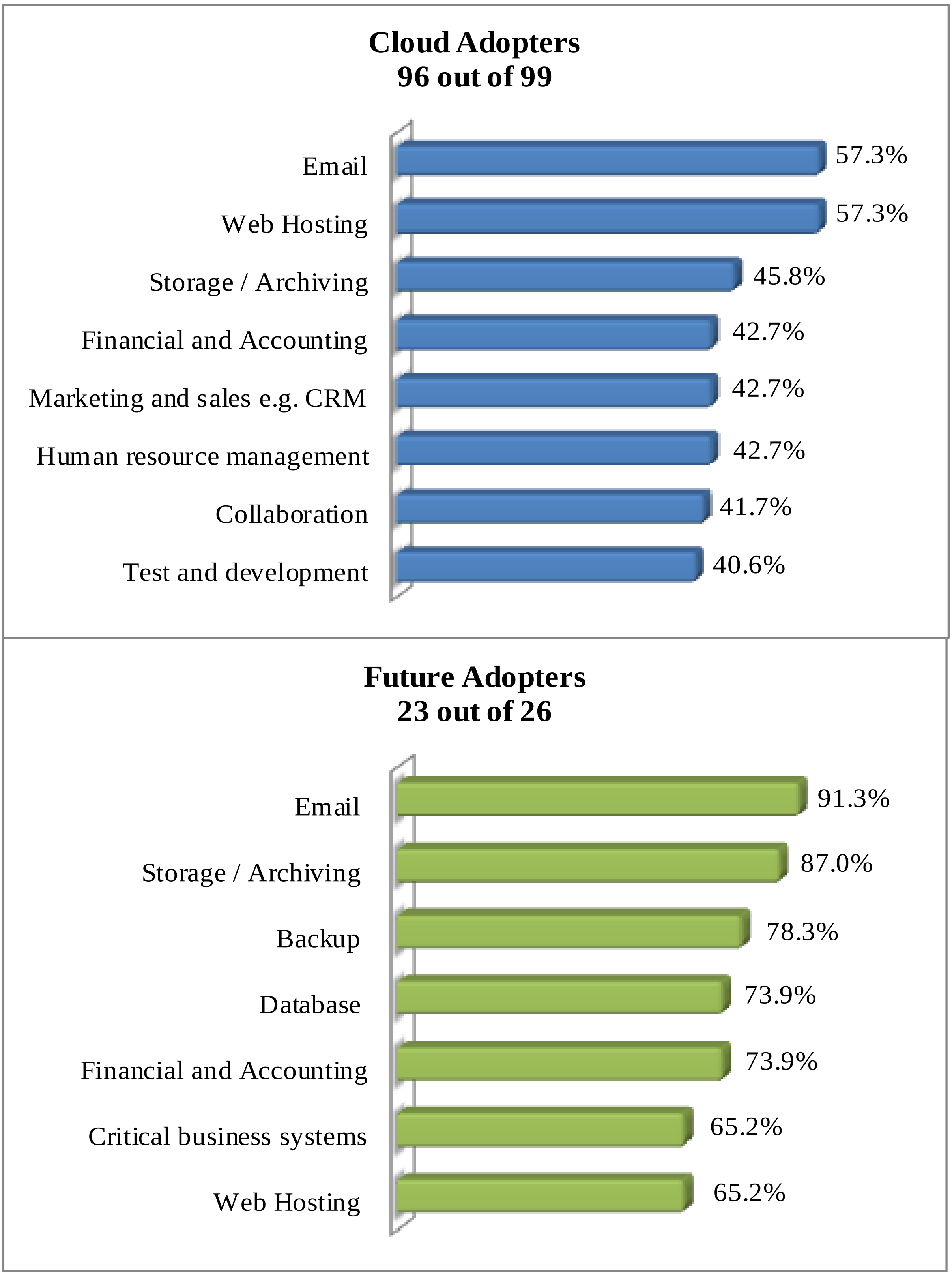


Figure 5.29: Top five cloud systems for Cloud & Future Adopters in 2013

Most major systems were located primarily in Public Cloud for Cloud Adopters, but were expected to be located in Out-sourced Private Cloud by Future Adopters in 2013, as shown in Table 5.20. The main cloud systems for Cloud Adopters were located in either Public Cloud or both types of Private Cloud, yet Hybrid Cloud was expected to be a third option for Future Adopters. Backup and database systems were reversed between both types of Private Cloud for Cloud and Future Adopters. The main deployment model for all the other top five cloud systems was the same for both Cloud and Future Adopters, except for email, testing and development and critical business cloud systems which were expected to be hosted in either Out-sourced Private Cloud or Hybrid Cloud by Future Adopters. These findings supported the assumption which stated there will be a shift towards Out-sourced Private Cloud and Hybrid Cloud but the anonymous nature of the surveys prevented from testing this assumption.

Table 5.20: Top cloud systems and their deployment models for Cloud & Future Adopters in 2013

Cloud System	Cloud Adopters (96 out of 99)		Futuer Adopters (23 out of 26)	
Email	Public Cloud		Public Cloud	Out-sourced Private Cloud
Web Hosting	Public Cloud		Public Cloud	
Storage / Archiving	Out-sourced Private Cloud		Out-sourced Private Cloud	
Marketing and sales e.g. CRM	Public Cloud		Public Cloud	
Database	Out-sourced Private Cloud		On-site Private Cloud	
Backup	On-site Private Cloud		Out-sourced Private Cloud	
Financial and Accounting	On-site Private Cloud		On-site Private Cloud	
Human resource management	Public Cloud	Out-sourced Private Cloud	Out-sourced Private Cloud	
Test and development	On-site Private Cloud		On-site Private Cloud	Hybrid Cloud
Collaboration	Public Cloud		Public Cloud	
Critical business systems	On-site Private Cloud		On-site Private Cloud	Out-sourced Private Cloud

No major cloud system of any of deployment model in 2013 was the same for both Cloud and Future Adopters, as shown in Table 5.21. This difference illustrates the dynamic changes within all deployment models in use by Cloud Adopters or expected to be used by Future Adopters.

It is interesting to note that web hosting, included for the first time in the 2013 survey, was the major system in three deployment models for Cloud Adopters; and in two deployment models for Future Adopters.

Table 5.21: Main cloud system for each deployment model for Cloud & Future Adopters in 2013

Cloud System	Cloud Adopters (96 out of 99)		Futuer Adopters (23 out of 26)	
Public Cloud	Web Hosting	14%	Email	14%
On-site Private Cloud	Financial and Accounting	9%	Database	11%
Out-sourced Private Cloud	Web Hosting	10%	Backup	11%
On-site Community Cloud	Web Hosting Library Services	20%	Backup Web Hosting Elearning Library Services	25%
Out-sourced Community Cloud	Human resource management	14%	Financial and Accounting Web Hosting Critical business systems Elearning Marketing and sales e.g. CRM Content Filtering Human resource management	14%
Hybrid Cloud	Email	19%	Test and development	18%

5.3. Applying Diffusion of Innovation Theory and Crossing the Chasm Theory

Although there are many theoretical approaches to investigating the rates of adoption for technological innovations, Rogers' (1962) theory of diffusion of innovation is the most widely known (Sahin, 2006). Rogers (2003) defined diffusion as "*the process by which an innovation is communicated through certain channels over time among the members of a social system*" and he also defined an innovation as "*an idea, practice, or object perceived as new by an individual or other unit of adoption*". He analysed the adoption life cycle of an innovation and classified adopters into five categories: (1) innovators 2.5%, (2) early adopters 13.5%, (3) early majority 34%, (4) late majority 34%; and (5) laggards 16% (see Figure 5.30). He also identified Relative Advantage, Compatibility, Observability, Trialability and Complexity as the five attributes of an innovation. The innovation characteristics communication channels, time and social system were defined in his theory as the main four elements of an innovation.

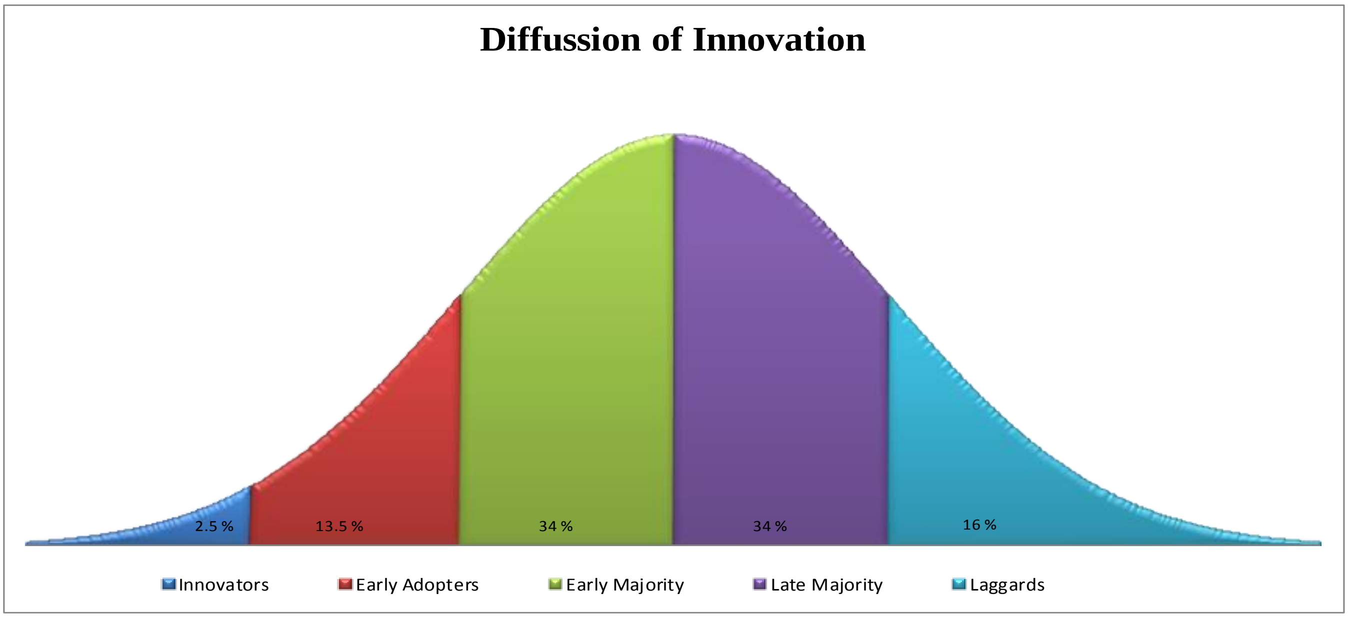


Figure 5.30: Proportions of categories in diffusion of innovation theory - adapted from (Rogers, 2003)

A more recent approach to innovation theory is the 'crossing the chasm' theory developed by Geoffrey Moore (Moore, 1999). Based on Rogers's diffusion of innovation theory for high tech innovations, 'crossing the chasm' can add significantly greater insight to an analysis of the diffusion of technological innovations such as CC. Moore (Moore, 1999) identified a *chasm*, a slowing in the adoption rate, between the early adopters and the early majority categories (see Figure 3.3). He found that the first stages of the market for an innovative product (innovators and early adopters) is driven by a visionary attitude, whereas the mainstream market (early majority, late majority and laggards) is driven by a pragmatist attitude – and that not all innovations survived as far as majority acceptance. Moore proposed some techniques to assist organisations to cross this chasm, including "find a pragmatist in pain" and help him to solve his problems using the innovation so as to influence other pragmatists.

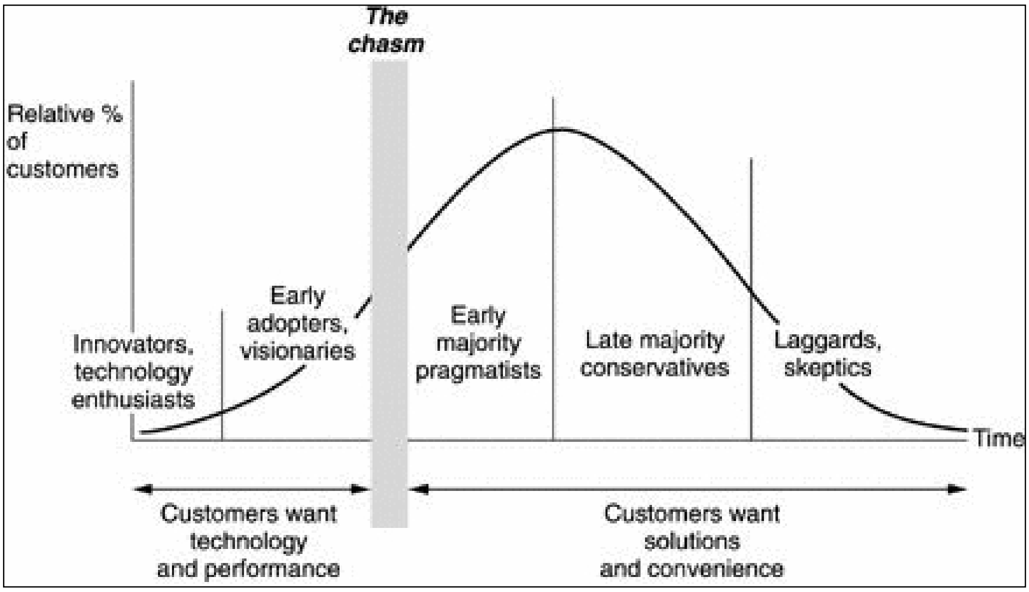


Figure 5.31: The Chasm in the Adoption Curve (Barker, 2011)

The two theories have been used simultaneously in various researches of other main IT innovations (see, for example: Agyeman et al., 2009, Cho et al., 2009, Chuang and Hsu, 2010, Constantiou et al., 2009, Egmond et al., 2006, Faiers and Neame, 2006, Greenhalgh et al., 2008, Lehmann and Esteban-Bravo, 2006, Lelarge, 2008, Linton, 2002, Towns, 2010) and this combination of theories has the potential to enrich the present study. These theories are applicable to this research because they can highlight *the acceptance* (adoption or rejection) and *the use* of the CC innovation, as well as its *evolution* across and within Australian organisations. In other words, both the diffusion and the development of the CC innovation can be more effectively studied with the assistance of these theories.

The adopters categories of Rogers' theory and Moore's chasm metaphor were applied in this project to identify whether a gap exists between the early adopters and early majority categories, since the largest obstacle for adopting an innovation is to achieve the transition between these segments (Moore, 1999, Agyeman et al., 2009). This study examined whether the chasm had been successfully crossed and, if so, how it had been crossed (i.e. what new capabilities, resources and skills had been developed). These theories would also provide assistance in discovering why, if the chasm had not been crossed, this had occurred (i.e. what challenges might have occurred to slow diffusion and prevent the pragmatists from adopting the CC innovation).

5.3.1. Applying Diffusion of Innovation Theory to the 2012 Survey

To enable the application of diffusion of innovation theory only Current and Future Adopters were included in the analysis, while Past Adopters and both types of Non-Adopters were excluded. By comparing the bell curve of the CC adoption level in 2012 (Figure 5.32) and the proportions of each category of adopters with diffusion of innovation theory (Figure 5.30), it was noticeable that Australian organisations have reached the early majority era of CC and were expected to enter the late majority era by 2013.

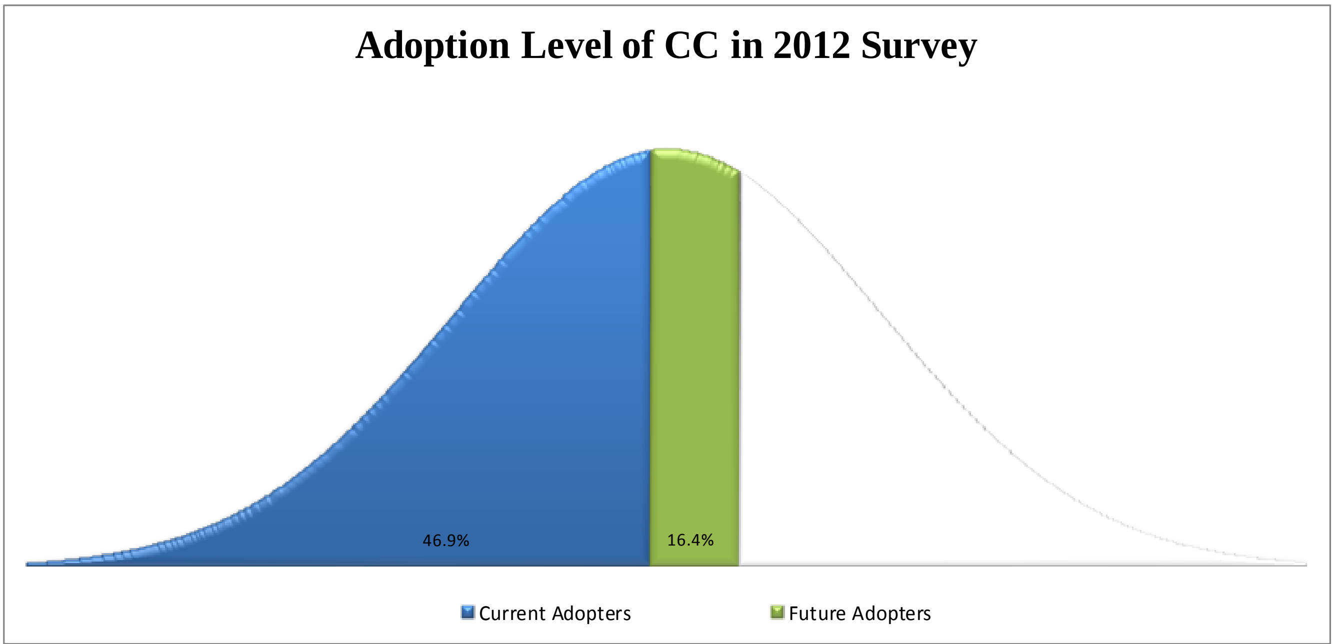


Figure 5.32: Adoption Level of CC in the 2012 Survey

Figure 5.33 provides more details about CC adoption level. According to the diffusion of innovation theory, *innovators* in Figure 5.30 should form 2.5% of adopters – and this is very close to the 2.9% of survey respondents who had adopted CC before 2007, as shown in Figure 5.33.

Diffusion of innovation theory also indicates that *early adopters* in Figure 5.30 should make up13.5% of adopters – and, again, this is almost equivalent to the 13.6% of respondents who had already adopted CC between 2007 and 2009, as illustrated in Figure 5.33.

From 2010 until the end of 2012, as illustrated in Figure 5.33, 33.1% of participating organisations had already adopted or expected to adopt CC by 2012. This indicated that Australia was at the early majority stage of diffusion of this innovation, since the early majority should make up 34% of adopters according to diffusion of innovation theory in Figure 5.30. It was therefore expected that 13% of the late majority would adopt CC between 2013 and 2016, if this trend held.

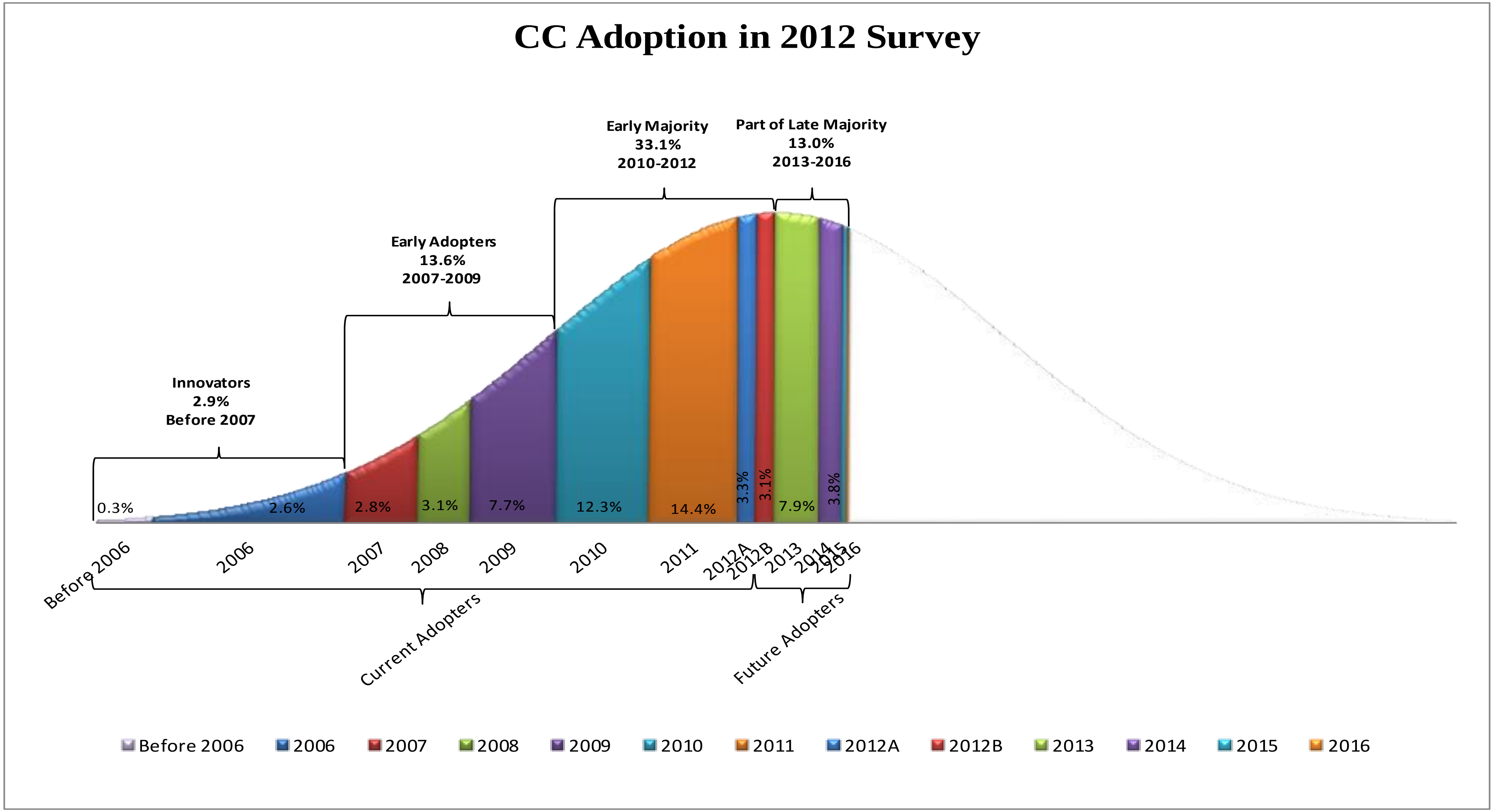


Figure 5.33: CC Adoption in the 2012 Survey

5.3.2. Applying Diffusion of Innovation Theory to the 2013 Survey

Comparing the bell curve adoption level of CC against the 2013 survey (Figure 5.34) and the proportions of categories from diffusion of innovation theory (Figure 5.30) indicated that Australian organisations were at the beginning of the late majority era of CC.

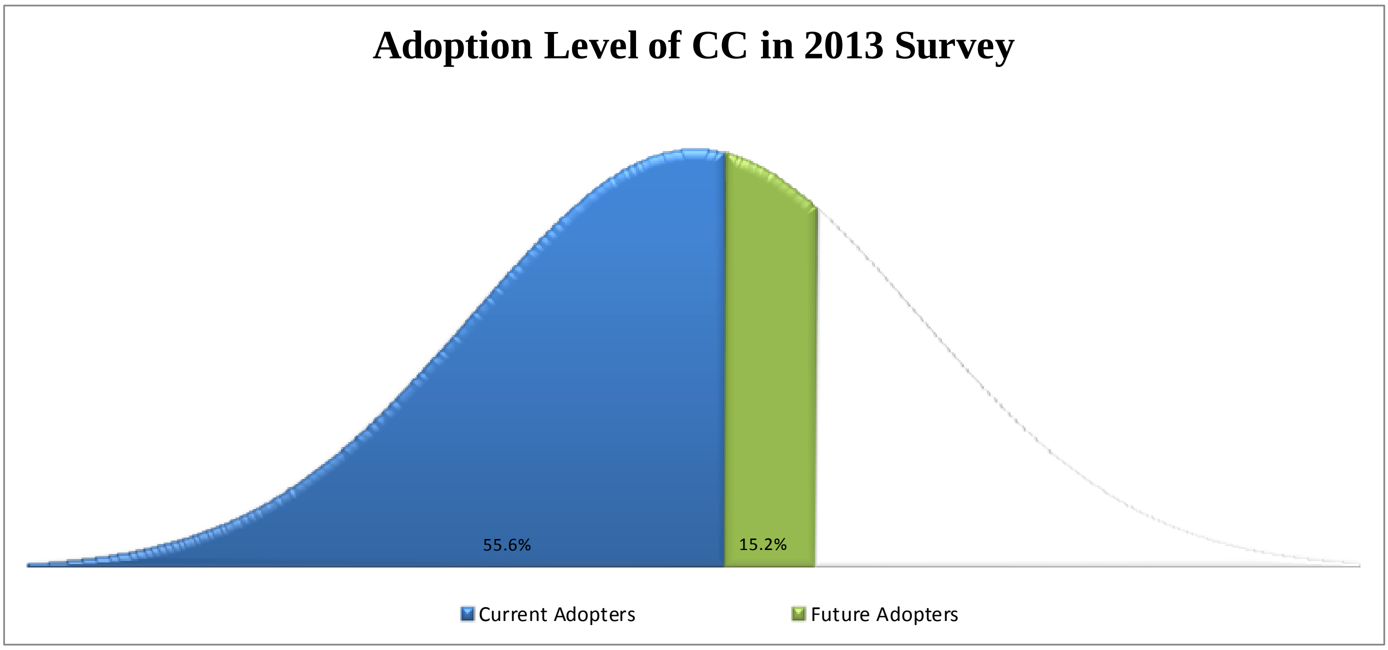


Figure 5.34: Adoption Level of CC in the 2013 Survey

Figure 5.35 provides more detail concerning Australia's 2013 CC adoption level. According to diffusion of innovation theory, *innovators* in Figure 5.30 should form 2.5% of adopters, whereas those who had adopted CC before 2007 actually made up 5.9%, as illustrated in Figure 5.35 – suggesting either that Australia was unusually innovative with respect to CC, or that this particular technological innovation was sweeping the world like wildfire!

Diffusion of innovation theory also indicates that *early adopters* in Figure 5.30 should form 13.5% of adopters and its closest category were those who had already adopted CC between 2007 and 2009 with 11.7%, as shown in Figure 5.35. This is a very close match, especially given the higher-than-normal group of *innovators*.

33.4% of survey respondents had adopted CC between 2010 and 2012, as shown in Figure 5.35, suggesting that these were the early majority, which the theory predicts should make up 34% of adopters (see Figure 5.30) – another very close match.

It was also expected, following the results of the 2012 survey, that 13% of the late majority would adopt CC between 2013 and 2016. This figure increased to 19.3% in the 2013 survey, but some of these respondents had already adopted CC in 2013A[6] (4.1%) and were expecting to adopt it by the end of 2013B (0.6%), while 14.6% were projected to adopt CC between 2014 and 2016. These findings suggest that interest in adopting CC is continuing to increase, although a follow-up survey will be needed to confirm the continuity of this adoption.

Generally speaking, the survey results matched the theory remarkably closely! Those few differences in proportions between the categories of diffusion of innovation theory and the actual rates of adoption in the 2013 survey may have occurred because the number of respondents in the 2013 survey was low compared with those in the 2012 survey. Of course, the more respondents collected in a survey, the more accurate the results which can be obtained. Nonetheless, it is unusual to find such a close match between Rogers' diffusion of innovation theory and real-world numbers – suggesting that the CC innovation is sufficiently popular to have taken on what one might almost call an archetypal adoption pattern!

Although it initially appeared, from the results of the 2012 survey, that a chasm might possibly open up between the early majority and the late majority during the remainder of the calendar year 2012, the results of the 2013 survey showed there was, in fact, no chasm at all in the adoption lifecycle of CC.

[6] The proportion cited for 2013A includes those who had already adopted CC before the 2013 survey was conducted, while the 2013B figures relate to those who were expecting to adopt CC by the end of the 2013 year, i.e. after the survey date.

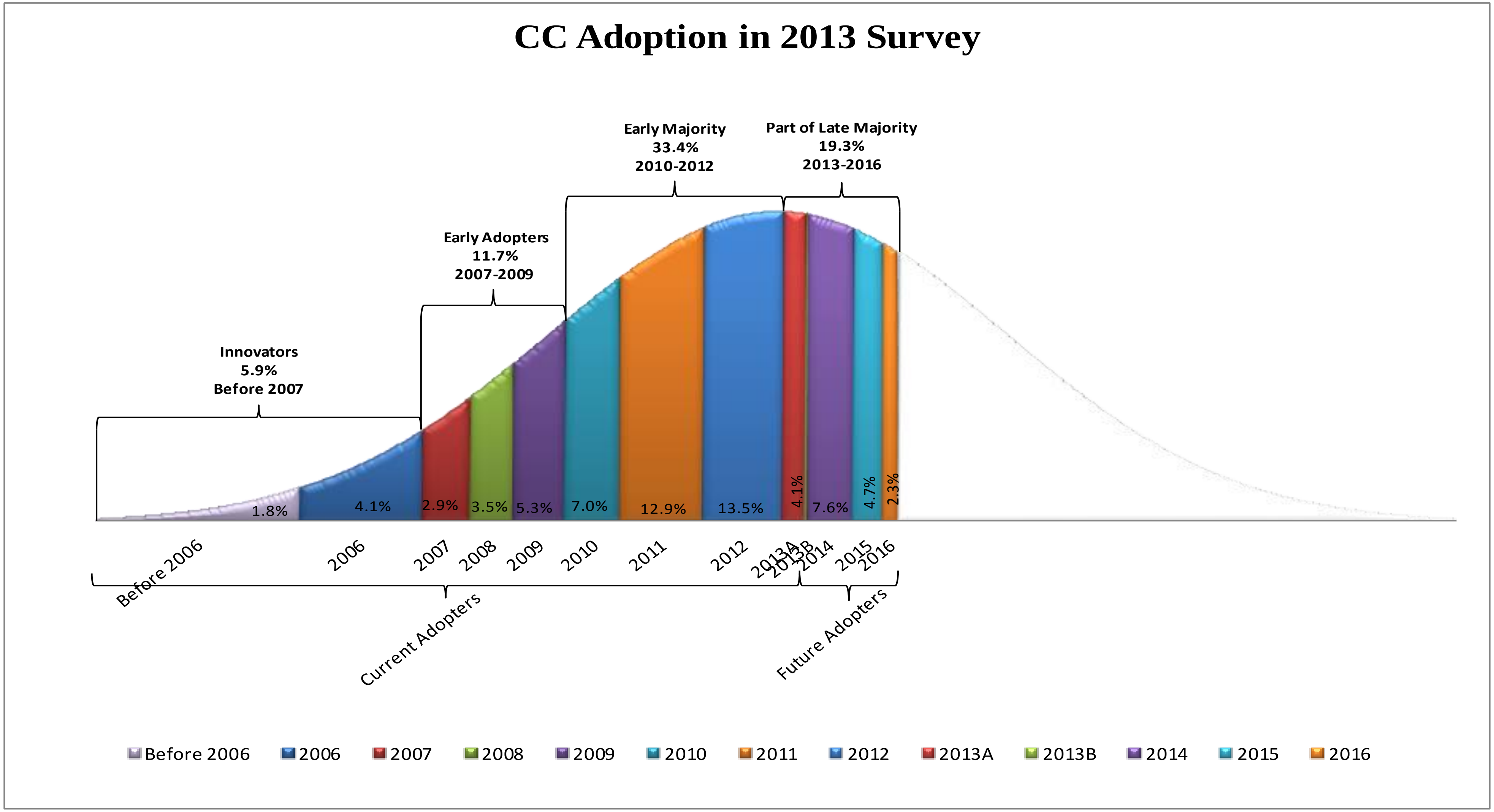


Figure 5.35: CC Adoption in the 2013 Survey

5.3.3. Diffusion of Cloud Computing in Australia

Since the proportions of the categories from diffusion of innovation theory and the actual levels of adoption in the 2013 survey were not identical, the next step was to compare between the two surveys – both individually and after combining them. The approach of combining the results of both surveys was taken because the respondents to the 2013 survey were not a subset of those in the 2012 survey, as indicated earlier.

The results from both surveys confirm that Innovators were those who had adopted CC before 2007 and Early Adopters were those who had adopted CC between 2007 and 2009, as presented in Table 5.22. The results also show that the Early Majority were those who adopted CC between 2010 and 2012, while the Late Majority were those who adopted CC after 2012. The adoption rate varies from one innovation to another and from one category to another, but average adoption rate for each category in CC is illustrated in Table 5.23.

Not only did Moore's chasm between the early adopters and the early majority fail to appear in the data, but the impact of the 'influentials' (early adopters) on 'imitators' (early majority) was observed in the acceleration of the adoption rate year on year (see Table 5.23) – the average adoption rate per year for the early majority was the highest rate found in any category! This may indicate a success in marketing CC in Australia, although the dramatic failure of Amazon's EC2 cloud in April 2011, at that time possibly the world's largest CSP, caused enormous recovery problems (Thorsten, 2011, IT PRO India, 2011, Weissberger, 2011) and remains one of the most widely cited examples of CSP failure. Although marketing can assist an innovative technology to cross the chasm (Lelarge, 2008, Egmond et al., 2006), it may also have prevented that chasm from occurring in CC. Therefore, the average adoption rate per year for the late majority may change because it was predicted on the basis of the answers given by the Future Adopters. Quite possibly, however, CC is simply the right innovation at the right time – and further qualitative investigation will help to establish whether this assumption is valid.

Table 5.22: Adoption date for Innovators, Early Adopters, Early Majority and Late Majority in 2012 and 2013

Current & Future Adopters														
Theoretical Category		**Date**	**The 2012 Survey**				**The 2013 Survey**				**Combine (2012 & 2013)**			
Innovators	**2.5%**	**Before 2006**	1	0.3%	11	**2.9%**	3	1.8%	10	**5.9%**	4	0.7%	21	**3.7%**
		2006	10	2.6%			7	4.1%			17	3.0%		
Early Adopters	**13.5%**	**2007**	11	2.8%	53	**13.6%**	5	2.9%	20	**11.7%**	16	2.9%	73	**13.1%**
		2008	12	3.1%			6	3.5%			18	3.2%		
		2009	30	7.7%			9	5.3%			39	7.0%		
Early Majority	**34.0%**	**2010**	48	12.3%	129	**33.1%**	12	7.0%	57	**33.4%**	60	10.7%	186	**33.2%**
		2011	56	14.4%			22	12.9%			78	13.9%		
		2012	25	6.4%			23	13.5%			48	8.6%		
Late Majority	**34.0%**	**2013**	31	7.9%	51	**13.0%**	8	4.7%	33	**19.3%**	39	7.0%	84	**15.0%**
		2014	15	3.8%			13	7.6%			28	5.0%		
		2015	4	1.0%			8	4.7%			12	2.1%		
		2016	1	0.3%			4	2.3%			5	0.9%		

* The percentages are results after dividing the numbers with the total number of respondents for each survey.
Total number of respondents in the 2012 survey is 390.
Total number of respondents in the 2013 survey is 171.
Total number of respondents after combining both surveys is 561.

Table 5.23: Average of CC adoption rate per year

Theoretical Category	Adoption period	Average adoption rate per year in the 2012 survey		Average adoption rate per year in the 2013 survey		Average adoption rate per year when both surveys were combined	
Innovators	Before 2007	2.6%	10	4.1%	7	3.0%	17
Early Adopters	2007-2009	4.5%	17.7	3.9%	6.7	4.3%	24.3
Early Majority	2010-2012	11.0%	43	11.1%	19	11.1%	62
Late Majority	2013-2016	3.3%	12.75	4.8%	8.25	3.7%	21

* The numbers of before 2006 were not taken into account because the number of years could not be determined to calculate the average.
The percentages are results after dividing the numbers with the total number of respondents for each survey.
Total number of respondents in the 2012 survey is 390.
Total number of respondents in the 2013 survey is 171.
Total number of respondents after combining both surveys is 561.

5.3.4. Applying the Attributes of an Innovation to Cloud Computing

The slow adoption rate (chasm) between early adopters and early majority, which was identified by Moore in the adoption of high-tech innovations (Moore, 1999), did not appear to exist in practice for those adopting CC in Australia. As Moore stated in his theory (Crossing the Chasm), the biggest obstacle to adopting an innovation is achieving the transition from early adopters (visionaries) to early majority (pragmatists) (Agyeman et al., 2009, Lelarge, 2008) but this had, in fact, already been achieved – based on the results of both surveys of this study.

What, therefore, are the possible reasons which prevented the opening of a chasm for adoption of CC in Australia? Since developing new capabilities, resources and skills can help in crossing the chasm (Cho et al., 2009), was this the explanation – and, if so, what were these capabilities, resources and skills? What developments have been made in CC to meet the pragmatists' requirements and facilitate the continuity of adoption in Australia?

Studying the attributes of CC as an innovation may highlight many factors that contributed to the avoidance of this chasm. Rogers (2003) identified the following five attributes of an innovation which determine its success:

1. *Relative Advantage*: the degree of perceiving an innovation as superior to the notion it replaces (Rogers, 2003). This can be measured by its adopters' point of view in terms of economic advantage, convenience, social prestige, or satisfaction (Rogers, 2003). Introducing new systems more easily, quickness of implementation, accessibility via any internet-connected device, ease of use in adding or removing services as needed; and reducing costs were the top realised benefits of CC as identified by the survey participants. These benefits were realised by 46% to 64% of Cloud Adopters in both surveys. Although both surveys showed that these benefits were anticipated prior to adoption of CC, the proportions of expectation did not match the realisation, since these benefits were important and expected to be achieved by 82% to 91% of Cloud Adopters. In addition, the top two expected benefits 'improving business performance significantly' and 'maintaining the systems more effectively' were not included in the top five realised benefits. Their importance as expected benefits varied between 87% and 93% in both surveys, while they were realised by only 22%–45%. However, 92%–94% of Cloud Adopters achieved all, most or some of their goals of CC in both surveys. This indicated that CC did, in fact, have a relative advantage – even though it did not fully meet the expectations of Cloud Adopters.

2. *Compatibility*: this is the extent to which an innovation is regarded to be consistent with the standards and requirements of potential adopters and with past experiences (Rogers, 2003). Moore suggested that the marketer should concentrate on one customer segment at a time and use this as a basis for the next segment (Lelarge, 2008). Thus the concerns of potential adopters (Future Adopters & Undecided Non-Adopters in our case) heavily influence diffusion of an innovation (Greenhalgh et al., 2008). In addition, an innovation will be more widely adopted if the pragmatists have a positive attitude toward it (Faiers and

Neame, 2006). The Australian government not only showed its interest in CC but also developed and enhanced an official CC policy (Archer, 2013, Department of Finance, 2014a, Tomlinson, 2014b), a privacy policy (Australian Government Information Management Office, 2012a, Goldenfein, 2013), a practicing guide (Australian Government Information Management Office, 2012a) and other activities that eventually led Australia to be the second environment for two consecutive years (Corbin, 2013, Osman, 2013). This helped to create an environment which attracted some giant international CSPs such as AWS Inc. to open global CC datacentres in Australia in 2012 (Amazon Web Services Inc., 2012) and these provided further impetus to both the development of CC and assisted in allaying concerns on the part of less confident potential adopters of CC.

Organisations and individuals do, however, have a common problem – how to accelerate the diffusion rate of an innovation (Rogers, 2003). Thus, not fully meeting the expectations of Cloud Adopters in Australia, as explained earlier, may potentially limit the adoption of CC. For example, the proportion of Past Adopters increased from 1% (4 of 390) in the 2012 survey to 2% (4 of 171) in the 2013 survey suggesting that CC did not meet the expectations of these respondents. Whether such a small proportion is truly representative, however, is not entirely clear.

3. *Complexity*: the degree of perceiving an innovation as challenging to understand and apply (Rogers, 2003). Rogers (2003) noticed that innovations diffuse at different rates because individuals perceive different characteristics in each innovation; and some degree of uncertainty occurs in the diffusion. At the beginning of this study there was considerable uncertainty and confusion over the concept of CC among Australian CIOs (Kotadia, 2010, Macquarie Telecom, 2011). Therefore, the positive influence of a group of Australian CSPs taking the initiative of establishing the OzHub coalition to develop an effective self-regulation framework which would increase trust and minimise uncertainty about

CC (Macquarie Telecom, 2011) may well have played a part in helping to overcome the fears of some sections of the CC adopting community.

However, both surveys showed that between 78% and 97% of all categories of respondents understood the concept of CC. Rogers (2003) stated that uncertainty, which causes the lack of predictability, can be reduced by means of information. Therefore, increasing the awareness of CC in all forms of media, including a series of CC documents produced by the Australian Government and the OzHub coalition, may have contributed to reducing the complexity of CC in the minds of would-be adopters. Even though this coalition disappeared quite suddenly, without trace, towards the end of 2014, it had by then already played its part in making the concept of CC clearer over time.

4. *Trialability*: the degree to which it is possible to experiment with an innovation on a limited basis (Rogers, 2003). *Reinvention*, the degree to which it is possible for a user to change or modify an innovation during adoption and implementation, is a significant principle in diffusion of innovations (Rogers, 2003). CC enables its users to scale the scope of their required service up or down automatically and immediately, then pay per for this amended usage (Abah and Francisca, 2012, InfoWorld, 2009, Guptill and McNee, 2008, Hunter, 2009). In addition, PaaS provides a complete system development platform for systems development professionals within an organisation or, possibly, across organisations (Xiaoqi, 2012, Hooper et al., 2013, Padhy and Patra, 2012, Linthicum, 2010a). This flexibility and reinvention advantage of CC provide a high degree of experimentation potential for CC with minimum cost compared to traditional licensed software. Both the trialability and the reinvention aspects of this innovation were considerably greater than any previous form of hosted computing had ever been!

5. *Observability*: the extent to which the outcomes of an innovation can be seen and understood by others (Rogers, 2003). Rogers (2003) stated that it is often difficult to adopt a new idea even if its advantages are obvious and, thus, many innovations require a long period to be widely adopted. CC is, however, readily

observable by organisations of any size – after all, even individuals use cloud-based email services such as Gmail or Hotmail widely! The existence of Future Adopters confirms that some of those who were not already using CC were able to observe the benefits of CC to their competitors or partners. In addition, both surveys showed that between 54% and 100% of all categories of respondents agreed that 'Cloud Computing will be one of the top ten strategic technologies for the next 5 years'.

It is thus not unreasonable to suggest that CC's match with Rogers' five principles of effective diffusion help to prevent the opening up of Moore's chasm for adopters of CC.

5.3.5. Adoption Process

Rogers (2003) defined the innovation decision process as "*the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt of reject, to implementation of the new idea, and to confirmation*". He classified the adoption process into five stages: (1) knowledge (2) persuasion (3) decision (adopt or reject) (4) implementation; and (5) confirmation (Rogers, 2003).

Rogers (2003) diagram of this adoption process was applied to the present study in order to identify at what stage each category stopped (see Figure 5.36). Obviously, most respondents to both surveys (78% to 97%) showed that they understood the concept of CC. Thus, Undecided Non Adopters stopped at the persuasion stage; Future Adopters and Definite Non-Adopters did not go beyond the decision stage; and Past Adopters stopped at implementation because they did not confirm their implementation as Current Adopters did.

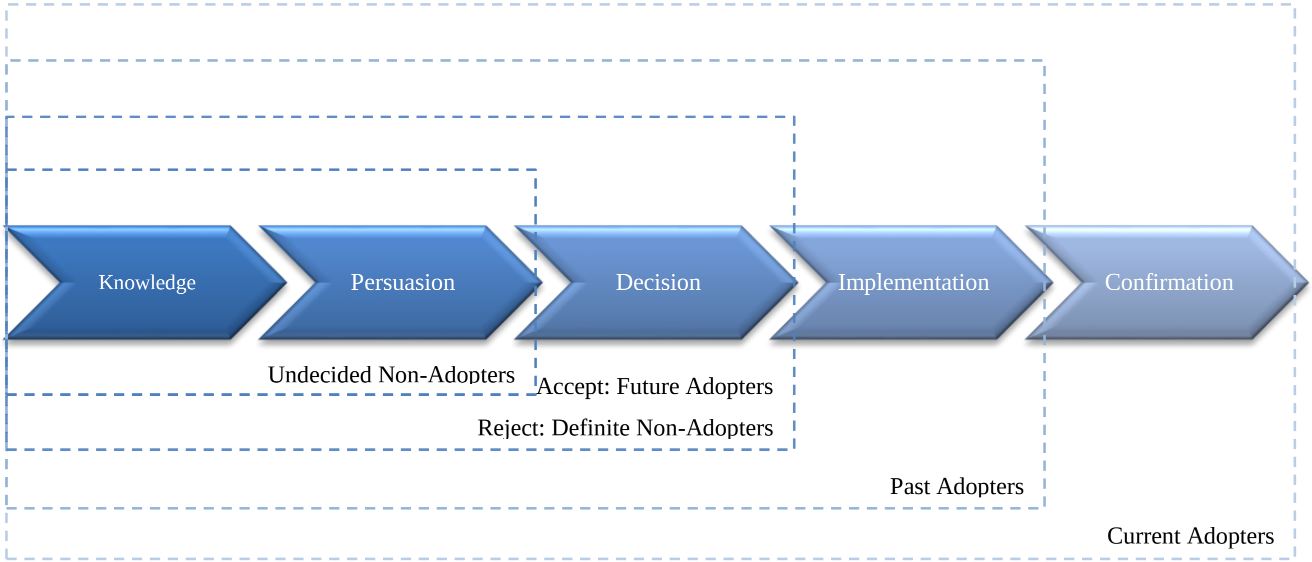


Figure 5.36: Stages of adoption process vs. adoption categories

5.3.6. Conclusion

Both Diffusion of Innovation Theory and Crossing the Chasm Theory assume that all individuals and organisations will adopt an innovation at different timeframes upon meeting their requirements and upon various development stages of that innovation, although Rogers (2003) identified two types of rejection: *active* and *passive rejection*. The rejection of those who discontinued their use of the innovation after previously adopting it (Past Adopters in our case) was considered to be *active rejection*, while *passive rejection* occurred with those who decided against adopting the innovation at all without trying it first (Definite Non-Adopters in our case).

Over the longer term there are two groups – Future Adopters and Undecided Non-Adopters – which are expected to shrink in time as they decide either to adopt or not to adopt after all. However, this study identified another two groups: Past Adopters and Definite Non-Adopters – those engaged in *active* or *passive rejection*. As Rogers (2003) noted, both types of rejection have not been distinguished or studied sufficiently in past research on diffusion (Sahin, 2006) and neither of these has been analysed in the reviewed literature. Clearly, these two groups (Past Adopters and Definite Non-Adopters) need more attention from future research, since the number of participants in these groups was not quite sufficient for in-depth analysis in the present research project. These disconfirming cases are important for the quality and generalisability of the collected data. To explore the nature and extent of these cases, case studies and more surveys focusing on these groups are suggested as further studies for CC, as well as for other innovations.

Chapter 6
Conclusion

6. Conclusion

6.1. Research Summary

The objective of this research project was to provide a broad picture of the existing state of CC in Australia and to explain the changes in uptake and usage occurring over a 16-month period between 2012 and 2013. These involved both the acceptance and use of the CC innovation, as well as its evolution across Australian organisations and the diffusion of the CC innovation.

In summary the aims of this thesis were to:

- provide an introduction to the CC innovation (Chapter 2)
- review and analyse the existing literature on CC (Chapter 2)
- extend the extant literature on CC, particularly within Australia, by identifying the CC activities of both the Australian government and the local CSPs (Chapter 2).
- understand the role, nature and adoption of CC identified from the literature by conducting two surveys in 2012 and 2013 (16 months apart) in Australia (Chapters 4 and 5)
- identify the changes that occurred during the period of this study by comparing the findings from the two surveys (Chapters 4 and 5)

- analyse the adoption of CC and its attributes by applying the Diffusion of Innovation Theory and Crossing the Chasm theories to the collected data (Chapter 5)

This research project began at the end of 2010, before the Australian government had released its first CC Strategic Directions Paper in April 2011. At that time Australian organisations appeared to be leading the adoption of CC in the Asia-Pacific region, with a number of commercial surveys indicating high rates of CC uptake. The wide discrepancies in the findings of these commercial surveys (Banks, 2011, Huang, 2013, VMware, 2012, Budmar, 2013, Barwick, 2013a) indicated a need to discover the real status of CC in Australia, using sound academic analytic techniques.

In consequence of the rapid increase of CC adoption in Australia – and despite the fact that a considerable amount of uncertainty and confusion over the concept of CC still existed among Australian CIOs – it seemed likely that CC adoption rates would continue to grow at a rapid pace. This research project therefore explored the nature, role, issues; and diffusion rates of this innovation to discover what was motivating those organisations adopting and those not adopting CC. Based on the existing literature and the significant piece of empirical research contained in the two surveys, the major deliverable of this research project is the creation of a wide vision about this new phenomenon and its uptake and evolution in Australia – based on a sound theoretical underpinning.

6.2. Findings

This Section provides a discussion of the answers to the overarching research question: What is the nature and character of CC use and diffusion within Australian organisations: (a longitudinal analysis 2012-2013)?

This question cannot be answered directly, because of the complexity of the CC phenomenon and the variety of motivations for adopting or not adopting it. This question was therefore divided into a number of subsidiary research questions, each of which could be answered by empirical research:

1. What is the overall understanding of the role and nature of CC?
2. What is the current view of the pattern of diffusion of CC by organisations and market sectors?
3. What is the role and nature of CC in contemporary Australian organisations?
4. What is the nature and character of the diffusion of CC in contemporary Australia?
   c) Across organisations (i.e. from one organisation to another)
   d) Within organisations
5. How have Australian organisations' views on the role and nature of CC changed over the period of the study?
6. How has the nature and character of the diffusion of CC in Australian organisations changed over the period of the study?

SRQ1: What is the overall understanding of the role and nature of CC?

This question was answered by means of a broad and thorough literature review (see Ch. 2). The most acceptable and recommended definition of CC to date has been produced by the US-based NIST which defines the phenomenon as "*a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*" (Hooper et al., 2013, Linthicum, 2010a, Fasihuddin et al., 2012, Department of Finance, 2014b). For more than 7 years, CC had shown a greater effect on the IT sector (Padhy and Patra, 2012, Mikkilineni and Sarathy, 2009, Baghdadi, 2013) which led to fundamental changes in the utilisation of IT resources (Motta et al., 2012, InfoWorld, 2009, Guptill and McNee, 2008, Hunter, 2009) and emergence of various new business models (Abah and Francisca, 2012, Baghdadi, 2013, Motta et al., 2012, Rimal et al., 2011). The provision of fast and secure on-demand services via the Internet is the basic objective of CC to support numerous numbers of users and services (Linthicum, 2010a, Hayes, 2008, Motta et al., 2012, MacVittie, 2008). In view of the fact that CC is an approach for enhancing the capacity and capability of organisations without acquiring new infrastructure, additional software licences, or training new staff (Knorr and Gruman, 2010, Linthicum, 2010a), they can take greater advantage of the considerable IT infrastructure of CSPs without carrying out the implementation and administration by themselves, hence ensures judicious use of both time and money (Linthicum, 2010a, Wattal and Kumar, 2014, Banerjee et al., 2012, Schadt et al., 2010). CC thus is an important approach that affords organisations higher productivity and cost effectiveness (Linthicum, 2010a, Foo, 2010b). In spite of the numerous potential benefits of CC, the reviewed literature revealed a number of concerns associated with it; notably are security, privacy, performance, development, legal and other problems (Motta et al., 2012, Rimal et al., 2011, Linthicum, 2010a, O'Driscoll et al., 2013).

SRQ2: What is the current view of the pattern of diffusion of CC by organisations and market sectors?

This question was also susceptible to answer by means of an analysis of the literature and Ch. 2 provides a much more detailed explanation of the summary provided here. CC has developed and grown in popularity rapidly since 2007 (Motta et al., 2012, Google Trends, 2011, Xiaoqi, 2012, Avram, 2014) to become a very fashionable topic (Google Trends, 2011, Motta et al., 2012, Wang et al., 2008). Although there are wide discrepancies between the proportions of respondents adopting CC reported in the substantial number of extant commercial surveys, there is general agreement that organisations globally are adopting cloud solutions rapidly (Redshift Research, 2011, Information Week, 2012, Dutt, 2012, Research and Markets, 2013). These commercial surveys also indicated a wide diffusion of CC had occurred in both public and private sectors around the globe. This pattern of diffusion is also reflected in the usage of all service delivery models as well as all deployment models of CC. Many CSPs thus opened new cloud datacentres concurrently in a number of countries to meet the demand for CC.

SRQ3: What is the role and nature of CC in contemporary Australian organisations?

This question was answered by means of the two surveys of Australian organisations – and the summary presented here is drawn from Ch. 4. The five characteristics of CC extracted from its definition are: on-demand self-service (registering online and receiving the services immediately); multi-device access (accessing via any internet-connected device); multi-tenancy; scalability (scaling the service up or down immediately); and measurability (measuring the provided services by the provider to issue the invoices) (Fasihuddin et al., 2012, Jain and Gupta, 2012, Celar et al., 2011, Abah and Francisca, 2012). The most widely-realised characteristic of CC in Australia was multi-device access (~70%). This feature has attracted many Cloud Adopters because, in addition to its simple and portable nature, multi-device access allows users to access the service of their choice via the full range of internet-connected devices, including desktop PCs, laptops, tablets, smartphones or other devices (Motta et al., 2012, Divakarla and Kumari, 2010, JB, 2009, Orfano, 2009). Multi-device cloud access has also facilitated and improved employees' ability to work as and when they choose, regardless of location (SaaSID, 2012).

Despite the significant security and privacy risks associated with multi-device access (Sengupta et al., 2011, SaaSID, 2012), CC users are able to connect these devices with their virtual identity, allowing them to interact with a variety of devices in a seamless manner under a single user ID (Sarma and Girão, 2009). Organisations able to manage these risks are therefore likely to find this approach very attractive.

In addition, many CC users find multi-device access attractive because it offers them a variety of options for a single application. A good example of this flexibility can be found in the retail space with Whispersync (a Kindle App from Amazon designed for reading books) which allows users to switch simultaneously, easily and in a continuous manner from one device to another and/or from one mode to another during reading, listening and viewing (Amazon, 2015).

Though this characterisation of multi-device access is evidenced in the literature, the literature available at the time did not provide data concerning uptake levels – perhaps because corporate multi-device access has not yet caught up with personal applications such as Whispersync.

Approximately 60% of Cloud Adopters in Australia experienced multi-tenancy by using Public Cloud and around 55% of them realised scalability of CC. The other two CC characteristics (on-demand self-service and measurability) were realised by fewer than half the Cloud Adopters and varied from 39% to 43% of Australian Cloud Adopters. In terms of the realised benefits of CC, between 47% and 64% of Australian Cloud Adopters believed that CC enabled them to introduce new systems more easily, implemented quickly, accessible via any internet-connected device, with easy-to-add or remove services as needed; and with reduced costs.

All the realised characteristics and benefits identified above were highlighted in the reviewed literature, but without being ranked or having their realisation levels measured, which this study was able to achieve – thus contributing to knowledge development. Implementation, especially for the most widely-realised characteristic (multi-device access), could well be an incentive for those who have not yet adopted CC – particularly small organisations which have had a slower uptake of CC compared with medium and large organisations.

SRQ4: What is the nature and character of the diffusion of CC in contemporary Australia?

a) Across organisations (i.e. from one organisation to another)

b) Within organisations

Detailed answers to the two parts of this subsidiary research question can be found in the empirical chapters 4 and 5 – the material below provides a brief summary. By the middle of 2012, 47.9% of responding Australian organisations had adopted CC. A further 16.4% indicated they would adopt CC in the near future, although 7.2% of respondents had decided not to adopt CC. The adoption proportion indicates that CC in Australia was at the end of Rogers' Early Majority stage by 2012.

By 2013, 16 months after the 2012 survey, the proportion of Cloud Adopters had increased to 57.9%, with a further 15.2% of respondents classifying themselves as Future Adopters – while the proportion of Definite Non-Adopters had declined slightly by 1.9% to form only 5.3%. In consequence, CC in Australia had passed from Rogers' Early Majority to the Late Majority stage by 2013. Thus, the adoption of CC in Australia follows the classic Diffusion of Innovation Theory without the appearance of a chasm between the Early and Late Majority stages.

This is not a new phenomenon, however: the absence of the chasm under certain circumstances has been clarified by Waters (2011), who explained that "Moore's theories are only applicable for disruptive or discontinuous innovations. The adoption of continuous innovations that do not force a significant change of behaviour by the customer are still best described by the original technology adoption lifecycle without the presence of a chasm". Not only did the chasm fail to appear in the data, but the acceleration rate of the adoption also increased on a yearly basis due to the effect of the 'influentials' (early adopters) on 'imitators' (early majority). Egmond et al. (2006) and Lelarge (2008) argued that marketing is a good strategy that facilitates an innovative technology to cross the chasm, although it could have also led to the avoidance of a chasm occurring for CC adoption in Australia. Thus, CC is a continuous innovation and there is a significant potential for successful marketing of CC in Australia, since the greatest rate of CC adoption found in any category was for the early majority who are considered to be the imitators of early adopters. Although it is clear that CC may well be the right innovation at the right time and that marketing has a greater influence on CC adoption, there is still a need for further qualitative research to substantiate this assumption.

In 2012 and 2013, almost all departments of the respondent organisations were involved in CC, since email was the cloud system that had been most used. In addition, in both years, all types of service delivery and deployment models identified in the reviewed literature had been used for CC adoption. These models were provided to Australian Cloud Adopters via international and/or local CSPs.

SRQ5: How have Australian organisations' views on the role and nature of CC changed over the period of the study?

There were no significant changes in Australian organisations' views on the role and nature of CC. The most widely-realised characteristic of CC in Australia remained multi-device access (72%) over the period of the two surveys. The application of multi-device access has simplified the usage of CC because users are now able to make use of a variety of options (i.e. desktop, laptop, tablet, smartphone or other devices) (Motta et al., 2012, Divakarla and Kumari, 2010, JB, 2009, Orfano, 2009) and modes (e.g. reading, listening and viewing) in accessing services (Amazon, 2015). Multi-device access has also provided a number of benefits for organisations in the form of improved working approach, versatility and agility for employees wishing to work in more than a single location (SaaSID, 2012). Workers are also able to interact with various devices in a seamless manner by connecting using their virtual identity (Sarma and Girão, 2009) although this benefit does lead to greater vulnerability (Sengupta et al., 2011, SaaSID, 2012). The reviewed literature offers evidence of the importance of multi-device access as a characteristic of CC, though information concerning uptake levels is not so readily available.

Multi-tenancy was experienced by ~60% Cloud Adopters in Australia using Public Cloud and approximately 57% of respondents realised scalability of CC. On-demand self-service and measurability were realised by 39% to 41% of Australian Cloud Adopters. In terms of realised benefits, between 45% and 63% of Australian Cloud Adopters believed that CC enabled them to introduce new systems more easily, implemented quickly, accessible via any internet-connected device, with easy-to-add or remove services as needed; and with reduced costs.

Although the reviewed literature identified these characteristics and benefits it did not provide details of their ranks and realisation levels, as the present study has done. The absence of significant changes in Australian organisations' views of the role and nature of CC presented in this study may be the result of the limited time frame between the two surveys (16 months), though it did confirm that uptake levels of the characteristics and the benefits of CC cited in the literature were correct. Therefore, future quantitative investigation is recommended to ascertain likely changes in Australian organisations' acceptance of and attitudes towards CC.

SRQ6: How has the nature and character of the diffusion of CC in Australian organisations changed over the period of the study?

This study observed a smooth transition for CC users between Rogers' Early and Late Majority categories. Over a 16 month period, by the end of 2013, there had been a 10% growth in CC adoption within Australia, from 47.9% to 57.9%. It is very probably that this rate of uptake CC will continue to increase, as indicated by Future Adopters who formed 15.2% of the respondents in 2013. Although the Definite Non-Adopters made up 7.2% of participants in 2012, their proportion had shrunk slightly (by ~2%) in 2013. These findings suggest on-going diffusion of CC in Australia.

Although almost all departments were involved in CC finance, accounting and human resources departments were more involved in using CC in 2013 than in 2012 a finding that was not reflected in the reviewed literature. This apparently new finding might well help CSPs to focus on the cloud service needs of finance, accounting and human resources departments, as well as similar needs which may be experienced by other departments in the future. The fact that cloud services are so readily taken up means that non-technical sections of organisations are increasingly becoming the target of CSP marketing (see, for example, France, 2013, McKendrick, 2013).

This move towards a more broadly-based client group for cloud services might also have implications in terms of selecting participants to undertake future qualitative research. Future participants might thus not only be CIOs and their equivalents but might well also include, for example, the heads of the finance, accounting and human resources departments.

6.3. Research Limitations

This research project provides a genuine longitudinal view of CC evolution within Australia. However, given that this is a PhD research and hence had a limited time frame, longitudinal case studies which would have provided a better indication of diffusion through organisations were not feasible – the 16 month gap between the two surveys, while useful in highlighting changes, is not long enough to provide a truly in-depth longitudinal perspective. Future work will be needed to extend the viewpoint of this project.

A further limitation was the requirement for an anonymous survey, which precluded direct one-on-one comparisons of individual respondents across the two surveys. The need for anonymity to encourage recruitment thus proved a two-edged sword. Greater insight could be provided by qualitative investigations and this is recommended in the future research Section.

Finally, despite significant efforts to encourage respondents to return for the second survey, respondent numbers for that second survey were considerably lower. This is one of the major difficulties of survey-based research and limits the generalisability of the findings of the second survey to some extent. Nonetheless, the numbers were large enough to enable valid statistical analysis and conclusion.

6.4. Future Research

There are three principal suggested research studies for future extension of the present project. The target group in all of these researches will be CIO’s or their equivalent (i.e. IT Manager, Technical Support Manager and Network Manager) as they are expected to be most capable of providing accurate responses and aware of the current status of CC adoption in their organisations.

The first suggested research is to repeat the current project in a year’s time in order to investigate the continuity of CC diffusion and its surrounding issues in Australia – such a repetition would provide a truly longitudinal dataset of Australian organisational uptake of CC. Thus, the same questionnaire as for this study (or a slightly amended one) could be used for data gathering to ensure comparability with the present study’s findings. Some questionnaire amendment would enable the classification of both benefits and concerns for each service delivery and deployment model, rather than having to consider only the benefits and concerns relating to CC in general. This approach might explain the conflicts and ambiguity in some issues, e.g. security problems might be a concern for SaaS rather than IaaS, or for Public Cloud instead of Private Cloud. Descriptive statistical techniques will be used to analyse the data to give comparability with the present study, and together with regression analysis will provide a further analysis technique to identify the statistically significant differences within and between this third survey and the two surveys of the present study. As with the present study, applying both Diffusion of Innovation Theory and Crossing the Chasm theory to this suggested future research would highlight the continuity of *the acceptance* (adoption or rejection) and *the use* of CC innovation as well as its *evolution* across and within Australian organisations. This suggested study might also enable observation of the transition between the Late Majority and the Laggards categories – or might identify a chasm between these two groups.

On many occasions during the analysis of this study's data, qualitative research with Australian organisations was suggested to enrich the findings. This research approach has the potential to provide rich data about situations, which enables understanding of behaviours within the given context (de Vaus, 2002, Neuman, 2006) and if these are in-depth case studies, they can result in deep explanatory insights (Babbie, 2001). Since both surveys showed that between 54% and 100% of all categories of respondents agreed that 'Cloud Computing will be one of the top ten strategic technologies for the next 5 years', corroborating Gartner's (2010) view, future qualitative research is clearly indicated to explore this strategic perception of CC in greater depth.

A second extension to the present study, therefore, will include interviews with a group of around 20-25 organisations representing the various categories of Cloud Adopters and Non-Adopters to provide insight into some of the more puzzling findings from the surveys. The interviews will form a data gathering technique for these case studies to elicit sufficient detail and establish possible explanations for discrepancies such as the ambiguity surrounding CC security issues.

Another contention is that although visualisation has been identified as a CC enabler (Linthicum, 2010a, O'Driscoll et al., 2013, Rimal and Choi, 2012, Mancini et al., 2009), the findings of this study showed no consensus, either between or within categories.

Similarly, despite the assertion that SOA is a prerequisite for CC (Banerjee et al., 2012, Murah, 2012, Wang et al., 2008, Linthicum, 2010a), this study revealed only a 'neutral' opinion for all categories on average. In addition, the study's findings showed discrepancies even between the views of those who applied one or both of these technical enhancements (visualisation and SOA).

Nonetheless, since it is quite possible that the reason for these findings is that survey respondents were simply unfamiliar with the technologies and techniques which have the potential to lead to effective deployment of CC, there is clearly a need for future qualitative research to either validate or disprove these assertions.

Concept mapping will also be used as a data analysis technique, since it helps to explore various ways of unpacking and understanding concepts (de Vaus, 2002) and can therefore also explore the influence and impact of both virtualisation and SOA as precursors to CC. This suggested future research will also provide explanations for issues such as: why both types of CC refusers (Past Adopters and Definite Non-Adopters) terminated and/or will not adopt CC; why the importance of expected benefits for CC did not match the realised ones; why Cloud Adopters have more contracts with international CSPs when changes to the federal Privacy Act led commenters to anticipate more companies would move to Australian CSPs; or why multi-State organisations have fewer 'internet outages' concerns than do organisations located in a single State. All these questions and others can be answered via a follow-up qualitative study which will provide richer data enabling deeper and more subjective analysis.

Different countries may well have differing attitudes and government policies relating to CC – and these attitudes and policies will have an impact on CC adoption in each of the affected countries. Therefore, the third suggestion for future research is to investigate the patterns of CC in another country and compare this with Australia's experience. The same questionnaire (or a slightly modified one) can be used for this purpose as a data gathering technique. The questionnaire amendment, as in the first suggested future research extension, will enable the classification of both benefits and concerns for each service delivery and deployment model instead of CC in general. The data analysis technique will involve both descriptive statistics and regression analysis to identify the statistically significant differences within and between this suggested research in another country and the Australian surveys of the present study. Further, applying both Diffusion of Innovation Theory and Crossing the Chasm theory to this suggested future research will highlight *the acceptance* (adoption or rejection) and *the use* of CC innovation as well as its *evolution* across and within different country organisations and will enable a comparison of the diffusion pattern within the second country with the Australian one from this study. Such a study offers a number of academic benefits and will potentially enable: identification of the effects of government policy towards CC on its adoption rates; a basis for discovering whether CC adoption rate and pattern is a standard international phenomenon – or whether individual national characteristics influence the pattern of adoption and diffusion; and whether organisational type and size influences CC adoption and diffusion differently in different countries.

6.5. Research Contributions

6.5.1. Contribution to Practice

A ZDNet round-table panel session identified considerable uncertainty and confusion regarding CC among Australian CIOs (Kotadia, 2010) and was one of the motivators for this project. This research project has provided significant assistance in clarifying the nature, role and effective application of CC in Australia, which will be of significant benefit to both public and private sector organisations.

6.5.2. Contribution to Theory

This study, in addition to extending the currently somewhat limited extant literature on CC, clarifies the role and nature of CC in contemporary organisations, thus forming a basis for the development of coherent theories regarding effective strategies for its application. In particular, the use of classical diffusion of innovation theory and the ‘crossing the chasm’ phenomenon to investigate CC diffusion within Australia provides a rich theoretical perspective which can be used as a foundation for later studies in this area.

6.6. Thoughtful Conclusions

This research project has not only revealed the perceptions of Australian Cloud Adopters, but has also identified those who definitely decided not to adopt CC and indicated their concerns. Although it indicated that the adoption pattern of CC in Australia definitely seems to be following the classic diffusion of innovation theory, the adoption of CC in Australia is unlikely ever to reach 100%, both because of resistors (Definite Non-Adopters), as well as because of those organisations which have adopted CC only to reject it at a later date (Past Adopters).

While CC is still in its infancy – and despite the fact that the number of respondents is not large – the project has shown that Australian usage of CC is increasing, with a strategic view of how to use this technological innovation. Whether small or large organisations, respondents to these surveys have identified what is most useful for them regarding CC.

Thus, the present study provided a broad picture of the existing state of CC innovation and its evolution in Australia. It also afforded a better opportunity for understanding the role, nature and adoption of CC, as well as its acceptance and use by organisations of all types, sizes and from all sectors, leading to a richer, deeper and more strategic use of CC. In addition, this project has identified the gaps which exist in our understanding of CC – these provide an opportunity for further research and could contribute greatly to building a still more strategic direction for CC development in Australia, as well as in other countries.

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Appendix A

Table 0.1: List of CC advantages and disadvantages (Linthicum, 2010a)

Advantages	Disadvantages
Cost is typically less than traditional solutions but it is not always less expensive but it is more cost effective.	Security is one of the concerns because the cloud is not under the firm’s direct control. However, most of business information is perfectly fine for cloud computing because does not include state secrets.
Network gives the opportunity to add value by mix and match services in order to meet business needs.	Control of the IT infrastructure is in the hands of cloud computing provider. Therefore, there are risks when the firm depend on another company that it does not control.
Innovative features in the cloud provide a lot of value for the money invested.	Cost in some cases is more expensive.
Expandability, which obviously related to cost, allows the firms add or remove a service as they need.	Openness to clouds might cost prohibitively when the firm decide to move to another cloud provider or back into its enterprise.
Speed to implementation of cloud computing can be days, or even some hours.	Compliance to the cloud provider's standards.
It’s green because it does not require producing more hardware.	Service-level agreements are not offered by many cloud providers. Moreover, they will try to pass the cost of the risks to the cloud consumer.

Table 0.2: List of CC advantages and disadvantages (Schadt et al., 2010)

Advantages	Disadvantages
pay-as-you-need	transferring big data
flexibility	Privacy
low cost	
High Performance Computation (HPC)	
Administrative functions such as backup and recovery	

Table 0.3: List of CC advantages and disadvantages (Avram, 2014)

Advantages	Disadvantages
It dramatically lowers the cost	Security and Privacy
It can provide an almost immediate access to hardware resources, with no upfront capital investments for users, leading to a faster time to market in many businesses.	Connectivity and Open Access
It can lower IT barriers to innovation.	Reliability
It makes it easier for enterprises to scale their services	Interoperability
It also makes possible new classes of applications and delivers services that were not possible before	Economic Value
	Changes in the IT Organization
	Political Issues Due to Global Boundaries

Table 0.4: List of CC advantages and disadvantages (Sultan, 2014)

Advantages	Disadvantages
reducing the cost (pay-as-you-go)	security issues
reduce the carbon footprint.	privacy issues
online delivery of software and virtual hardware services that obviate the need to own, maintain and update the software and hardware infrastructures	governance issues
flexibility opened many possibilities for organizations that did not exist before	integration issues
	ability to cope with business process change
	performance issues
	availability issues
	vendor-lock and failures

Table 0.5: List of CC advantages (Orfano, 2009)

Advantages
Cloud Adopters can use CSP's infrastructure without implementing and administrating it (i.e. saves money and time)
All CC data are accessible through the internet regardless of geographic location
CC is Eco-friendly

Table 0.6: List of CC disadvantages (Xiaoqi, 2012)

Disadvantages
security issues
privacy issues
data integrity issues
performance issues
availability issues
little control on the data
Transaction management.

Table 0.7: List of CC disadvantages (Motta et al., 2012)

Disadvantages
Performance issues
Security issues
Cost issues
Legal issues

Table 0.8: List of CC advantages and disadvantages (Venkatraman, 2011)

Advantages	Disadvantages
Potential for scalability	Cloud reliability
Flexibility and scalability	additional expenditure in customisation
Paying for what you use	

Table 0.9: List of CC advantages and disadvantages (Braun et al., 2011)

Advantages	Disadvantages
Cost Savings	Expert Assistance
Economies of Scale	Due Diligence
Reductions in Personnel	Operating Characteristics
Scalability	Service Availability
Mobile Work Force	Support
Quality and Responsiveness	Cessation of Services for Non-payment
Disaster Recovery and Business Continuation	Termination and Duties on Termination
Information Security	Vendor Failure; Back-Up and Recovery Options
Regulatory Compliance	Improvements and Enhancements
	Security

Table 0.10: List of CC advantages and disadvantages (Kremian, 2012)

Advantages	Disadvantages
Storage and Scalability	Control and Reliability
Backup and Disaster Recovery	Security, Privacy and Compliance
Mobility	Compatibility
Cost Efficiency	Unpredicted Costs
Enable IT Innovation	Contracts and Lock-Ins (SLAs)

Table 0.11: List of CC advantages and disadvantages (Shagin, 2012)

Advantages	Disadvantages
Flexibility	Network Dependency
Cost Reduction and Increased Efficiency	Difficulty in creating hybrid systems
Reliability	Centralization
Security Gains	Data Integrity/Security

Table 0.12: List of CC advantages and disadvantages (The Open Group, 2011)

Advantages	Disadvantages
Agility (Changing Business Processes, Development and Testing, Resource Scaling & Reduced Need for Training)	Security, privacy, and compliance, including data ownership and availability in shared environments, regulation and legal issues, corporate policies, and identity management for access control
Productivity (Collaborative Working & Shared Logic)	Lack of functionality or inflexibility of SaaS applications
Quality (Better Usage Information, Better Manageability, Better Quality of IT Provision, Better Business Continuity & Better Carbon Footprint)	Dependency on an Internet connection
Cost (Server Consolidation, Thin Clients, Community Cost Sharing & Replacing CAPEX by OPEX)	Vendor lock-in as a result of lack of standards, and portability issues due to immaturity of cloud products
New Business Opportunities (Cloud Service Provision & Added Service Provision)	Vendor management, which requires a different approach, in which SLAs are critical
	Change management and testing, which can be a challenge, especially in shared environments
	Integration with on-premise systems, which may be difficult, or even impossible
	Lack of transparency of interfaces between SaaS vendors, particularly with regard to managing the interfaces
	Lack of experience with cloud financial models and licensing

Table 0.13: List of CC advantages and disadvantages (Page, 2010)

Advantages	Disadvantages
There should be cost savings	beware of illusory cost saving
upgrades are smoother and more frequent	security isn't simple
CC increases agility	customisation is not so easy
CC enables remote working	beware supplier lock-in
CC frees up the IT department	
smaller businesses gain reliability and flexibility	
IT is probably green	

Table 0.14: List of CC advantages and disadvantages (Tsagklis, 2013)

Advantages	Disadvantages
Cost Efficiency	Security and privacy in the Cloud
Convenience and continuous availability	Dependency and vendor lock-in
Backup and Recovery	Technical Difficulties and Downtime
Cloud is environmentally friendly	Limited control and flexibility
Resiliency and Redundancy	Increased Vulnerability
Scalability and Performance	
Quick deployment and ease of integration	
Increased Storage Capacity	
Device Diversity and Location Independence	
Smaller learning curve	

Appendix B

Below is the latest edition of the questionnaire since it was modified as a result of the experiences with the first survey. Figure 0.1 can assist in understanding the sequence of the questions for each category.

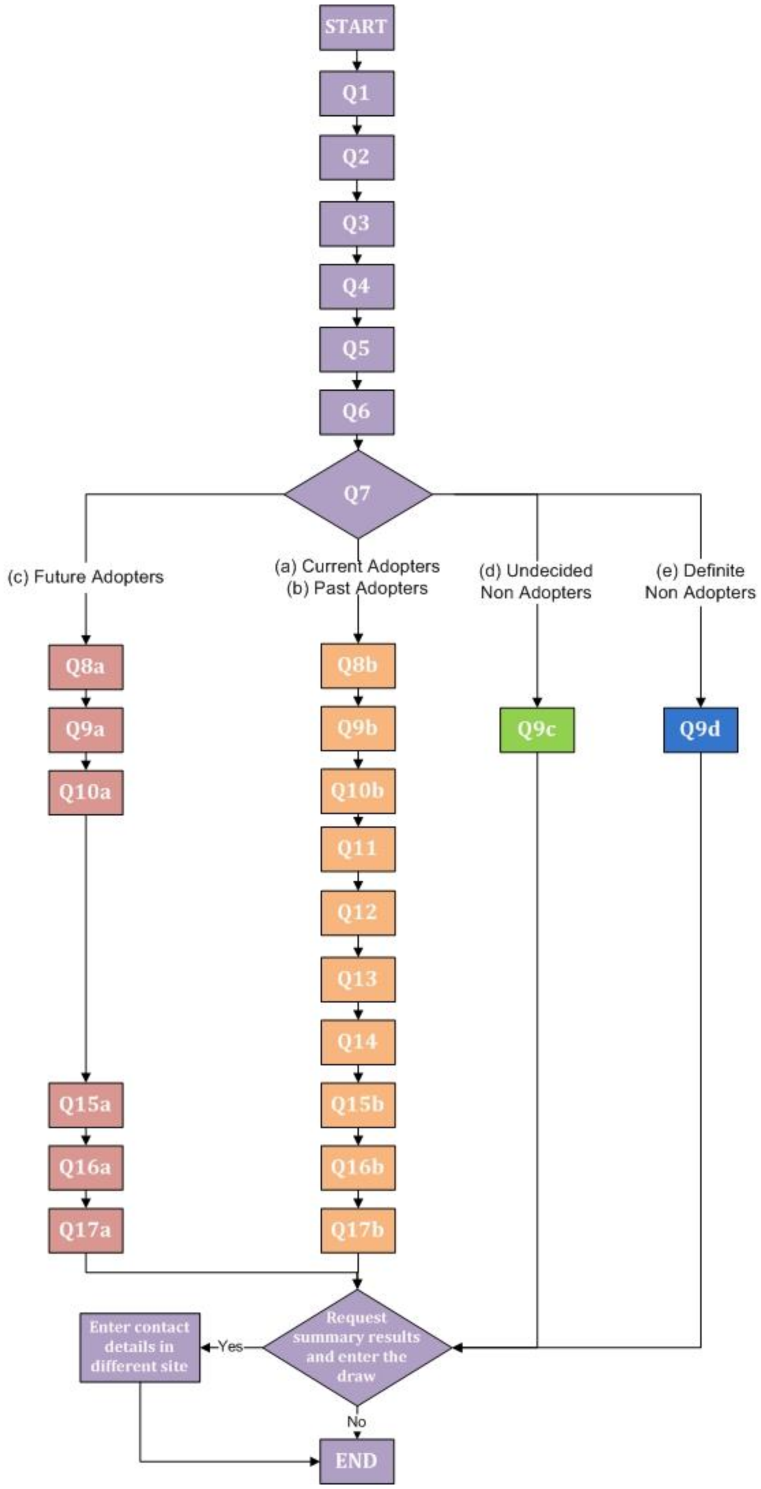

Figure 0.1: Logic design for the second survey (2013)

Demographic Questions

*** Q1: Please indicate the industry sectors to which your organisation belongs [Mark multiple sectors if relevant]**

- ☐ Agriculture
- ☐ Construction
- ☐ Education
- ☐ Energy
- ☐ Engineering / Aerospace
- ☐ Financial
- ☐ Fishing
- ☐ Government
- ☐ Healthcare
- ☐ Information Technology
- ☐ Manufacturing
- ☐ Media
- ☐ Mining
- ☐ Not For Profit
- ☐ Real Estate
- ☐ Research / Consulting
- ☐ Retail
- ☐ Services
- ☐ Telecommunication
- ☐ Tourism
- ☐ Transportation
- ☐ Utilities
- ☐ Wholesale / Distribution
- ☐ Other (please specify) ____________

*** Q2: Please select the states in which your organisation and its branches are located [Select more than one if appropriate]**

- ☐ ACT
- ☐ NSW
- ☐ NT
- ☐ QLD
- ☐ SA
- ☐ TAS
- ☐ VIC
- ☐ WA

*** Q3: Approximately how many employees are currently working in your organisation?**

- ○ Under 5
- ○ 5-10
- ○ 11-20
- ○ 21-50
- ○ 51-100
- ○ 101-200
- ○ 201-499
- ○ 500- 999
- ○ 1000-4999
- ○ 5000-10000
- ○ More than 10000

*** Q4: Please indicate your job title.**

- ○ CIO
- ○ IT Manager
- ○ Technical Support Manager
- ○ Network Manager
- ○ Other (please specify) ____________

Beliefs and Adoption of Cloud Computing

***Q5: How well do you believe you understand the concept of Cloud Computing?**

- Very Well
- Reasonably Well
- Neutral
- Not very well
- I really don't understand it at all

***Q6: To what extent do you agree with the following statements? [Please respond to all items a-g]**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
a) The main drivers of Cloud Computing adoption are economics and simplicity of software operation and delivery	○	○	○	○	○	○
b) Cloud Computing is a tool that enables the organisation to be more productive and cost effective	○	○	○	○	○	○
c) Cloud Computing will be one of the top ten strategic technologies for the next 5 years	○	○	○	○	○	○
d) Virtualisation is required to enable Cloud Computing	○	○	○	○	○	○
e) Service Oriented Architecture (SOA) is required to enable Cloud Computing	○	○	○	○	○	○
f) Cloud Computing in Australia is currently immature	○	○	○	○	○	○
g) Cloud Computing is the future of IT	○	○	○	○	○	○

***Q7: Has your organisation already adopted Cloud Computing?**

- a) We have already adopted it (*Current Adopters*)
- b) We adopted Cloud Computing in the past but have since then terminated our use of it (*Past Adopters*)
- c) We expect to adopt it in the near future (*Future Adopters*)
- d) We have not yet decided whether to adopt Cloud Computing (*Undecided Non Adopters*)
- e) We will not adopt Cloud Computing (*Definite Non Adopters*)

Date of Adoption - (Future Adopters)

***Q8a: When do you expect your organisation will adopt Cloud Computing?**

- 2013
- 2014
- 2015
- 2016
- 2017
- Other (please specify)

Date of Adoption - (Current Adopters & Past Adopters)

***Q8b: When did your organisation adopt Cloud Computing?**

- 2006
- 2007
- 2008
- 2009
- 2010
- 2011
- 2012
- 2013
- Other (please specify)

Concerns about Cloud Computing - (Future Adopters)

*Q9a: Which of the following concerns do you believe are likely to prevent your organisation from adopting Cloud Computing? [Tick all that apply]

- ☐ Security problems
- ☐ Privacy problems
- ☐ Availability problems with cloud service providers
- ☐ Integration problems
- ☐ Development problems
- ☐ Recovery problems
- ☐ Legal problems
- ☐ Unsatisfactory Service Level Agreement (SLA)
- ☐ Quality problems
- ☐ Organisational and cultural problems
- ☐ Loss of control
- ☐ Lack of trust with cloud service Providers
- ☐ Lack of service orientation
- ☐ Insufficient skills in your organisation
- ☐ Immaturity of technology
- ☐ Internet Outages
- ☐ Bandwidth problems
- ☐ Cross border problems
- ☐ Data sovereignty
- ☐ Government legislation
- ☐ Performance problems
- ☐ Usage costs
- ☐ None
- ☐ Other (please specify) ____________________

Concerns about Cloud Computing - (Current Adopters & Past Adopters)

*Q9b: Which of the following problems concerned you when your organisation adopted Cloud Computing? [Tick all that apply]

- ☐ Security problems
- ☐ Privacy problems
- ☐ Availability problems with cloud service providers
- ☐ Integration problems
- ☐ Development problems
- ☐ Recovery problems
- ☐ Legal problems
- ☐ Unsatisfactory Service Level Agreement (SLA)
- ☐ Quality problems
- ☐ Organisational and cultural problems
- ☐ Loss of control
- ☐ Lack of trust with cloud service Providers
- ☐ Lack of service orientation
- ☐ Insufficient skills in your organisation
- ☐ Immaturity of technology
- ☐ Internet Outages
- ☐ Bandwidth problems
- ☐ Cross border problems
- ☐ Data sovereignty
- ☐ Government legislation
- ☐ Performance problems
- ☐ Usage costs
- ☐ None
- ☐ Other (please specify)

Concerns about Cloud Computing - (Undecided Non Adopters)

*Q9c: Which of the following concerns are likely to prevent your organisation from adopting Cloud Computing? [Tick all that apply]

- ☐ Security problems
- ☐ Privacy problems
- ☐ Availability problems with cloud service providers
- ☐ Integration problems
- ☐ Development problems
- ☐ Recovery problems
- ☐ Legal problems
- ☐ Unsatisfactory Service Level Agreement (SLA)
- ☐ Quality problems
- ☐ Organisational and cultural problems
- ☐ Loss of control
- ☐ Lack of trust with cloud service Providers
- ☐ Lack of service orientation
- ☐ Insufficient skills in your organisation
- ☐ Immaturity of technology
- ☐ Internet Outages
- ☐ Bandwidth problems
- ☐ Cross border problems
- ☐ Data sovereignty
- ☐ Government legislation
- ☐ Performance problems
- ☐ Usage costs
- ☐ None
- ☐ Other (please specify)

Concerns about Cloud Computing – (Definite Non Adopters)

*Q9d: Which of the following concerns prevented your organisation from adopting Cloud Computing? [Tick all that apply]

- ☐ Security problems
- ☐ Privacy problems
- ☐ Availability problems with cloud service providers
- ☐ Integration problems
- ☐ Development problems
- ☐ Recovery problems
- ☐ Legal problems
- ☐ Unsatisfactory Service Level Agreement (SLA)
- ☐ Quality problems
- ☐ Organisational and cultural problems
- ☐ Loss of control
- ☐ Lack of trust with cloud service Providers
- ☐ Lack of service orientation
- ☐ Insufficient skills in your organisation
- ☐ Immaturity of technology
- ☐ Internet Outages
- ☐ Bandwidth problems
- ☐ Cross border problems
- ☐ Data sovereignty
- ☐ Government legislation
- ☐ Performance problems
- ☐ Usage costs
- ☐ None
- ☐ Other (please specify) ______

Expected Benefits - (Future Adopters)

*Q10a: Please indicate how important the following EXPECTED benefits were in your decision to adopt Cloud Computing.

	Important	very important	Important	Not very important	Not at all important
a) To reduce costs	○	○	○	○	○
b) To maintain our systems more effectively	○	○	○	○	○
c) To improve business performance significantly	○	○	○	○	○
d) To enable us to introduce new systems more easily	○	○	○	○	○
e) To add or remove services as needed	○	○	○	○	○
f) To facilitate internal communication	○	○	○	○	○
g) To increase productivity	○	○	○	○	○
h) To improve security	○	○	○	○	○
i) It can be implemented quickly	○	○	○	○	○
j) To avoid the expense of buying licences	○	○	○	○	○
k) Implementation or administration of IT infrastructure is not needed	○	○	○	○	○
l) It is accessible via any internet-connected device	○	○	○	○	○
m) It is green IT	○	○	○	○	○
n) To mitigate risks	○	○	○	○	○
o) For business continuity	○	○	○	○	○

Other (please specify)

Expected Benefits and Realised Benefits - (Current Adopters & Past Adopters)

*Q10b: Please indicate how important the following EXPECTED benefits were in your decision to adopt Cloud Computing.

	Important	very important	Important	Not very important	Not at all important
a) To reduce costs	○	○	○	○	○
b) To maintain our systems more effectively	○	○	○	○	○
c) To improve business performance significantly	○	○	○	○	○
d) To enable us to introduce new systems more easily	○	○	○	○	○
e) To add or remove services as needed	○	○	○	○	○
f) To facilitate internal communication	○	○	○	○	○
g) To increase productivity	○	○	○	○	○
h) To improve security	○	○	○	○	○
i) It can be implemented quickly	○	○	○	○	○
j) To avoid the expense of buying licences	○	○	○	○	○
k) Implementation or administration of IT infrastructure is not needed	○	○	○	○	○
l) It is accessible via any internet-connected device	○	○	○	○	○
m) It is green IT	○	○	○	○	○
n) To mitigate risks	○	○	○	○	○
o) For business continuity	○	○	○	○	○

Other (please specify) ____________________

*Q11: Please indicate which of the following benefits were actually REALISED after your adoption of Cloud Computing? [Tick all that apply]

- ☐ It reduced costs
- ☐ It led to more effective systems maintenance
- ☐ It improved our business performance significantly
- ☐ It enabled us to introduce new systems more easily
- ☐ It was easy to add or remove services as needed
- ☐ It facilitated internal communication
- ☐ It increased productivity
- ☐ It improved security
- ☐ None
- ☐ Other (please specify)
- ☐ It was implemented quickly.
- ☐ It avoided the expense of buying licences
- ☐ Implementation or administration of IT infrastructure was not needed in Cloud Computing
- ☐ It was accessible via any internet-connected device
- ☐ It was green IT
- ☐ It mitigated risks
- ☐ It enabled business continuity

Experience after Using Cloud Computing - (Current Adopters & Past Adopters)

*Q12: To what extent have your organisational goals for Cloud Computing adoption been achieved?

- ○ Fully achieved
- ○ Mostly achieved
- ○ Partially achieved
- ○ Not really achieved
- ○ Not achieved at all

*Q13: How many times per month on average did you find Cloud Computing services unavailable (i.e. you can't access Cloud Computing services)?

- ○ 0
- ○ 1-5
- ○ 6-10
- ○ 11-15
- ○ 16-20
- ○ More than 20

*Q14: From your experience with Cloud Computing services which of the following statements do you believe is true? [Tick all that apply]

- ☐ The provided service is not affected when our cloud service provider adds more computer resources to the cloud.
- ☐ Our cloud service provider monitors the services that are out of order or performing poorly.
- ☐ Our cloud service provider can measure the provided service in order to issue invoices or bills.
- ☐ The provided service is secure.
- ☐ Our organisation can scale the service up or down immediately on demand.
- ☐ We can register online and receive services immediately.
- ☐ We can access the service via any internet-connected devices such as desktop, laptop, smart phone, tablet or other device.
- ☐ Our existing systems were virtualised before we moved to the cloud.
- ☐ Service Oriented Architecture (SOA) was applied before we moved to the cloud.
- ☐ None

Service Delivery Models - (Future Adopters)

*Q15a: Please indicate the service delivery models and the type of cloud service provider that you are looking to use in Cloud Computing: [Indicate more than one type of cloud service provider and service delivery model if applicable]

Please note that:

• Software as a Service (SaaS), also known as application -as-a-service, is fully provisioned software available for rent.
• Platform as a Service (PaaS) is a development environment.
• Infrastructure as a Service (IaaS) or Hardware as a Service (HaaS) is really datacentre -as-a-service which rent access to computers, space to store data or a processing facility.

	International cloud service provider	Australian cloud service provider
SaaS	☐	☐
PaaS	☐	☐
IaaS	☐	☐

Service Delivery Models - (Current Adopters & Past Adopters)

*Q15b: Please indicate the service delivery models and the type of cloud service provider that you have used in Cloud Computing: [Indicate more than one type of cloud service provider and service delivery model if applicable]

Please note that:

• Software as a Service (SaaS), also known as application -as-a-service, is fully provisioned software available for rent.
• Platform as a Service (PaaS) is a development environment.
• Infrastructure as a Service (IaaS) or Hardware as a Service (HaaS) is really datacentre -as-a-service which rent access to computers, space to store data or a processing facility.

	International cloud service provider	Australian cloud service provider
SaaS	☐	☐
PaaS	☐	☐
IaaS	☐	☐

Deployment Models - (Future Adopters)

*Q16a: Please indicate the service delivery models and the deployment models listed below that you are looking to use in Cloud Computing: [Indicate more than one deployment model and service delivery model if applicable]

	SaaS	PaaS	IaaS
Public Cloud	☐	☐	☐
On-site Private Cloud (within your organisation network)	☐	☐	☐
Out-sourced Private Cloud (within your Cloud Service Provider's network)	☐	☐	☐
On-site Community Cloud (a group of organisations share their private clouds)	☐	☐	☐
Out-sourced Community Cloud (a group of organisations share a private cloud within their Cloud Service Provider's network)	☐	☐	☐
Hybrid Cloud (a combination of two or more deployment models)	☐	☐	☐

Deployment Models - (Current Adopters & Past Adopters)

*Q16b: Please indicate the service delivery models and the deployment models listed below that you have used in Cloud Computing: [Indicate more than one deployment model and service delivery model if applicable]

	SaaS	PaaS	IaaS
Public Cloud	☐	☐	☐
On-site Private Cloud (within your organisation network)	☐	☐	☐
Out-sourced Private Cloud (within your Cloud Service Provider's network)	☐	☐	☐
On-site Community Cloud (a group of organisations share their private clouds)	☐	☐	☐
Out-sourced Community Cloud (a group of organisations share a private cloud within their Cloud Service Provider's network)	☐	☐	☐
Hybrid Cloud (a combination of two or more deployment models)	☐	☐	☐

Cloud Systems and Their Deployment Models - (Future Adopters)

*Q17a: Please indicate the cloud systems and the deployment models that you are looking to use in Cloud Computing: [Indicate more than one system if applicable]

	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	☐	☐	☐	☐	☐	☐
Manufacturing	☐	☐	☐	☐	☐	☐
Real time	☐	☐	☐	☐	☐	☐
Marketing and sales e.g. CRM	☐	☐	☐	☐	☐	☐
Human resource management	☐	☐	☐	☐	☐	☐
Database	☐	☐	☐	☐	☐	☐
Storage / Archiving	☐	☐	☐	☐	☐	☐
Backup	☐	☐	☐	☐	☐	☐
Email	☐	☐	☐	☐	☐	☐
Critical business systems	☐	☐	☐	☐	☐	☐
Processing	☐	☐	☐	☐	☐	☐
Test and development	☐	☐	☐	☐	☐	☐
Project Management	☐	☐	☐	☐	☐	☐
Collaboration	☐	☐	☐	☐	☐	☐
Content Filtering	☐	☐	☐	☐	☐	☐
E-Learning	☐	☐	☐	☐	☐	☐
Library Services	☐	☐	☐	☐	☐	☐
Phone System	☐	☐	☐	☐	☐	☐
Web Hosting	☐	☐	☐	☐	☐	☐

Other (please specify) ____________________

Cloud Systems and Their Deployment Models - (Current Adopters & Past Adopters)

* Q17b: Please indicate the cloud systems and the deployment models that you have used in Cloud Computing: [Indicate more than one system if applicable]

	Public Cloud	On-site Private Cloud	Out-sourced Private Cloud	On-site Community Cloud	Out-sourced Community Cloud	Hybrid Cloud
Financial and Accounting	☐	☐	☐	☐	☐	☐
Manufacturing	☐	☐	☐	☐	☐	☐
Real time	☐	☐	☐	☐	☐	☐
Marketing and sales e.g. CRM	☐	☐	☐	☐	☐	☐
Human resource management	☐	☐	☐	☐	☐	☐
Database	☐	☐	☐	☐	☐	☐
Storage / Archiving	☐	☐	☐	☐	☐	☐
Backup	☐	☐	☐	☐	☐	☐
Email	☐	☐	☐	☐	☐	☐
Critical business systems	☐	☐	☐	☐	☐	☐
Processing	☐	☐	☐	☐	☐	☐
Test and development	☐	☐	☐	☐	☐	☐
Project Management	☐	☐	☐	☐	☐	☐
Collaboration	☐	☐	☐	☐	☐	☐
Content Filtering	☐	☐	☐	☐	☐	☐
E-Learning	☐	☐	☐	☐	☐	☐
Library Services	☐	☐	☐	☐	☐	☐
Phone System	☐	☐	☐	☐	☐	☐
Web Hosting	☐	☐	☐	☐	☐	☐

Other (please specify) ____________

Appendix C, (page 388), consisted of 2 embedded text files of statistical output related to chapters 4 and 5. It has been removed and the 2 files have been converted to supplementary PDFs.