Cloud Adoption by Small and Medium Sized Enterprises

An Australian Study (2015-2016)

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Declaration

This thesis is submitted in fulfilment of the requirements of the degree of Doctor of Philosophy at Macquarie University and has not been submitted for a higher degree to any other university or institution. This thesis represents my original work and contributions. I certify that to the best of my knowledge, all the content of this study complies to the ethics approval number 5201300674, which was approved by the Macquarie University Ethics Committee in 18/Oct/2013.

Bahjat Fakieh

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Summary

Cloud computing is predicted to provide organisations with the flexibility to compete effectively in a rapidly changing business environment. Adopting cloud services will increase opportunities for achieving competitive advantage and improving business outcomes. This is particularly important in the Australian Small and Medium Enterprise (SME) sector as more than 99% of Australian businesses are in this category.

Industry studies (e.g. MYOB) show the uptake of cloud computing in Australian SMEs in 2011 was around 20%. Compared to other OECD countries, the adoption of cloud computing by Australian SMEs appears to be significantly lower. For example, Flood (2013) predicts that 75% of American businesses and 61% of British businesses utilise cloud services. Another example, South Africa (a non-member of the OECD), has 52% of SMEs (including micro businesses) using cloud services (Hinde and Belle, 2012).

The overarching research question is "*what are the adoption rates and critical success factors and challenges for Australian SME adoption of cloud computing to achieve competitive advantage?*"

In this thesis, the adoption rate of cloud computing by Australian SMEs in 2015-2016, as well as the drivers of adopting cloud computing as critical success factors, and the possible cloud challenges to Australian SMEs were explored among 470 SMEs in six Australian cities, which were Sydney, Melbourne, Brisbane, Canberra, Wollongong, and Newcastle. This research provides an objective benchmark on the status of SME adoption of cloud computing in the Australian context.

Resource Based Theory (RBT) and the Technology, Organization, Environment (TOE) theories were combined in this study to develop the conceptual framework. The research consisted of two phases. The first phase was a quantitative survey to explore the adoption rate of cloud computing by SMEs and to understand the success factors and challenges. The second qualitative phase used semi-structured interviews to explore drivers and challenges in-depth from the adopter SMEs' perspectives.

The research here contributed to exploring the status of adopting cloud computing by Australian SMEs in 2015-2016, and highlighted possible drivers and challenges when SMEs utilise cloud services. Another outcome was the development of a cloud adoption framework to assess SMEs in understanding the possible influences and challenges if and when they attempt to adopt cloud computing.

Abbreviations

ABS	The Australian Bureau of Statistics
AWS	Amazon Web Services
B2B	Business to Business
BPaaS	Business Process as a Service
CaaS	Communication as a Service
CEOs	Chief Executive Officers
CIOs	Chief Information Officers
CISR	Centre for Information Systems Research
CRM	Customer Relationship Management
CSFs	Critical Success Factors
DaaS	Data Storage as a Service
DBaaS	Database as a Service
DOI	Diffusion of Innovation
EC2	Elastic Cloud Computing
GDP	Gross Domestic Product
HR	Human Resources
IaaS	Infrastructure as a Service
IAM	Identity and Access Management
ICT	Information and Communication Technology
IDaaS	Identity as a Service
IDC	International Data Corporation
IT	Information Technology
Mbps	Megabit per second

MIT	Massachusetts Institute of Technology
NBN	National Broadband Network
NIST	National Institute of Standards and Technology
OECD	Organisation for Economic Co-operation and Development
PaaS	Platform as a Service
PC	Personal Computer
PEOU	Perceived Ease of Use
PU	Perceived Usefulness
QoS	Quality of Service
RBA	Reserve Bank of Australia
RBT	Resource Based Theory
RBV	Resource Based View of the Firm Theory
SaaS	Software as a Service
SLA	Service Level Agreement
SMEs	Small and Medium sized Enterpris
StaaS	Storage as a Service
TAM	Technology Acceptance Model
TOE	Technology, Organisation, Environment framework
UET	Upper Echelon Theory
VM	Virtual Machines
VoIP	Voice Over IP
VPN	Virtual Private Network
VPNs	Virtual Local Area Networks
XaaS	everything as a service

List of Publications

BUSCH, P., SMITH, S., GILL, A., HARRIS, P., FAKIEH, B. & BLOUNT, Y. 2014. A Study of Government Cloud Adoption: The Australian Context. *The 25th Australasian Conference on Information Systems (ACIS 2014).* Auckland, New Zealand: ACIS.

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Chapter One: Introduction

1.1 OVERVIEW

1.1.1 The Significance of Technology on Businesses

The Internet and more specifically the Cloud has provided opportunities and challenges for organisations. The revolution of *Information and Communication Technology* (ICT) coupled with the trend of linking business objectives to ICT resources is not a recent trend but spans decades (Reich and Benbasat, 1996, Mukhopadhyay et al., 1995, Powell and Dent-Micallef, 1997, Luftman et al., 1993). The clear trend of considering utilising ICT resources as a critical success factor to add value to the business has not stopped and has dramatically increased in recent years. Many studies have focused on the possible potential of utilising ICT by business organisations (Melville et al., 2004, Drnevich and Croson, 2013, Piotrowicz and Cuthbertson, 2014). For instance, researchers have examined alignment of business and ICT strategies at the high level of achieving benefits from adopting ICT (Drnevich and Croson, 2013). Some of these studies focused on the effect of ICT resources to improve business performance (Melville et al., 2004). Other studies focused on ICT resources as tools to perform business activities such as using ICT in the retail industry (Piotrowicz and Cuthbertson, 2014).

The potential of using ICT in businesses to achieve competitive advantage, led developers and service providers to innovate products and services. These products and services have assisted organisations with improving productivity, increasing efficiency and competing effectively in a globalised world. Recently, researchers focused more on specific areas in the ICT industry for business from micro to large enterprises rather than exploring the potential of ICT in general (Avram, 2014, Chang et al., 2013, Gupta et al., 2013, Olson and Shi, 2007, Gopalkrishnan et al., 2012, Chen et al., 2012, Dijkman et al., 2015).

Examples of major trends using ICT for business include cloud computing (Avram, 2014, Chang et al., 2013, Gupta et al., 2013), big data (Gopalkrishnan et al., 2012), data mining (Olson and Shi, 2007), business intelligence and analytics (Chen et al., 2012) and the Internet of Things (IoT) (Dijkman et al., 2015). This research focuses on cloud computing because cloud underpins many of the other ICT trends. Possible questions here include what is cloud computing? What are its main concepts? What are the possible advantages and challenges of adopting cloud computing? The next section addresses these questions briefly.

1.1.2 Cloud Computing

Cloud computing is one of the trends in the *Information Technology* (IT) industry representing a significant shift in IT resources and service delivery (Avram, 2014, Jadeja and Modi, 2012). There are many definitions in the literature that consider cloud computing from different perspectives (Kaufman, 2009, Mladenow et al., 2012, Winkler, 2011, Avram, 2014, Mell and Grance, 2011, Isom and Holley, 2012). Most simply cloud computing is the hiring of required IT resources from service providers via the internet (ACMA, 2013).

1.1.2.1 Three delivery models

Cloud resources are used in three main ways - called service delivery models. The first is where organisations hire virtualised hardware resources via the internet, known as *Infrastructure as a Service* (IaaS) (Garrison et al., 2012, Sadiku et al., 2014, Dillon et al., 2010). The second approach focuses on utilising *IaaS* plus the required development environment to provide organisations with the ability to develop their own solutions - known as *Platform as a Service* (PaaS) (Jamsa, 2012, Stammer and Wilson, 2013, Sadiku et al., 2014, Ashrafa, 2014). In the third model, service providers tend to develop and provide off-the shelf online solutions to organisations. Therefore, organisations need not take care of virtualised hardware nor develop solutions by themselves, where online software required is provided as a service, hence this model is known as *Software as a Service* (SaaS) (Jamsa, 2012, Leymann et al., 2014, Knorr and Gruman, 2008, Marinos and Briscoe, 2009, Ashrafa, 2014).

The evolution of cloud computing does not stop at these three models. Several services were derived from the main three models to provide different services to the market. Some of these services in turn provide alternative definitions to cloud computing from different perspectives. For example, cloud providers offer *Business Process as a Service* (BPaaS) to organisations (Isom and Holley, 2012, Stammer and Wilson, 2013), which utilise business processes as a service online. Another example of innovative cloud services is offering identity and access management to different systems - known as *Identity as a Service* (IDaaS) (Kreizman, 2013).

1.1.2.2 Four deployment models

Cloud computing services can be deployed in one of four different models. The service could be open to public access, identified as *Public Cloud* (Rafaels, 2015, Marston et al., 2010, Singh et al., 2015, Carroll et al., 2011, Victories, 2015). The second model is the *Private Model*, where service is provided only to organisations who utilise it (Rafaels, 2015, Singh et al., 2015, Ramgovind et al., 2010, Victories, 2015, Cearley and Reeves, 2011). Between this public and private cloud model rests *Hybrid Cloud* as the third deployment model delivering part of the system privately to organisations yet open in other parts to the public (Marston et al., 2010, Rafaels, 2015, Singh et al., 2015, Conway and Curry, 2012, Victories, 2015). The last deployment model is the *Community Model* providing open system accessibility to specific groups of users or organisations (Marston et al., 2010, Rafaels, 2015, Jamsa, 2012, Conway and Curry, 2012, Victories, 2015, Marinos and Briscoe, 2009).

Like many other technologies, cloud computing has specific characteristics, advantages and challenges. Some of the significant characteristics of cloud computing include firstly delivering on demand self-service to select appropriate services (Fox et al., 2009, Khurana and Verma, 2013, Dillon et al., 2010). Also, cloud computing offers a clear measured service where systems calculate operating costs and generate invoices automatically (Mell and Grance, 2011, Dillon et al., 2010, Cearley and Reeves, 2011). Rapid elasticity is a third property to offer auto scaling of utilised resources (Khurana and Verma, 2013, Herbst et al., 2013, Cearley and Reeves, 2011) to utilise and pay for the resources used only, known as *Pay-as-you-go* (Fox et al., 2009, Mell and Grance, 2011). These features support the ability to utilise unlimited resources, minimising management effort. Cloud computing also allows resource sharing via virtualisation where resources are shared from a pool, known as *Resource Pooling* (Mell and Grance, 2011, Khurana and Verma, 2013, Dillon et al., 2010). Additionally, cloud computing provides broad network access to utilise services from different devices, such as PCs, tablets, and smart phones (Harding, 2011, Alliance, 2011, Dillon et al., 2010).

1.1.2.3 Cloud Benefits

Cloud computing provides benefits for organisations. For example, Cloud has the potential to empower innovation by providing required resources offering many features, such as collaboration and data sharing (Marston et al., 2010, HBR, 2014). Cloud computing also offers better utilisation of scalable distributed resources (Marston et al., 2010) in affordable ways, not otherwise affordable if the organisation attempts to purchase resources outright (Mudge, 2010, Astri, 2015, HBR, 2014, Tari et al., 2015). This approach helps organisations reduce ICT investment and focus more on their core business. Additionally, cloud computing allows organisations to utilise the latest and up to date ICT resources instead of relying on aging legacy systems (Jadeja and Modi, 2012, Dikaiakos et al., 2009). Developing countries also stand to gain from cloud computing through opportunities to access these latest technologies remotely, which might not available in their market or may be very expensive if they decided to purchase them (Marston et al., 2010, Avram, 2014).

1.1.2.4 Cloud Challenges

Cloud computing however has a number of challenges. Regulation governing cloud computing is one of these challenges related to political or legal issues (Ashrafa, 2014, Kshetri, 2013), for example national compliance requirements (Gershater, 2012, DoC, 2014). Concern of data availability in the cloud is another obstacle when adopting the cloud (Choo, 2010, Tari et al., 2015, Moreno-Vozmediano et al., 2013). Trust, privacy, and security are broad yet significant challenges that hinder cloud adoption (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010). Integration with legacy systems (Ross and Blumenstein, 2015) and lack of cloud standards (Armbrust et al., 2010) are two technical challenges, whilst concern for full control of data (Armbrust et al., 2010, Marinos and Briscoe, 2009) and inadequate knowledge of cloud computing (Garrison et al., 2012) are two examples of organisational challenges.

At its overarching level, the research presented here explores the status of cloud computing with regard to Australian *Small and Medium* sized *Enterprises* (SMEs). The potential questions are why focus on SMEs? What is the global significance of SMEs as well as local in Australia? The next section provides brief answers to these questions.

1.1.3 Why SMEs

SMEs play a critical role in growing national economies (Mohlameane and Ruxwana, 2013, Mamman et al., 2015). The significance of SMEs is clear in both developed and developing countries (Mohlameane and Ruxwana, 2013, Mamman et al., 2015), prompting academics and research-focused businesses to consider SMEs in their studies (Neumark et al., 2008, Mamman et al., 2015). For instance, prior studies highlighted that SMEs represented more than 90% of all national businesses in the U.S. and China (Du and Banwo, 2015, Kongolo, 2010) as well as 90% of firms in South Africa (Berry et al., 2002).

The majority of businesses in developed countries are considered SMEs (Kostka et al., 2013, Gunasekaran et al., 2011). This sector is a major national source of enhancing national economies, providing job opportunities and reducing poverty (Kongolo, 2010, Fida, 2008, Bies, 2002). Similar to the global effect of SMEs, Australian SMEs also produce large economic value making them one of the main drivers of the Australian national economy

(ADIS, 2011). The SME sector contributes more than AU$480 Billion to the national economy and employs much of the local work force (ADIS, 2011). This significance of SMEs inspired this research through in-depth economic analysis to try linking the possible effect of cloud computing to the national economy from one side, as well as to explore the effect of SMEs on the national economy in detail.

The next section discusses the motivation of this research to highlight trends of cloud computing and the influence on SMEs and vice versa.

1.2 RESEARCH MOTIVATION

Our understanding of the benefits and challenges of SMEs using Cloud as well as the number of SMEs using Cloud, is limited. Some industry and vendor reports highlight the huge global market of cloud computing. For example, a 2016 report by *American Business Magazine* (Forbes.com) discussed the significant growth of the cloud computing industry (Columbus, 2016). The report highlighted expected annual global growth of the cloud computing industry to increase by 19.4%. Also discussed was the status of the cloud computing industry from the service providers' perspective. *Microsoft* – as one of the top global cloud service providers – predicted about 30% of its revenue in 2018 will be based on delivering cloud computing (Columbus, 2016). The same report showed *Amazon Web Services* (AWS) – a leading global cloud product suite by *Amazon.com* – generated $7.88 Billion in just the final quarter of 2015, which was 69% higher than the income of the same quarter in 2014 (Columbus, 2016). Another report from *Microsoft* expected global revenue of public ICT service use in 2018 would reach $127 Billion, and the global market value of the managed services opportunity would be $256 Billion in the same year (rhipe, 2015). The EIU (2016) and MYOB (2015) suggest all sizes of organisations (micro, small, medium and large) in all industry sectors (such as retail, banking, education and health care) can benefit from Cloud adoption (MYOB, 2015, EIU, 2016).

Exploring the status of cloud computing from the Australian perspectives showed cloud computing was also attractive to the Australian market (Pardo et al., 2016). The U.S. *Department of Commerce* report (2016) ranked Australia as the 10th foreign utiliser of U.S. based cloud computing services (Pardo et al., 2016). The report highlighted Australia is one of the most attractive markets to export U.S. cloud computing products and services, where revenue from Australia in 2015 was $4.1 Billion and forecasted at that time to be $4.7 Billion by 2016. These figures highlight the significant value of the cloud computing market in Australia and around the world - which begs the question - what would happen if organisations attempted to spend budgets on cloud computing - would they utilise adopted services successfully? A question is asked here regarding possible drivers and challenges organisations could encounter when adopting cloud computing in order to implement cloud successfully? To answer this question, what was first required was to know the status of cloud computing in Australia.

Initial research revealed limited information regarding the adoption rate of cloud computing in Australia. In addition, several studies at the commencement of this research focused on large enterprises, with limited scope given to SMEs. Hence this research started by exploring and analysing the significance of SMEs in Australia (comprising as they do more than 99% of Australian organisations) (Connolly et al., 2012). Initial analysis showed the importance of this sector, however little literature was found regarding the adoption rate of cloud computing by SMEs specifically in Australia, except for a few industry studies.

1.3 RESEARCH AIM

The brief introduction in the previous sections determined the direction of this research. The goal was to answer three main questions, which are:

- *What has been the adoption rate of cloud computing for Australian SMEs during the period 2015-2016?*
- *What are the potential benefits of cloud computing utilisation to improve business capabilities and achieve competitive advantage?*
- *What are the potential challenges of cloud computing utilisation that the Australian SME sector faces?*

Answering these questions encouraged two phases in conducting the research presented here. The first phase was a quantitative study to show descriptive statistics and to introduce the second phase - a qualitative study. The first phase was performed via a quantitative survey. Exploring the adoption rate of cloud computing by SMEs was conducted in the quantitative phase. Exploring the potential drivers and challenges of cloud computing adoption and use started in the quantitative stage to gain an overview of factors uncovered. Those factors were then explored in-depth during the second phase using semi-structured interviews.

1.4 THESIS CONTENT

The motivation section illustrated a gap that can be clearly presented via three issues. The first was the absence of academic studies showing the approximate adoption rate of cloud computing by SMEs in Australia. The second issue is exploring possible influences as drivers in adopting cloud computing by SMEs. The third issue is around exploring possible challenges SMEs encounter when utilising cloud based solutions. These dilemmas will be the main topic of this study to bridge the gap in the literature.

The thesis takes the following form: Chapter two examines the national significance of SMEs and possible effects of cloud computing on SMEs. The chapter will start with a discussion of the national economy, which will be followed by analysing factors that would affect the national economy including the effect of IT resources down to the level of cloud computing. After analysing possible effects of cloud computing this chapter will discuss the significance of SMEs in Australia.

After discussing the significance of SMEs and cloud computing, chapter three reviews the technical literature to understand cloud computing in detail. The chapter will start with discussion regarding the global trend toward cloud computing and the global status of computing by SMEs. The reader will then gain a technical background of cloud computing. Then a discussion of common cloud computing services will follow including service delivery and deployment models. Gaps in the literature are identified which then leads to research questions being raised.

Chapter four discusses most commonly used theories and epistemologies in similar studies, then the chapter selects options for the research presented here. Five commonly used theories in similar studies, are *Upper Echelon Theory* (UET) (Hambrick and Mason, 1984, Dwivedi et al., 2009a, Geyer, 2016), *Diffusion of Innovation* (DOI) (Yigitbasioglu, 2015, Conrad, 2009, Hong and Zhu, 2006, Grandon and Pearson, 2004), *Technology Acceptance Models* 1, 2, and 3 (TAM) (Davis et al., 1989, Yigitbasioglu, 2015, Autry et al., 2010, Paul Jones et al., 2013), *Resource Based Theory* (RBT) or *Resource Based View* of the Firm Theory (RBV) (Carcary et al., 2014, Garrison et al., 2012, Yigitbasioglu, 2015, Caldeira and Ward, 2003), and the *Technology, Organisation, Environment* framework (TOE) (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013). Chapter four ends in selecting relevant theories - which are RBT and TOE to develop a conceptual framework.

Chapter five explains research methods required, beginning with several sampling methods and selecting the method for this study - namely convenience sampling. After that different research dimensions are discussed before selecting an appropriate one, which is a cross-sectional dimension. Solely qualitative research to explore possible drivers and challenges in adopting cloud computing by Australian SMEs was considered, however, the absence of academic studies to show the approximate adoption rate by this sector led to the inclusion of a quantitative phase prior the qualitative phase to provide descriptive statistical information regarding the adoption and to explore possible factors – as initial drivers and challenges of cloud adoption. The adoption status of cloud by participating SMEs is discussed next. Then, if the firm utilise cloud services, they are asked to rank list drivers that were explored from the literature. If the firm did not utilise cloud services, they will be asked to rank challenges that were also collected from the literature. The rest of this chapter discusses the quantitative and the qualitative phases of the research.

Chapter six analyses the data collected from the quantitative first phase, focusing mainly on descriptive statistical data analysis to explore approximate adoption rates of cloud computing by Australian SMEs, as well as to highlight possible drivers and challenges when the organisation utilises cloud services. Data is presented which initially includes the number of participating organisations and also checking whether the participating firm fits within the required sample required, namely SMEs. Moreover, this section summarises convenience sample participation from each city included in Australia. After that the adoption rate is explored from several perspectives to gain further insight on the status of cloud adoption. This part also explores the status of adopting cloud computing according to business industry. In addition, the status of cloud adoption by SMEs with regard to service delivery and deployment models are included. Rankings of drivers and challenges appear last which form the basis for chapter seven.

Chapter seven qualitatively focuses on possible drivers and challenges of cloud use by SMEs in Australia. Participating SMEs from the quantitative phase were invited for a further interview. This phase focused on adopter SMEs only, starting with exploring possible influences as drivers to cloud adoption. The chapter shows adopter SMEs were asked to discuss the likelihood of drivers for adoption. Drivers were discussed in detail to explore possible reasons for each factor. Non-adopter SMEs ranked challenges against cloud services. Those challenges were taken to the adopter SMEs to explore their experiences, and if the challenge was encountered how the adopter firm dealt with these to avoid or mitigate them.

Chapter eight discusses the data from chapters six and seven, starting with a theoretical background recalling the conceptual framework developed from selected theories in chapter four. Discussing the quantitative results in this chapter highlights results if the adoption rate was explored from different perspectives. Also, discussed are results if adopting different delivery and deployment models as well as adoption per business industry. The qualitative phase was discussed as well in this chapter. All analysed qualitative data from chapter seven is summarised and organised in three tables to gain focused insight on each factor as drivers or challenges. The last part of this chapter highlights the contribution of this research, which started with developing a suggested framework for adopting cloud computing by SMEs in Australia. This framework concludes by highlighting certain guidance for SMEs and service providers.

Chapter nine concludes this thesis.

Chapter Two: SMEs, The National Economy and Competitive Advantage

2.1 INTRODUCTION

The significance of the national economy and the possible opportunities to utilise information technology; including cloud computing; that would enhance the national productivity lead this chapter to discuss the possible relationship and the possible effect utilising cloud computing on different levels toward adding to the national economy.

The chapter starts by discussing the concept of the national economy including the main factors that would affect it. After that, it highlights the national productivity as one of the main players in the national economy from the Australian context. Then, the chapter will go further to discuss the significance of business innovation as a key player in the national productivity. Moving in further details, business innovation will be followed by highlighting competitiveness as a factor of business highlighting competitiveness. Information technology; including cloud computing; would be a significant factor in improving business competitiveness. Therefore, the possible effect of information technology and cloud computing will be discussed.

After that, this chapter highlights *Small and Medium Enterprises* (SMEs) and the relation between them and utilising information technology including cloud computing. It will discuss the motivations that led to focus on SMEs in Australia, including the significance of this sector in Australia.

The hierarchy of this chapter will follow an approach of discussing these different topics from general to specific, starting by identifying the national economy in the next section.

2.2 THE NATIONAL ECONOMY

The economy as a noun in general is defined as the relationship between three main factors, which are trade, production, and the supply of cash in a particular region or country (Stevenson, 2010) as in figure 2.1 below. The national economy status is evaluated using several methods and concepts. One of the most important economic principles is the *Gross Domestic Product*

(GDP), which shows the market value of all national products and services in a single value of the national economy in a specific period of time (Mankiw, 2014, Gans et al., 2011). The global economic importance of the GDP rate leads countries to report the GDP periodically; mostly annually.

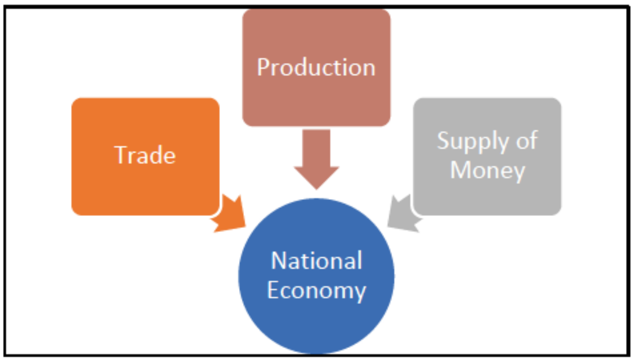

Figure 2.1: The main factors that affect the economy

According to Reserve Bank of Australia reports, the national economy scored annual GDP growth by 2.5% in 2015 (RBA, 2016) that came after a growth rate by 2.2%, 2.3% and 2.7% in 2014, 2013 and 2012 respectively (RBA, 2015), as shown in the following table:

Table 2.1: Australian GDP from Jan-2012 to Sept-2015. Source: (RBA, 2015)

Quarter	GDP Growth (%)
Jun-2012	3.9
Sep-2012	3.2
Dec-2012	2.7
Mar-2013	1.8
Jun-2013	2.1
Sep-2013	2.0
Dec-2013	2.3
Mar-2014	3.0
Jun-2014	2.7
Sep-2014	2.5
Dec-2014	2.2
Mar-2015	2.1
Jun-2015	1.9
Sep-2015	2.5

Even though the Australian economy is growing steadily, economics and business media claimed that this growth is considered as very weak (Jericho, 2015) compared to many other countries.

This is illustrated in a recent World Bank report that shows global annual GDP growth from 2011 to 2014. In 2014, Turkmenistan and Ethiopia had the highest growth rate of 10.3% then followed by The Democratic Republic of the Congo by 9%. However, several developed countries came very far behind. For instance, New Zealand was the 118^{h} by 3.17%, the United kingdom in the 131th by 2.85%, Australia in the 140th by 2.5%, that followed by Guinea-Bissau, Slovak Republic Hong Kong, Swaziland, North America, and the United States that fit between 2.4-2.5% (WB, 2015). Please see the appendix for more details regarding the global GDP growth.

Clearly, Australia is uncompetitive in terms of GDP growth compared to many other countries although similar in growth to similar economies. *The previous review highlighted the importance in improving the national economy to be more competitive compared to the other countries. Therefore, the main goal that needs to be studied is how to add to the national economy?* The targeted improvement depends on several factors. One of them is by focusing on improving the national productivity (Kent, 2015).

2.3 NATIONAL PRODUCTIVITY

The Reserve Bank of Australia has highlighted the link between labour productivity improvements and growth (Kent, 2015). Production is the process of combining many inputs such as resources including people and physical assets to produce outputs and generate income. Productivity in general is used to measure production efficiency as the ratio of the output to the input (Coelli et al., 2005, PC, 2009, Gordon et al., 2015). The Australian Bureau of Statistics (ABS) describes productivity as the process of transforming a combination of inputs; including labour and physical assets; into the targeted outputs; such as goods and services; that improve the national production efficiency, which leads to better Australian living standards and competitiveness in the international market (ABS, 2012).

Generally, productivity is usually calculated using the following formula (Coelli et al., 2005) that shows that if the outcomes of the business was higher than the spent resources, the organisation will have a positive productivity.

$$Productivity\ (P) = \frac{Output\ (O)}{Input\ (I)}$$

while the Australian government measures the official productivity more specifically in the income that generate the national economy, and serving specific services (APH, 2010):

Summary:

The previous sections stated that demand in raising the national economy is based on three major factors which are trade, production and supply of money. Any improvement in any of these factors could help in boosting the economy. Production is one of these factors, and its efficiency is affected by improving the productivity rate. Therefore, the following figure links the demand in improving the national productivity that could mostly end up by improving the national economy via increasing the production efficiency. The concluding question in this step is how to contribute in improving the national productivity? One means of improving the national economy is to examine the critical factors affecting the national productivity.

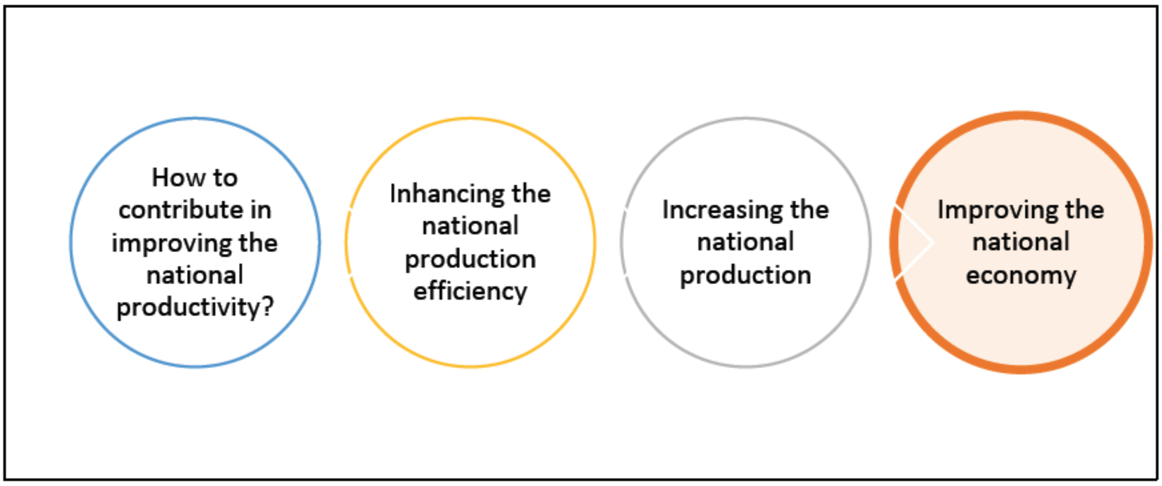

Figure 2.2: The second step in identifying the gap

National productivity has a significant importance in the national economy. Gruen (Gruen, 2012) emphasised the importance of improving the national productivity by focusing on enhancing the actual productivity in the form of increasing the efficiency, which is based on three important factors: which are allocative, dynamic, and technical or cost efficiency that would improve the average income, and provided services (Gruen, 2012) and; will add to the national economic growth. In 2015, the Australian Productivity Commission recommended improving productivity as one of the important factors in supporting growth in the national economy (Gordon et al., 2015). The document focused again on the national productivity growth that will increase the outputs, which is affected by the available capital, workers, up to date technologies, and resource endowments (Gordon et al., 2015). The following figure shows the most important productivity factors from the Australian government perspective:

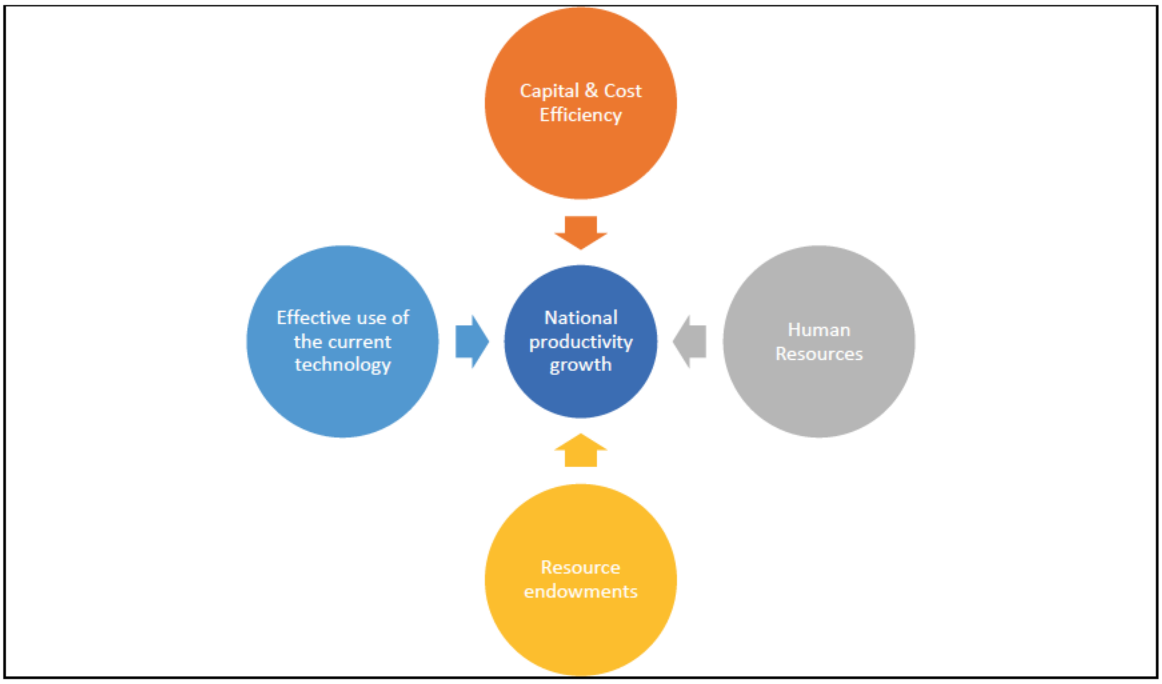

Figure 2.3: Some of the National Productivity Growth Factors (Gordon et al., 2015)

More specifically at the organisational level, firms' productivity and improving their outcomes can add to the national productivity as one of the major national economy drivers. Utilising up to date technologies (Gordon et al., 2015, Brynjolfsson and McAfee, 2012) and business innovation play significant roles in improving business productivity (Gordon et al., 2015, Keeley et al., 2013). The significance of business innovation is noticeable in driving productivity growth at the firm level by creating viable new offering (Gordon et al., 2015, Keeley et al., 2013).

2.4 THE SIGNIFICANCE OF BUSINESS INNOVATION

Business innovation is a key factor that would drive several benefits (Cooke et al., 2000, Schwab and Sala-i-Martin, 2011). It is presenting competitive countries and improving national economy and employment rates. This could result in a higher living standards and creating more opportunities for individuals and countries. Also, business innovation would assist in providing many of the daily needed goods and services to people and communities (Cooke et al., 2000, Schwab and Sala-i-Martin, 2011). The significance of business innovation creates more pressure considering it as an important success factor in different business levels; including small and medium sized organisations (SMEs) for many reasons including facing the entry of international SMEs to local markets as competitors (Parrilli and Elola, 2012, Swann, 1998). However, SMEs are facing some challenges in business innovation due to the fast market changes and the high cost of the up to date digital technologies; including hiring skilled personnel; but they have to overcome those challenges to be competitive (McAdam et al., 2014, Clark, 2010).

Business innovation could be applied in different forms including introducing new product, new applicable and useful business process, opening a new market, and finding a new source of supply(Schumpeter, 1934, Majerová, 2015). These forms also include another economy driver, which is applying and updating digital technologies as a form of innovating new business process, which is known as a *technical innovation* (Freeman, 2004, Rice, 2013, Kell et al., 2013). In addition, the rapid development of applications, tablets, and smartphones and their engagement in individuals' daily activities empowers business innovation in different forms including creating new industries that made a significant shift in some companies' targets and outcomes (Faletski, 2012).

The technical innovation in the business can improve productivity in three forms, which are saving budget in moving to a lower cost of units and services (Diewert and Fox, 2008, Sheng et al., 2015), organisational change in adopting new technologies, and improving the technical efficiency (Gordon et al., 2015).

Technological innovation follows five main characteristics of business innovation (Freeman, 2004, Iversen et al., 2008), which are:

- *Clustering* of related innovations in business.
- *Creating* new industries, systems, products or processes.
- *Comprehending*, by bringing new markets, skills or technologies.
- *Coping, facing, overcoming,* or *removing* any market or technology that could hinder innovation in business.
- *Coupling* to link the technology to market needs.

More specifically, product innovation as part of business innovation, is formed by three main factors, which are globalisation, reducing production life cycle, and the fast response to technology change (Damanpour, 1991).

The previous section gave more details in the factors that could add to the national economy starting from the firm level to improve the productivity. These factors were the cost efficiency, effective utilisation of technology, resource endowment, human resources, and business innovation. Figure 2.4 summarises and illustrates the relationship between these factors toward enhancing the national economy:

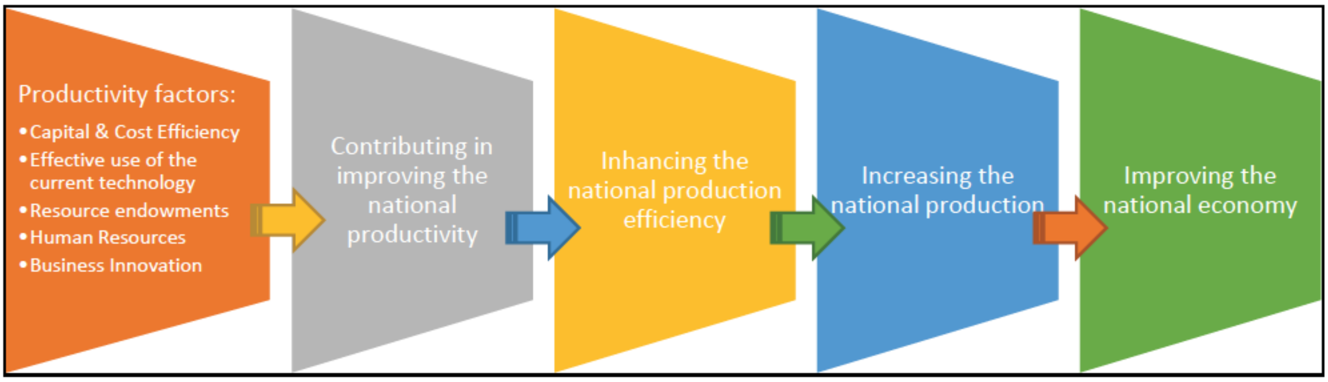

Figure 2.4: Major drivers to the national economy

2.5 COMPETITIVENESS

Competitiveness is defined as a set of policies, factors, and organisations that represent the level of the productivity in the national economy (Schwab and Sala-i-Martín, 2015). Global competitiveness is one of the main two required targets for improving the national economy (Majerová, 2015). Competitiveness is considered as a goal of globalisation, which is applied in four forms (Shurchuluu, 2002). The four forms are: the end of socialism, moving from natural resources to brainpower industries, demography in a form of moving people across countries to improve their lifestyle, and information and communication technology (Shurchuluu, 2002).

Productivity, which improves efficiency, is one of the key players in improving competitiveness (Shurchuluu, 2002). The *Global Competitiveness report* (2015) identified three main categories in empowering the national economy, which are factor-driven, efficiency-driven, and innovative-driven economics. The effective factors on the efficiency driven category are described in the global competitiveness index framework. This framework shows twelve pillars classified under three main categories (Schwab and Sala-i-Martín, 2015), as shown in figure 2.5:

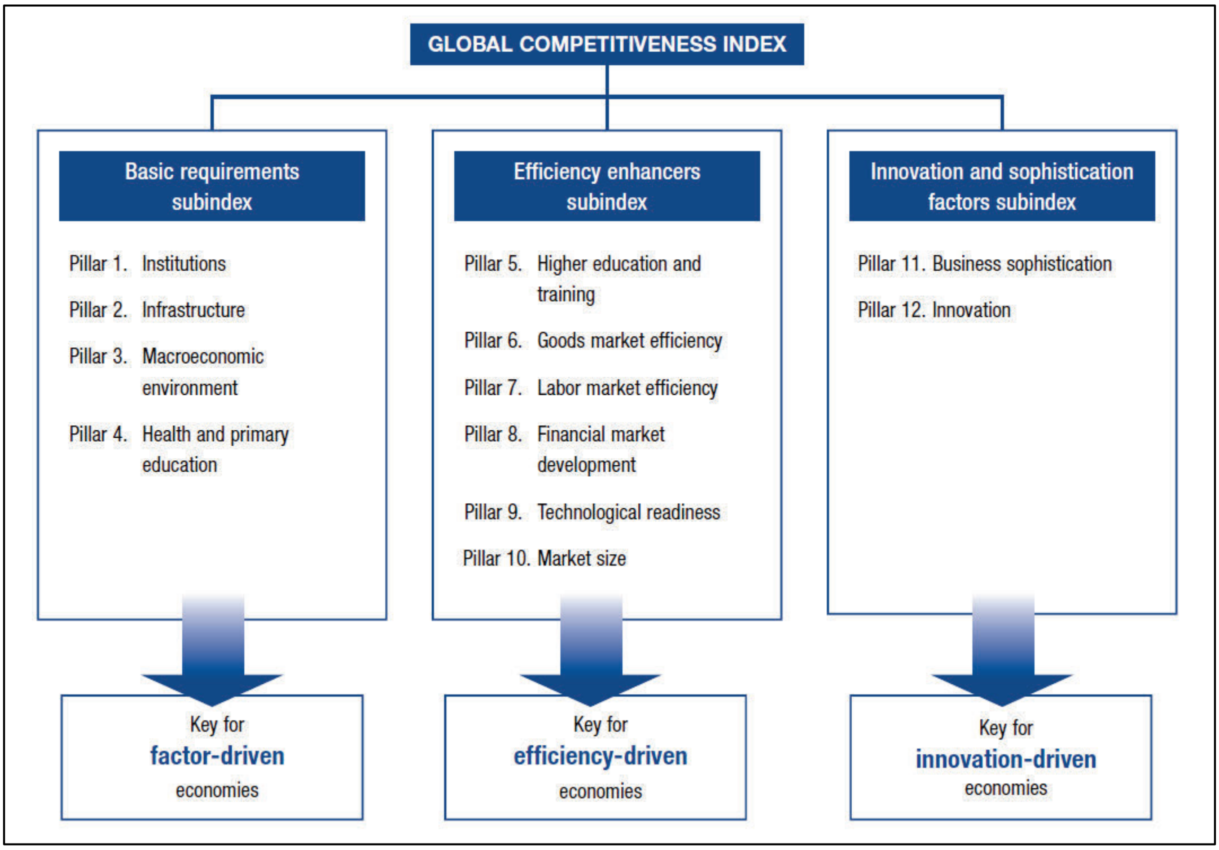

Figure 2.5: Global Competitive Index Framework. Source: (Schwab and Sala-i-Martín, 2015)

As seen in the figure above, utilising a ready technology resources is one of the main pillars to enhance the efficiency that would add to the national economy.

This framework also represents the World Competitiveness formula that shows competitive assets and processes as two drivers of global competitiveness. Each of these drivers consists of several factors (Shurchuluu, 2002), as the following:

Competitive Assets	*X*	*Competitive Processes*	=	*Global Competitiveness*
- People		*- Speed*		*- Growth*
- Finance		*- Quality*		*- Profit*
- Technology		*- Services*		*- Duration*
- Infrastructure		*- Customisation*		*- Market Share*

Figure 2.6: World Competitiveness formula

Linking this section (2.5) to the previous sections showed the high demand on raising the national economy and being globally competitive. These national goals require key factors to be achieved. The potential of up to date information technologies appeared in all of the discussed perspectives as a driver of the national economy and world competitiveness, which is also considered as an important component in the economy (Ritchie and Brindley, 2005). This potential would include cloud computing that would improve business outcomes and productivity (Buyya et al., 2009, Marston et al., 2010).

Briefly, cloud computing[1]; as one of the major current information technology's trends; plays a significant role in enhance the productivity and innovation in business organisations (Buyya et al., 2009, Marston et al., 2010) that can lead to improving the national economy. The significant importance of IT technologies; including cloud computing; to global competitiveness and the national economy is summarised in figure 2.7.

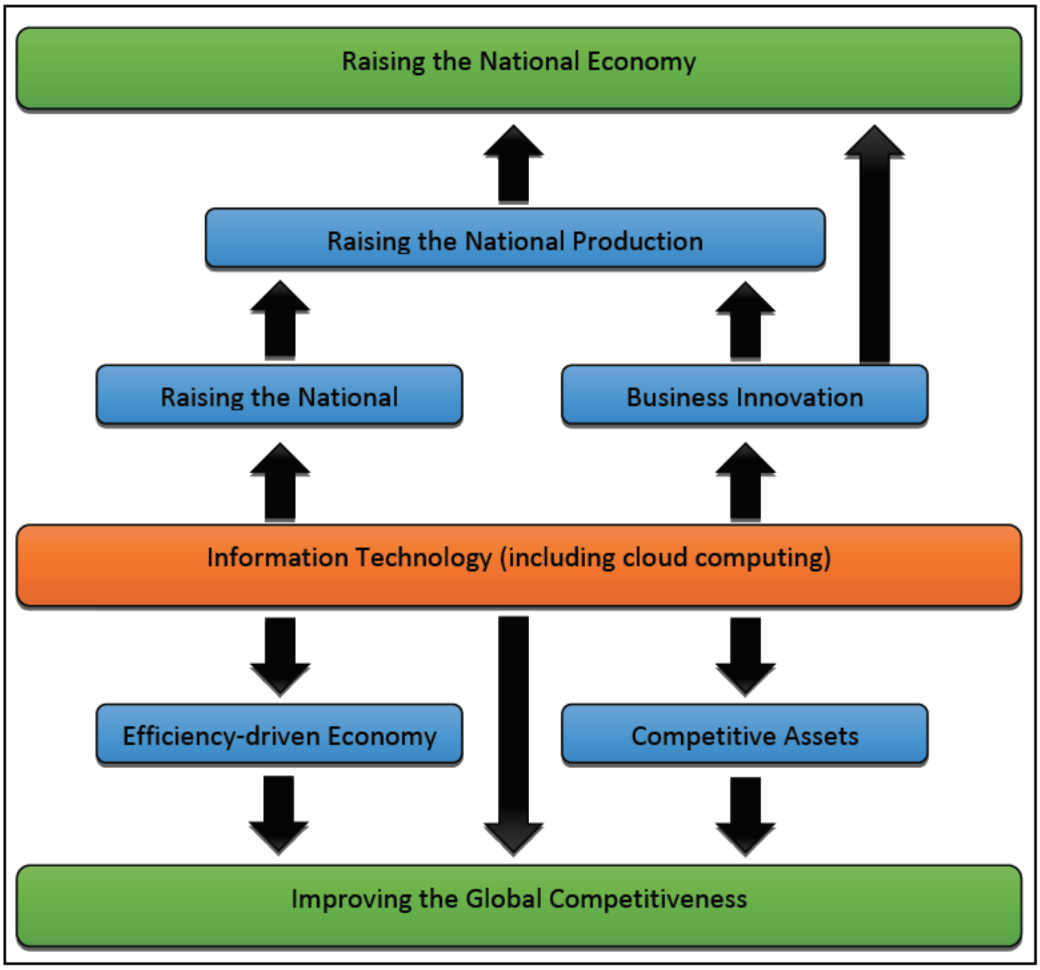

Figure 2.7: The Effect of Cloud Computing and Information Technology on Improving the National Productivity and the Global Competitiveness[2]

[1] The technical concepts of cloud computing will be discussed in chapter 3.
[2] This figure was illustrated for the reader the general aim of this thesis which is to study the national cloud computing status.

2.6 INFORMATION TECHNOLOGY, NATIONAL ECONOMY, AND GLOBAL COMPETITIVENESS

The ICT industry would play a significant role in improving the national economy and global competitiveness; as highlighted briefly in the previous sections. Another significant economic concept that heavily considered the ICT industry in developing economies is called the *National Innovation System.* This concept focuses on the flow of information and technology among people (Nelson, 1993). The *National Innovation System* shows the positive effect of the digital technologies' readiness and the updated IT infrastructure and technologies in improving the global competitiveness. This concept states that technological leadership is able to give nations more global competitiveness than if calculating by currency rate, prices or salary rate (Nelson, 1993, Freeman, 2004). Japan is an example of one of the leading countries that shifted their economy quickly as a result of many factors, including the use of information technology placing Japan as a top global technological power (Nelson, 1993, Freeman, 2004).

More specifically at the firms' level; as a key player in the national economy; the information technological capabilities could act as enabler for the national economy. In conjunction with the other business resources in the organisation, ICT gives the business positive impacts in improving performance, productivity, cost saving, business outcomes, and corporate innovation (Chen et al., 2015, Bhatt et al., 2010, Wang et al., 2013b, Melville et al., 2004). The very fast evolution and spread of technology in conjunction with the dramatic cost drop of utilising required technologies in the last few years increases the potential of utilising information technology in business environment. For instance, the global number of mobile phone subscribers reached 6.8 million in 2013 (ITU, 2013). This number jumped to 7.4 billion in 2015 (ITU, 2015). This increase gives potential to expand the business and improve their outcomes by using information technologies to reach more customers via mobile applications and services. From the knowledge-based perspective, one of the important benefits of using digital technologies is in giving enterprises the opportunity to share their knowledge and experiences. In addition, it would help in building business relationships among companies that benefit large, medium or even small organisations (Luo and Bu, 2016). This improvement prediction is confirmed by the *Centre for Information Systems Research* (CISR) at the *Massachusetts Institute of Technology* (MIT) which studied the effect of having better technology models in the business, and reported that the revenue of businesses having and using the proper technologies, were 11% above the average (Weill and Woerner, 2013).

After discussing the significance of utilising ICT, the next section will discuss a main pillar of this study, which is SMEs. It will include an example of a global classification of SMEs that will be followed by the Australian definition.

2.7 SMEs AT A GLANCE

Theoretically, SMEs stands for Small and Medium sized Enterprises (Ayyagari et al., 2007). SMEs play a significant role in country's development (Kongolo, 2010). However, there is no global standard to classify organisations as SMEs, where each country has its own classification system according to different factors, including employment number, industry type, capital or sales (USITC, 2010b, Azarnik et al., 2012).

In the United States, organisations are classified as SMEs according to different factors, such as the type of business, number of employees, and annual revenue. The industry type is a major factor in identifying the U.S. SMEs, where organisations are classified as manufacturing and non-exporting services, exporting services firms, and farms as an independent group. After that, each group has different criteria in identifying SMEs. From a staffing perspective, firms are considered as SMEs if they employ fewer than 500 persons (USITC, 2010b, Grover and Suominen, 2014). The most common SME classification in the U.S. is represented in the following table:

Table 2.2: Business classification in the U.S. Context. Source: (USITC, 2010b)

	Business Type			
	Non-exporting services and manufacturing	Exporting Services businesses		Farms
		Most of Businesses	Computer-based services	
Annual revenue	N/A	≤ US$7M	≤ US$25M	< US$250k
Employees number	0 to 499	0 to 499	0 to 499	0 to 499

In Australia, the government has classified business organisations according to a company's size into three main groups. The first group represents small business that consists of 0 to 19 employees (ADIS, 2011, CSC, 2014). Micro business is a specific class of small businesses, employing 0 to 4 workers. Medium-sized business is the second group with 20 to 199 employees, while the last group is large business, where enterprise workers exceed 200 personnel. This paper focuses on SMEs as small, micro and medium businesses (ADIS, 2011). This classification is summarized in table 2.3.

Table 2.3: Business classification in the Australian Context

Organization Classification	No. of employees
Micro	0 ~ 4
Small	5 ~ 19
Medium	20 ~ 199
Large	200+

2.8 SMEs AND INFORMATION TECHNOLOGY

Many studies among the last decades showed that this sector has a significant impact on the national economy and the development of the country (Abrahams, 2003, Fida, 2008, Feeney and Riding, 1997). SMEs create job opportunities for both of urban and rural people (Abrahams, 2003, Fida, 2008, Feeney and Riding, 1997). Also, SMEs provides local communities many of the required goods and service for their life, as they depend heavily on SMEs, and lead to an innovative and stable economy (Abrahams, 2003, Fida, 2008, Feeney and Riding, 1997). In addition, any declining in national living standards and increasing of unemployment rate, would be healed by SMEs. The weaknesses of the national economy is faced by SMEs in helping to increase the living standards and creating jobs (Abrahams, 2003).

Even though, using digital technology is not well considered by SMEs in some countries (Parrilli and Elola, 2012), the rapid development of the online business industry brought several benefits to a significant number of organisations including SMEs (Tutunea, 2014). Utilising the required information and communication technology resources, gives SMEs the potential to grow their businesses and expand nationally and internationally. It may not the main business driver to success, but it is one of many factors in giving more opportunities for SMEs to survive, succeed and compete. In addition, it opens the door for SMEs to build national and international business relationships that should be considered as a benefit of using information technology resources in SMEs sector (Du and Banwo, 2015).

The benefits of utilising digital technologies became more common in business environments to bring more sustainability and improvement to the firm (Tutunea, 2014). Some organisations in an Australian-based study stated that adopting IT resources would be costly at the installation phase, but comes with different strategical benefits if the adopted technologies been utilised professionally. Some of these benefits are reducing the operational costs and speeding up business processes, and could be considered in processes and strategic plans (Love and Irani, 2004). In South Korea, domestic SMEs have a limited local market for their products. International trend that relying heavily on information technology makes the global market more possible for Korean businesses (Lee et al., 2012, Du and Banwo, 2015).

2.9 SMEs AND CLOUD COMPUTING

Many SMEs are not considering the potential of IT in running their businesses. On the other hand, some SMEs have realised this importance of utilising digital technologies to operate, and improve their business outcomes (Mohlameane and Ruxwana, 2013, Mutula and Van Brakel, 2007). However, many of these companies try to use traditional IT solutions to be competitive. This trend could result in reach their goals, but it led to several new challenges in the firm in installing and operating digital solutions including insufficient budget, physical locations, lack of skilled technical staff, and the limited knowledge of utilising information technology (Mohlameane and Ruxwana, 2013, Mutula and Van Brakel, 2007).

Cloud computing is one of the recent IT technologies that facilitate online business processes. Although utilising cloud computing might disrupt legacy systems and processes in businesses (Ross and Blumenstein, 2013), cloud computing opens the door for local firms to access global markets. In short, cloud computing provides more opportunities for businesses; including SMEs; to grow and become more competitive (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012). Utilising cloud computing enables SMEs to sell cloud-based services worldwide and take the advantage of widespread end user devices and technologies. For example, there has been a considerable increase in smart phones and tablets using cloud-based services to gain access to services globally (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012).

The belief in bringing competitive advantage to SMEs through cloud computing is supported in a study by Harvard university on 527 businesses, stating 74% of the studied population admitted cloud computing would provide competitive advantage to their firms. In addition, 71% agreed that utilising cloud-based services would reduce business complexity (HBR, 2014).

Cloud computing became an important factor in boosting business innovation and entrepreneurship in SMEs (Ross and Blumenstein, 2015, Ross and Blumenstein, 2013). It provides SMEs the ability to overcome some of the common challenges that affect them negatively more than large enterprises. These challenges including financial IT, utilising resources and operational costs. Cloud computing overcomes these issues by hiring the required resources and pay for the used services only as SMEs usually rely on limited budgets comparing to large firms (Ross and Blumenstein, 2015, Ross and Blumenstein, 2013). In addition, having a specific IT department is not an easy option for SMEs that usually have limited spaces. This challenge can be solved by using cloud-based resources that give firms to run an entire IT department or even data centres remotely and use physical spaces to run their essential business activities (Ross and Blumenstein, 2015, Ross and Blumenstein, 2013). Moreover, cloud computing brings many other benefits to SMEs including scalability, accessing the global market and capital, and increasing SMEs global collaborations (Ross and Blumenstein, 2015, Ross and Blumenstein, 2013). These features allow SMEs to focus more on developing and growing their core business than spending extra time and money in managing and operating the IT resources include maintenance, update, and technical support. The expected business innovation would also lead to product innovation that plays a significant role in improving business outcomes and competitiveness (Sabherwal and Becerra-Fernandez, 2011, Ross and Blumenstein, 2015).

Moreover, it is mentioned above that cloud computing gives SMEs the opportunity to reach other markets and more customers; this potential through online application stores; such as iTunes, Google Play, and Microsoft store; has the potential to deploy SMEs' applications and services in the global market without having an IT data centre or even a server. This advantage encouraged SMEs and individuals to take advantage of cloud computing to deploy more applications and services online. For instance, it was reported that the iTunes app store received around 13,000 applications each month (Urban, 2013).

Recently, business organisations in all sizes; specially SMEs; started considering cloud-based services as a part of their business processes to overcome some of the common challenges and to bring more opportunities to the firm. This trend also appeared in developing countries, where companies could have more challenges, such as utilising the latest digital technologies (Fox et al., 2009, Mohlameane and Ruxwana, 2013).

2.10 WHY FOCUS ON SMEs?

The SME sector plays a significant role in driving the growth and sustainability of the national economy globally in both developed and developing countries from different perspectives (Mohlameane and Ruxwana, 2013, Mamman et al., 2015). This importance leads many economists and researchers to focus on SMEs and their studies (Neumark et al., 2008, Mamman et al., 2015). Globally, the SME sector is considered the “lifeblood” of advanced economies covering around 75% of firms (Kostka et al., 2013, Gunasekaran et al., 2011), and provides the potential to countries and people that employed 60% of workers globally in 2012 (Du and Banwo, 2015).

SMEs are considered an important generator of employment and a considerable national driver in reducing the poverty rate in several countries. A study showed the SME sector contributed to the GDP rate by 60% in the form of employing more than 70% in the low-income countries and employs more than 65% with a contribution of 55% of the GDP rate in high-income countries (Fida, 2008). This importance also one of the national key player in presenting efficient national economy, tax revenue, efficient national resource allocation and better distribution income (Kongolo, 2010, Fida, 2008, Bies, 2002).

In a developed nation such as the U.S., the government considers small businesses as the backbone of the national economy - the main source of employment in the U.S., the largest national exporting sector, and the user of imported goods (USITC, 2010a). A study in 2001-2002 shows that small U.S. businesses represented 99.7% of the national firms, and contributed heavily to the Gross Domestic Product by employing %60~%80 of the entire U.S. workers (Kongolo, 2010). In a similar period, a study had been conducted in South Africa showing that local SMEs represented about 90% of all firms in the country that offered around 60% of employment opportunities and contributed by 51% to 57% in the national GDP rate (Berry et al., 2002, Kongolo, 2010).

This importance of SMEs also appeared in developing countries that considered SMEs as key players in their economies, as the economic situation there put more pressure on growth and creating jobs to fulfil needs in fighting poverty (Aremu and Adeyemi, 2011, Ayyagari et al., 2014, de Wit and de Kok, 2014). For instance, according to the 2013 report from the National Bureau of Statistics in China, around 99.7% of all local firms were SMEs that created around 80% of jobs in the country (Du and Banwo, 2015). Another example from Tanzania, where SMEs have a significant importance in the national economy in the form of providing a source of income in creating job opportunities and improving locals’ life styles (Hamisi, 2011).

In Australia, SMEs have the potential to improve national productivity because they employ 70% of the workforce and contribute more than AU$480 billion to the economy (ADIS, 2011). There exists an opportunity for SMEs to adopt cloud services to develop flexible IT platforms at a relatively low cost. This is applicable by taking the advantage of any of the three cloud-based service delivery models, which are IaaS, PaaS and/or SaaS in providing the required IT resources for SMEs to take advantage of online services; such as e-commerce; without a massive investment in IT resources (Galer, 2013).

2.11 THE SIGNIFICANCE OF AUSTRALIAN SMEs

The Reserve Bank of Australia (2012) considers SMEs to be the backbone of the national economy of Australia. The bank reported the total number of Australian businesses in 2011 was approximately 2,045,000. These figures show that 96% of businesses in Australia were classified as small businesses, and of those 1,815,000 were classified as micro businesses (Connolly et al., 2012, Kuruppu et al., 2013). Medium sized organisations represent 4% of Australian businesses with 81,000 companies. Large business were only 0.3% with 6,000 enterprises (Connolly et al., 2012).

The *Australian Department of Innovation Industry* reported there were around 4.8 million people working in small businesses by the end of June 2010 (ADIS, 2011). The Reserve Bank of Australia (2012) reported around 47% of employees were working in small businesses (including micro businesses), 23% in medium organisations, and 30% in large enterprises (Connolly et al., 2012). This shows that approximately 70% of employees are working in the SME sector, which plays a significant role in the Australian economy, and thus the need to take advantage of cloud computing to stay competitive and improve national productivity.

Interestingly, in 2014 the City of Sydney council considered local small business as the core of Sydney's economy, highlighting the importance of small sized businesses because they cover more than 80% of all businesses, with more than 100,000 employees contributing around 25% to Sydney's economic annual output, estimated to be more than AU$25 billion. Also, the council aids the strong relationship between small businesses and other sectors of medium and large enterprises, through supporting their operations as efficiently as possible (CSC, 2014).

From the electronic commerce perspective, in October 2009 approximately 51.5% of small businesses and 29.2% of micro businesses in Australia had internet activities. These numbers shows the importance of online IT services in more than half of the small businesses in Australia (ADIS, 2011).

Cloud computing is considered one of the business success factors that could lead to improvements in business outcomes and the national economy as a whole (Mladenow et al., 2012). Cloud computing is described as a group of innovative IT utilities that provide on-demand on-line services (Surendro and Fardani, 2012), which provide several benefits to small and medium businesses with limited budgets which cannot support a specific investment in their IT resources. Cloud computing can help them by providing most of the needed utilities online by renting the required resources that varies from hardware infrastructure to operating systems, software, file storage, databases and more. This utilisation is supposed to mitigate the IT resources issues for those companies that lead to improving their income and adding value to the Australian economy. Cloud computing can also act one of the most important success factors for business survival in improving and managing business processes as well as innovating new business ideas, for example using mobile computing, dealing with Big Data issues, and for social media (Isom and Holley, 2012).

In order to be effective, cloud computing requires access to fast and reliable internet infrastructure to guarantee the quality of services and to ensure online availability for 24/7 operations. The Australian government has moved an important technical step forward in introducing the *National Broadband Network* (NBN) that is planned to reach 93% of Australian buildings in order to provide peak speed up to 100 Mbps (DoBCD, 2013c) with several options of speed and three different technologies, which are fixed wireless, optical fibre and internet by satellite technology, where the last one is proposed to work by 2015 (DoBCD, 2013b). This shift can support the Australian government's trend in its regulation of cloud computing in three main strategies. The first strategy is increasing the business value of cloud computing in the government digital environment. Secondly, promoting the utilisation of cloud services for small businesses and non-profitable organisations, which is very important to the scholarship presented in this paper. The third strategy is focused on supporting the cloud services sectors (DoBCD, 2013a). Globally, Japan is one of the leading countries in internet and computing technologies in providing internet services, a critical factor to gaining global competitive advantage. Japan leads the world's internet speed by introducing the fastest internet in the world reaching up to 2 Gigabits per second (Alabaster, 2013); this shows for Australia to be competitive it needs to have fast ubiquitous broadband. The next section examines the challenges SMEs face when adopting cloud computing.

2.12 COMMON CHALLENGES FOR SMEs

Like all organisation types, the SME sector usually faced several challenges affecting their productivity and outcomes. Some of these challenges are common globally, and some are specific for Australian SMEs. Some of the common SME challenges in the business environment would be classified as the following:

Financial issues in establishing and running the business. This issue appears more in some developing countries who have limited economies, such as in Nigeria (Osotimehin et al., 2012, Agwu and Emeti, 2014). In addition, SMEs in some of the developed countries are also suffer from different financial issues (Hogeforster, 2014). For example, in Japan SMEs find it difficult to have to sufficient funds to cover possible risks and lack the needed strength to survive after such problems, such as the unexpected environmental hazards including earthquakes, and tsunamis (Lam and Shin, 2012).

The *local and regional economy* plays an important role in growing SMEs (Lam and Shin, 2012, Agwu and Emeti, 2014). In linking the economic issues to the financial issues that is discussed above, SMEs could even find many financial difficulties if they attempt to borrow some funds from banks and other financial institutions, due to several reasons. The low possibilities to pay back the loan and the limited available funds in those institutions are two of the common reasons (Lam and Shin, 2012) as well as the funding mechanisms that are used by lenders (Wonglimpiyarat, 2015). A weak local economy brings recession to businesses, as a result of the individuals' low income in turn due to many factors including the unemployment rate that then hinders purchasing and utilising more goods and services (Agwu and Emeti, 2014, Cant and Wiid, 2013). The regional economic weakness also impacts local firms in a form if any organisation attempts to expand its business regionally or import some goods and services from the surrounded countries, it may find some difficulties as the economic situations in the other countries doesn't allow their businesses to collaborate with other local ones. In addition, even if the local organisations plan to export goods and services to the surrounding countries. If those countries suffer from a weak economy, it would impact local firms negatively in finding customers from the targeted countries (Lam and Shin, 2012).

Political issues and wars that would leave a negative impact on all businesses, can be linked to the economic issues above. The lack of local security would harm SMEs from running and expanding their activities. In addition, this unstable situation would cause investors and global firms not to invest in or deal with the local firms (Folabi, 2015, Hogeforster, 2014).

Skilled personnel issues in hiring qualified personnel to fill a specific gap in the firm. This issue seems common in several countries (Hogeforster, 2014, Cernat et al., 2014). A study was conducted in eleven European countries that included 608 organisations, stating the biggest challenge that would affect European SMEs in the future is finding the qualified personnel to fill the high demand (Hogeforster, 2014). Locally, some of the Australian SMEs are facing several challenges in establishing, running and operating their businesses. One of these issues is getting the proper access to human resources and expertise; due to the high demand and the limited number of highly qualified staff, to improve their operational capabilities and to improve their business skills (CSC, 2014).

Managerial issues are one of the common challenges in both of developing and developed countries, which is represented in the lack of educational management skills and experience in many of SMEs that could affect business innovation and productivity. This issue also includes the managerial development, training, mentoring, decision-making and supporting business staff (Hogeforster, 2014, Folabi, 2015, Lam and Shin, 2012, Farsi and Toghraee, 2014).

Business Knowledge would be attached to the managerial one as a very important factor. The lack of business knowledge would bring several challenges to SMEs. This knowledge covers the awareness of the firm itself, business industry, the targeted market, and the surrounding situations including economic and political issues (Cant and Wiid, 2013).

Rapid technological change would be a challenge in some SMEs. As discussed above, if the firm has limits in funds, skills, and/or management support, it will be difficult to keep the business up to date with the latest technologies. Even if new or updated solutions could give more opportunities to firms, other challenges force them not to utilise them (Farsi and Toghraee, 2014, Cant and Wiid, 2013).

Basic infrastructure issues, due to poverty or war in countries is, such the accessibility to sufficient clean water and power as well as proper waste management strategies (Tendler and Amorim, 1996, Agwu and Emeti, 2014).

Transportation and transport networks in some developing countries could affect business processes, and result in the limited expansion, fewer opportunities and competitiveness (Folabi, 2015). The following figure summarises the common challenges that could face SMEs.

Figure 2.8: SMEs common challenges

2.13 SUMMARY

The purpose of chapter two was to give economic analysis to link the significance of SMEs and cloud computing to the national economy. It covered several aspects that started by defining the national economy, discussing the metrics to evaluate it, and identifying the three effective factors on the national economy, which are trade, production and supply of money. The production factor would be enhanced by improving the factor of the national productivity. This factor has five main pillars that would affect its growth. These pillars are the available capital, workers, up to date technologies, and resource endowments as well as business innovation. Also, chapter two discussed the significance of information technology and cloud computing to the national economy.

The other part of this chapter discussed what SMEs is, and the effect of cloud computing and information technology on SMEs productivity and outcomes. After that, the chapter highlighted the global significance of SMEs that led to focus on this sector in this research. After that, SMEs significance in Australia was discussed before concluding this chapter by highlighting the most common challenges that would face SMEs. These challenges will help in designing the conceptual framework and in the data collection stage.

The next chapter will highlight the other pillar of this study, which is cloud computing. It will give technical background that would help in understanding the nature and the content of the collected data.

Chapter Three: Cloud Computing

3.1 INTRODUCTION

The previous chapter provided detailed insight into the national economy and global competitiveness. The chapter highlighted the significant factors that help countries in improving their economies and achieving competitive advantage. The chapter explored the extent to which cloud computing contributes to national productivity and achieving competitive advantage.

The previous chapter shows that cloud computing has a significant impact on national productivity and improving competitiveness. The purpose of this chapter is to provide insights on cloud computing and explain the technical concepts relating to cloud technologies. This chapter explains the importance of specific technical concepts that inform information system's researchers and business decision makers to gain further understanding of cloud computing.

This chapter will start with historic information regarding the evolution of information technologies from the earliest days until cloud computing. After that, the entire chapter will focus on cloud computing.

The chapter will define cloud computing and discuss its background briefly. Then, it will touch on cloud computing with regards to *small and medium organisations* (SMEs) briefly; as it was discussed in detail in chapter two; to link them to the gap that will be identified by the end of this chapter.

Cloud computing service delivery and deployment models are two important concepts in adopting and utilising cloud services. Therefore, these models are discussed in this chapter after defining cloud computing. The chapter will also explain some significant technologies in implementing cloud based solutions. Two of the most important technologies are virtualisation (Hwang et al., 2013, Barham et al., 2003) and grid computing (Bote-Lorenzo et al., 2004, Catlett, 1992), which are discussed in this chapter for these reasons. Virtualisation (Hwang et al., 2013, Barham et al., 2003) is one of the main technologies in cloud computing. A second key technology is grid computing (Bote-Lorenzo et al., 2004, Catlett, 1992) that has some features of cloud computing. This has led to confusion in differentiating between grid and cloud computing. Therefore, grid computing and its comparison to cloud computing are also discussed in this chapter.

The characteristics, advantages and common challenges of cloud computing are discussed to show how this technology is utilised in the business environment. The chapter concludes by identifying the gap and stating the research questions.

3.2 ICT BACKGROUND

Information and Communications Technology (ICT) has evolved as software, hardware and communication models have changed. Mainframes could be considered as the start of this revolution that began from 1960s to the 1980s, which used the concept of centralised large computers (Jamsa, 2012). In 1981, IBM lunched a new revolution of information technology; the small and personal computer (*PC)* that moved users from working on a centralised computer to local processing, applications and data storage (Jamsa, 2012). In the 1990s, many simple networks were introduced in the IT market as local network solutions for simple messaging, file sharing and printing. In 1995, the networking concepts were expanded by the revolution of the internet that introduced a major upheaval in the ICT industry (Jadeja and Modi, 2012).

ICT has become one of the critical success factors for business organisations. Consequently, businesses spend a great deal of their budget on IT, who also rely on IT to run their businesses, interact with customers and streamline operations. IT expenses are increasing, as organisations adopt new technologies and solutions to gain the maximum benefits from IT resources (Roehrig, 2008, Williamson et al., 2015).

Businesses need to understand how IT resources are contributing to their business. In a study that was conducted on six data centres stating that most servers were using only 10% to 30% of their capabilities (Marston et al., 2010). Another study from Gartner (Marston et al., 2010) showed that around two thirds of IT budgets were devoted to operation and support processes (Marston et al., 2010). This shows that organisations potentially waste significant expenses on unused resources such as data storage. Therefore, cloud computing was born with several features to enhance businesses, including saving budgets by not paying for unused resources and paying for used resources only - known as Pay-as-you-Go (Fox et al., 2009, Mell and Grance, 2011).

3.3 THE GLOBAL TREND TOWARD CLOUD COMPUTING

The phenomena of cloud computing is considered one of the major transformations in computing history that changed the methodologies of delivering information technology services aiding businesses to control their IT expenses by outsourcing their IT assets and paying for used resources only (Marston et al., 2010, Duan et al., 2012, Patidar et al., 2012). It is expected that the trend of utilizing cloud computing is continuously increasing (OneStopClick, 2014, Cheng et al., 2016, Ried et al., 2011). It is expected that global investment in cloud computing services and infrastructure will exceed $108 billion in 2017 (OneStopClick, 2014); this number is expected to reach $241 billion by 2020 (Cheng et al., 2016, Ried et al., 2011). In addition, *Gartner* expected that the global market of cloud computing will reach $150 billion in 2014 and *AMI partners* predicted the growth of the cloud computing market to be $100 billion for SMEs by 2014 (Marston et al., 2010). There is a limited amount of academic research relating to SMEs and cloud computing. This limitation is discussed in the next section. A U.S. industry-based study expected the continuous rise of utilising cloud services by U.S. SMEs. It expected market growth from $43 billion in 2015 to $55 billion in 2016. In addition, the study forecast around 78% of U.S. SMEs would utilise cloud computing (Columbus, 2015).

Cloud computing facilitates online business and improves digital productivity. There is significant opportunity for organisations of all sizes to gain tangible benefits, such as scalability, flexibility, affordability, maintainability, and online operating service availability at an affordable cost. Cloud computing gives opportunity to businesses to start dedicating limited IT budget, and increase this up to demand (Avram, 2014, Khurana and Verma, 2013).

3.4 CLOUD COMPUTING AND SMEs

Most of the research on the utilisation of cloud computing has focused on large sized enterprises that examine how to achieve the most benefits of utilising cloud services. However, there is little research on how SMEs can improve business productivity and outcomes using the cloud (Gupta et al., 2013). As discussed in the previous chapter, the global importance of SMEs (Aremu and Adeyemi, 2011, Ayyagari et al., 2014, de Wit and de Kok, 2014) provides impetus for studying this critical sector from different aspects, such as ICT including cloud computing (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012). However, there is an absence in academic studies on the rate of utilisation of cloud services in Australian SMEs as well as the critical success factors in adopting cloud computing for Australian businesses. This chapter analyses the background of cloud computing and some of its features. Then, it will introduce the proposed research project to examine the critical success factors influencing the adoption of cloud computing by SMEs in the Australian context, as well as exploring possible adoption challenges in Australia.

3.5 BACKGROUND OF CLOUD COMPUTING

Cloud computing represents a major shift in ICT by delivering and hosting services via the internet (Avram, 2014, Jadeja and Modi, 2012). Simply put, cloud computing is the use of internet-based IT resources and services (Marinos and Briscoe, 2009). It is a paradigm that transfers storage and computational processes from local PCs to remote centralised computers and servers. These remote machines are provided and managed by a third party – the cloud service provider (Khurana and Verma, 2013). Cloud computing is one of the current major trends in information technology, which is considered as an advancement of several existing technologies, such as virtualisation and grid computing (Buyya et al., 2010). *YouTube* and *Twitter* are two examples taking advantage of cloud services that target businesses and individuals (Lin and Chen, 2012). *Google Apps* and *Customer Relationship Management system (CRM)* from Salesforce.com are two well-known examples leveraging from one of the main three service delivery models of cloud computing, namely *Software as a Service* (*SaaS*) in business environments (Jamsa, 2012). The technical concept of cloud computing refers to the transforming of physical resource utilisation such as processors and data storage (Jamsa, 2012), from systems developers to the virtual environment which has the flexibility to scale up and down depending on the demand of usage in turn enabling organisations to pay for the used resources only (Jamsa, 2012). The term *Cloud Computing,* was first mentioned in 1999 for business purposes when www.salesforce.com introduced its business applications (Withee and Reed, 2012). Major online retailer www.amazon.com followed in 2002 when it provided its cloud based storage services, followed by Amazon Elastic Cloud Computing (EC2) in 2006 for small businesses (Withee and Reed, 2012). During this time several cloud applications and services from various companies, such as Microsoft and Google as well as Force.com and Amazon were developed (Withee and Reed, 2012).

Some features of cloud computing existed prior to the internet, one of the main features of which was centralised processing. Service providers used their substantial resources to process all clients' transactions. This method was originally used during the 1960s to 1970s (Lageschulte et al., 2011), when computing expert Professor John McCarthy predicted that if computing services could be facilitated like a public utility, it would become an important new industry (Gillam, 2010, Bond, 2015). In addition, IBM in the same time frame - 1960s to 1970s, imagined providing a shared virtualised solution to serve more than one customer with centralised physical resources (Tutunea, 2014, Weinhardt et al., 2009). Medium sized computers then came to change this concept slightly by distributing processing via computers, however this change was within the enterprise. In the 1990s, Microsoft Windows changed this concept by assigning processing to clients' desktops as well as to businesses in general, which in turn changed some of their processes to work on client desktops (Lageschulte et al., 2011). Since then cloud computing has turned the processing trend back to the centralised concept of data processing, and can thus be considered the modern version of the mainframe (Lageschulte et al., 2011).

Weber (2010) estimated that business investment in cloud computing technology in 2010 was approximately $US2.4 billion. Gartner predicted this number to rise to $US8 billion in 2013 (Weber, 2010). According to the *International Data Corporation "IDC"* report concerning generated income from providing cloud services, noted revenue generated by Amazon.com in providing Amazon Web Services (AWS) reached $7.88 billion in the fourth quarter of 2015 with an increment of 69% compared to the same period in 2014 (Columbus, 2016).

Cloud computing is predicted to be a trend that will provide organisations with the flexibility they need to compete effectively in a rapidly changing business environment. This is particularly important in the Australian SME sector as more than 99% of Australian businesses fall in to this category (Connolly et al., 2012). Thus, the overarching question explored in this research is *What are the adoption rates, critical success factors and challenges for Australian SME adoption of cloud computing to achieve competitive advantage?* The next section explores the evolution of cloud computing.

3.6 WHAT IS CLOUD COMPUTING?

The term "cloud" originated from the use of Virtual Private Network technology (VPN) in the networks and telecommunication industry (Kaufman, 2009). There are many definitions that continue to emerge around the concept of cloud computing. Most of these definitions are based on two main commanding factors of cloud computing, which are *IT hardware and software efficiency* and *business agility* (Kim, 2009). One of the generic technical definitions considers cloud computing as delivering any cloud-based solution, which is known as everything as a service (XaaS) (Mladenow et al., 2012), where X means "everything". XaaS refers to the availability of the IT infrastructure, platforms, software, databases, and the other IT resources on the internet that can be accessed remotely (Winkler, 2011). Another definition of cloud computing states that "it is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location" (Marston et al., 2010) as illustrated in figure 3.1 below.

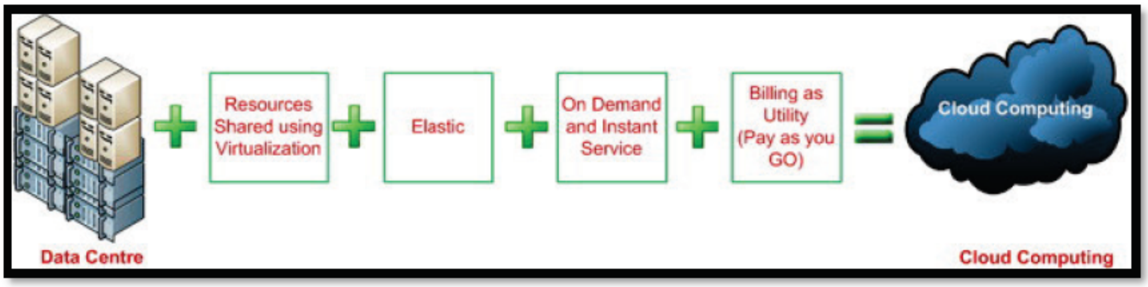

Figure 3.1: What is Cloud Computing? source: (Khorshed et al., 2012)

An industry report defines cloud computing as a scalable hardware-based solution to deliver networks, storage, and processing that is elastically managed by the consumer (Avram, 2014). Another technical view of cloud computing defines it as a distributed and parallel system of interconnected virtualised systems to deliver IT resources according to pre-established service level agreements between the vendor and cloud clients (Buyya et al., 2009). While the National Institute of Standards and Technology (NIST) defines cloud computing as *"a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011 , p.2)*. The overview of accessing these resources remotely is shown briefly in figure 3.2.

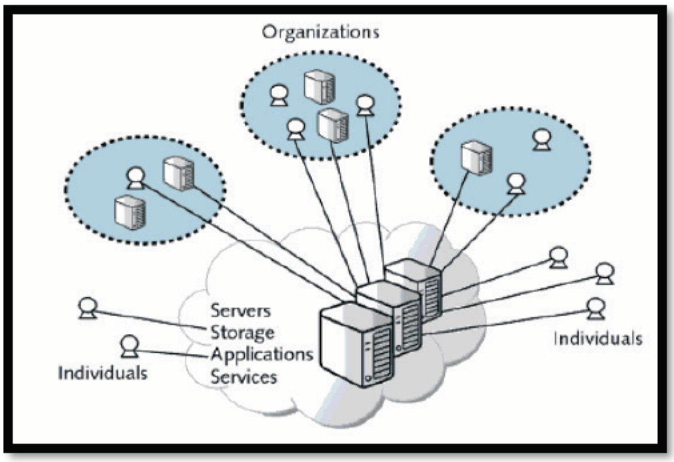

Figure 3.2: The basic model of Cloud Computing. source: (Harding, 2011)

There is another way to view cloud computing which is from the business perspective. It could describe cloud computing as a model of delivering, enabling and consuming the IT services with the flexibility of economical scaling up and down as well as adding, changing or removing the IT based business processes (Isom and Holley, 2012). However there does seem to be some consensus that the basic model of cloud computing consists of users, organisations, and/or applications that share different IT resources; such as applications, data, servers, and storage through the internet (Harding, 2011)

The aforementioned literature led us to a definition of cloud computing here as *an innovation of facilitating business processes by utilising from flexible and scalable online on-demand IT hardware and software resources to achieve the flexibility of adding, removing, and reengineering business processes with minimum cost*. This definition tends to be close to the business view of cloud computing (Isom and Holley, 2012), as this research focuses on cloud computing from the perspective of SMEs.

3.7 SERVICE DELIVERY MODELS

The market of cloud computing provides several service delivery models to businesses. However, there are three main service delivery models of cloud computing, which are *Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)* (Mell and Grance, 2011, Stammer and Wilson, 2013, Sultan and van de Bunt-Kokhuis, 2012, Sadiku et al., 2014, Leymann et al., 2014, Qureshi and Kamal, 2011, Dillon et al., 2010). After determining these three main service delivery models, several products and services were derived from these three models and were introduced to the market, as will be discussed in this section. As discussed above, the evolution of several derived cloud model to expect deliver any solution under the concept of everything as a service, which is known as XaaS (Mladenow et al., 2012). These models are by default created and administrated by cloud service providers, but some applications could be managed by cloud service consumers (Tutunea, 2014).

3.7.1 IaaS

IaaS is also known as *hardware-as-a-service*. It provides hardware resources for customers, such as storage, network and processing to be used directly (Garrison et al., 2012, Sadiku et al., 2014, Dillon et al., 2010). IaaS supplies a virtual data centre in the cloud. In detail, virtualisation is used to create separate virtual hardware resources for each customer based on the concept of Virtual Machines (VM) (Garrison et al., 2012, Sadiku et al., 2014, Dillon et al., 2010). In this model, developers are responsible for installing the required software assets, such as operating systems, backup systems, developing platforms, and databases. The main feature of this model is the ability to install, configure and customise most of the hardware and software resources (Garrison et al., 2012, Sadiku et al., 2014, Ashrafa, 2014). IaaS solves the issue of the need to rely on powerful and reliable data centres for companies that cannot afford the cost of installation and operation (Jamsa, 2012, Sadiku et al., 2014). Also, IaaS helps protect business data centres from flood, earthquake and fire damage as well as other crises, instead of creating costly data centres which is of special relevance for large enterprises (Jamsa, 2012, Leymann et al., 2014). However, the expected additional administrative tasks might lead the customer to assign specific staff for administrative purposes. Amazon, Rackspace, and Nirvanix are three examples of IaaS providers.

3.7.2 PaaS

PaaS acts as a superset of IaaS by providing IaaS plus the necessary operating systems and development environments in forms of applications to develop, host and run end-user cloud-based applications. This includes providing network support, dedicated or virtual servers, operating systems, development environments, databases, and data storage (Jamsa, 2012, Stammer and Wilson, 2013, Sadiku et al., 2014, Ashrafa, 2014). PaaS is considered as a development platform that provides the ability to fully control the software development lifecycle (Dillon et al., 2010). The hardware and software resources are managed by cloud service providers, which is a feature of PaaS to allow developers to focus on their development, rather than consuming time in other administrative tasks. In addition, developers in PaaS have the opportunity to develop and deploy their solutions flexibly without worrying about servers' capabilities or uploading to production servers. *Google App Engine* is one of the leading PaaS providers globally that provides a development platform, which depends on Java, Python, and the Go programming languages. Force.com is another well-known example of PaaS that relies on a robust cloud-based database provided by Database.com, and provides four different components in their PaaS, which Appforce, Siteforce, VMforce, and ISVforce. Microsoft is also a main player in the PaaS industry via MS. Windows Azure and MS. SQL Azure. Microsoft PaaS environment depends mainly on Dot NET technology with the support of JAVA, Ruby, and PHP languages. Moreover, there are several other PaaS providers in the global market, such as Netsuite, Openshift, Cloud Foundry and LongJump (Jamsa, 2012, Stammer and Wilson, 2013, Leymann et al., 2014).

3.7.3 SaaS

SaaS lies further on top of this stack by providing required applications to customers via the cloud that are usually accessed via web browsers (Jamsa, 2012, Leymann et al., 2014, Knorr and Gruman, 2008, Marinos and Briscoe, 2009, Ashrafa, 2014). SaaS is used to avoid on-premise data centres with the significance of operations, management, developing, and support. Some SaaS advantages include scalability (adding or removing resources), cost because data centres are in the cloud, and simple integration, where users mostly need web browsers only to interact with systems. Therefore, it would be a suitable option for the start-up companies to get the advantages of powerful and well-designed applications. However, there are some drawbacks of using SaaS, such as data location and control, security and customization. Salesforce.com is one of the well-known examples of SaaS as an extension of Force.com, by providing cloud based CRM applications. TALEO is yet another example of a cloud based human resource management system (Jamsa, 2012, Leymann et al., 2014). Some companies might require more than one solution from the cloud. Therefore, they might integrate a group of different applications to reach the desired goal. This concept is called ***Mashup*** cloud applications (Jamsa, 2012, Leymann et al., 2014). The following figure (3.3) summarises the main three service delivery models in cloud computing presented as they would logically fit together.

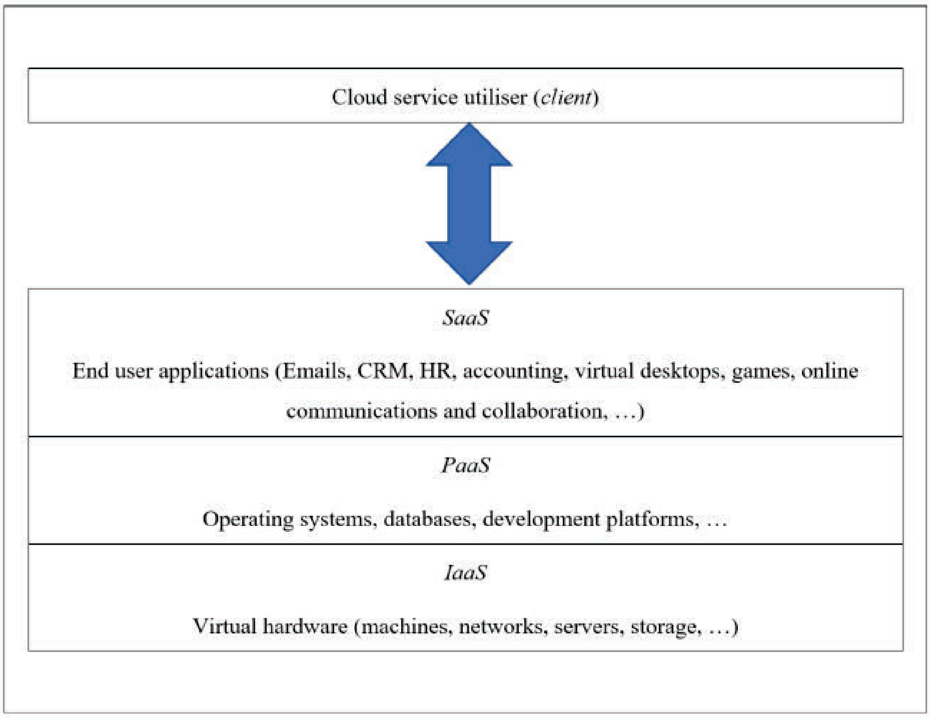

Figure 3.3: Overview of cloud computing service delivery models

The fast revolution of cloud computing services led to derive other services to the market from the main three mentioned above. In addition, the future of cloud computing would introduce more services than currently exist in the market (Moreno-Vozmediano et al., 2013).

3.7.4 IDaaS

Identity as a Service (*IDaaS*) is one of these derived services. Gartner defines IDaaS as "service that delivers the access, administration and intelligence functions of identity and access management" (Kreizman, 2013). Most organisations use more than one system. Each system has its identity login information to access it. The variety of systems and their access methods generated many challenges. One of these issues is having multiple servers to access each system. With the absence of username and password integration among systems, another problem appears in having many usernames and passwords for each employee. Moreover, it is more complicated to track, suspend, or delete employees' login information (Jamsa, 2012). IDaaS came to solve these issues by providing a cloud based ID management that integrates the access information among different systems. This concept is called *Single Sign-On* (*SSO*), which is also used by several companies to unify users' passwords providing several advantages of united access to multiple systems and centralised control of ID management (Jamsa, 2012). However, any failure in this unified gateway will affect all systems that depend on it (Jamsa, 2012). By the end of 2015, Gartner predicted that IDaaS would be considered for around 25% of all new identity and access management (IAM) compared by 5% in 2012 (Kreizman, 2013). It seems that large organisations prefer to support their on-premise and cloud based services by integrated IDaaS, while small and medium organisations are expanding their ID management systems via their internal applications or via SaaS (Fontana, 2013). *PingIdentity* is one of the famous IDaaS that provides authentication, authorisation, account management, and audit logging (Jamsa, 2012). *PasswordBank* is another IDaaS example that provides different levels of service for organisations that recently acquired by Symantec corporation for $25 million in 2013 (King, 2013).

3.7.5 StaaS

Storage as a Service (*StaaS*) is another derived service that depends mainly on the IaaS model with some utilisation from SaaS. It provides a cloud-based service to store data and files with features of reliability, performance, compatibility, and backup that can be accessed via web browsers, application program interfaces APIs, and/or mounted disk drives (Jamsa, 2012). It provides several cloud-based advantages to users, such as scalability, pay for use, reliability, accessibility, and usability. However, the storage performance and security level would be less than on-premise storage (Jamsa, 2012). StaaS would be a positive solution to business organisations and is suggested as a suitable option for small and medium enterprises that cannot invest significantly in their storage infrastructure (Patel and Dansena, 2013). Microsoft SkyDrive, Google Drive, Dropbox, and Mozy are examples of cloud based file storage that utilise from IaaS and SaaS, while Oracle cloud database and Microsoft SQL Azure are two well-known of cloud based data storage that use IaaS and PaaS, whereas Database.com is a typical example of cloud based data storage that performs IaaS only.

3.7.6 DBaaS

Database as a Service (*DBaaS*) is one of the specialised IaaS services that provides utilisation from online databases (Stammer and Wilson, 2013, Dillon et al., 2010). DBaaS is also known as *Data Storage as a Service (DaaS)*. Cloud-based database consumers take the advantage of not paying anything for required infrastructure – including hardware, software and licenses – to run their database solutions and as mentioned before pay for services used only (Dillon et al., 2010). This service mostly covers all required hardware and software resources to provide database capability to cloud consumers. Cloud service provider is responsible for enabling, maintaining and operating these databases based on the agreed contract between cloud service provider and consumer, which is usually known as *Service Level Agreement (SLA)* (Stammer and Wilson, 2013, Ashrafa, 2014). Cloud provider could be represented by one provider or more than one parties, such as service provider and infrastructure provider (Stammer and Wilson, 2013).

3.7.7 CaaS

Communication as a Service (CaaS) is a cloud based model that allows consumers to utilise internet based communication services, such as voice over IP (VoIP) and instant messages (IM) with no requirement to pay for operational hardware or software (Stammer and Wilson, 2013, Tutunea, 2014).

3.7.8 BPaaS

From the business perspective, there is an additional service delivery model called Business process as a Service *(BPaaS)*, which is used to deliver any vertical or horizontal business processes via the cloud, such as e-procurement, and business travel services, and business process monitoring (Isom and Holley, 2012, Stammer and Wilson, 2013).

What is clear is that cloud computing technologies are used to save, manage, and control data remotely and are stored in unknown and distant places from the enterprise's geographical location. However, some business organisations do choose the geographical location of their data, such as companies that require management of their customers' information in a specific location (Sultan, 2011).

3.8 CLOUD COMPUTING DEPLOYMENT MODELS

The deployment of cloud services relies on one of four deployment models, which are public, private, hybrid, and community (Marston et al., 2010, Carroll et al., 2011, Kaur et al., 2015, Rafaels, 2015, Jamsa, 2012, Victories, 2015, Girola et al., 2011, Patidar et al., 2012).

3.8.1 Public cloud

The first model is the Public cloud, which is deployed by the provider by opening it for most or all internet customers that is to say - for the public. It is usually used by small and medium organisations as a cost effective method to take advantage of the latest IT solutions for businesses (Rafaels, 2015, Marston et al., 2010, Singh et al., 2015, Carroll et al., 2011, Victories, 2015). The public cloud option is usually preferred to businesses who want to open their online solutions to the public with a consideration of managing the workload and performance by taking advantage of cloud computing power of scalability that gives their applications more capability to handle different workloads (Victories, 2015). One of the benefits of utilising public cloud for firms is that there is no need for any up-front financial investment to build up required infrastructure, when they hire all required resources from the cloud service provider. Public cloud utilisers will start paying when they start using the required service in the cloud platform. However, utilising public cloud from different cloud providers could result in complicating the service management, where each brand might need a different company to manage the provided services (Girola et al., 2011).

3.8.2 Private cloud

The private model comes is the second deployment model, also known as internal cloud that provides cloud services to a specific customer, and usually the cloud-based solution is designed to be used within the organisation, and sit behind the firm's firewalls (Rafaels, 2015, Singh et al., 2015, Ramgovind et al., 2010, Victories, 2015, Cearley and Reeves, 2011). There is no technical difference between using public and private cloud services except from a security view to restrict accessibility to specific clients, which is based on service level agreement

(Victories, 2015). A disadvantage of using private cloud comparing to the public one is that the cloud service utiliser has to invest up-front to build up required IT infrastructure if it is not ready. However, private cloud is better than public from management's viewpoint, where the service provider or a third party can provide fully managed services (Girola et al., 2011).

3.8.3 Hybrid cloud

The third model called Hybrid, is a mix of public and private model that can be initiated from two or more servers (Marston et al., 2010, Rafaels, 2015, Singh et al., 2015, Conway and Curry, 2012, Victories, 2015). It allows cloud customers to utilise from some cloud services privately for their local system from one side, and open some other services publicly for their clients. From the technical view, some of the utilised services are assigned to bypass the local firewalls to be reachable by the public. Some of the common examples of using hybrid cloud privately are sales, human resources (HR), and CRM systems, while their customers might use market place and business services online applications in a form of public cloud (Marston et al., 2010, Rafaels, 2015, Singh et al., 2015, Conway and Curry, 2012, Victories, 2015).

3.8.4 Community model

The fourth model is known as the community model that allows only a group of organisations in a specific community to utilise from provided cloud services in a shared platform that is accessible from all of these firms (Marston et al., 2010, Rafaels, 2015, Jamsa, 2012, Conway and Curry, 2012, Victories, 2015, Marinos and Briscoe, 2009). The main goal of using community cloud is to achieve a common goal among subscribed organisations, such as if multiple organisations are working in project-based businesses (Marston et al., 2010, Rafaels, 2015, Jamsa, 2012, Conway and Curry, 2012, Victories, 2015). Community cloud computing brings several advantages to the participating organisations (Marinos and Briscoe, 2009). Building a technical framework of social business structure among the participated parties is one of the targeted benefits of using community cloud (Marinos and Briscoe, 2009, Benkler, 2004). In addition, community cloud provides common sources of information for participating firms that help in minimising effort and errors in using required information (Marinos and Briscoe, 2009). The community-based services have the ability to be managed internally by one or more of the participating organisations. In addition, the cloud is managed externally by the cloud service provider or a third party (Marston et al., 2010, Rafaels, 2015, Jamsa, 2012, Conway and Curry, 2012, Victories, 2015).

3.9 TECHNICAL CONCEPTS RELATING TO CLOUD COMPUTING

Cloud computing is like an umbrella consisting of many technologies, such as virtualisation (Liang and Yu, 2015, Hwang et al., 2013, Duan et al., 2012), and grid computing (Foster and Kesselman, 2003, Marinos and Briscoe, 2009).

3.9.1 Virtualisation

Previously, computers or servers could only utilise one operating system on the top of the hardware resources. This limitation of having only one operating system on the physical computer caused some challenges in utilising IT hardware resources to the business. Some of these challenges could be difficult to handle in the business, such as the need to have a dedicated server for each of the required operating systems (Hwang et al., 2013, Bari et al., 2013). As discussed in chapter 2, SMEs usually have a limited budget and do not have the ability to invest heavily in developing or upgrading their IT resources. Therefore, the issue of having only one operating system per each physical server would be a significant challenge for many businesses.

Virtualisation is a concept of sharing the hardware resources among several virtual machines (VM). Each virtual machine can operate as a complete computer or server that would consist of virtual hardware, virtual operating systems, and the operational applications on the top of that stack (Hwang et al., 2013, Barham et al., 2003). The simplest visual representation of virtualisation technology is represented in figure 3.4.

The potential of virtualisation to businesses led to heavy investment in virtualisation in different areas (Liang and Yu, 2015) including virtual data storage (Bairavasundaram et al., 2014, van der Linden et al., 2015), virtual machines (Plouffe et al., 2014, Boutaba et al., 2013), virtual memory (Garg et al., 2016, Seshadri et al., 2015), virtual data centres (Sun et al., 2016, Lee, 2015), virtual local area networks (VLANs), virtual private networks (VPNs) (Chowdhury and Boutaba, 2009, Chowdhury and Boutaba, 2010), and wireless network virtualisation (Wang et al., 2013a, Liang and Yu, 2015).

Virtualisation is one of the most important features of using cloud computing in order to assign only the required resources to be used as an independent server. The features of virtualisation make it one of many important solutions in the internet and cloud computing industry (Duan et al., 2012, Hwang et al., 2013, Azodolmolky et al., 2013).

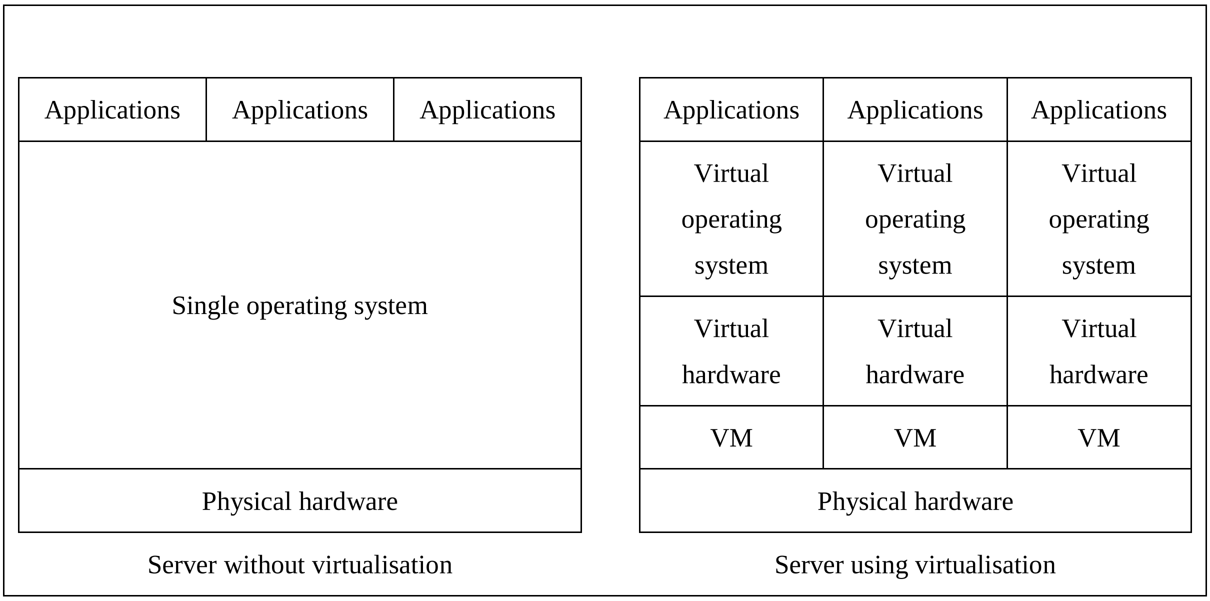

Figure 3.4: Conceptual view of virtualisation

Many of the required resources in cloud-based utilisation can be assigned manually or dynamically in the virtual environment, where the service can be automatically upgraded or degraded based on the demand, which is one of the main benefits of cloud computing (Hwang et al., 2013, Duan et al., 2012). Some of the important examples of assigning the virtual resources automatically appears in the configuration of cloud services, such Microsoft Windows Azure, and Amazon Web Services. Another concept of interest is grid computing.

3.9.2 Grid computing

The concept of grid computing was introduced in the early 1990s in the United States to link several supercomputing locations together (Bote-Lorenzo et al., 2004, Lyster et al., 1992, Hutton, 2012, Wilkinson, 2009). The idea of grid computing at that time was a *Meta-computer* or *Meta-system* (Bote-Lorenzo et al., 2004, Catlett, 1992). Grid computing has the advantage of combining many remote and geographically distributed IT resources – software and hardware – in a single virtual machine to maximise capability and efficiency (Foster and Kesselman, 2003, Marinos and Briscoe, 2009, Bote-Lorenzo et al., 2004, Hutton, 2012).

Grid computing is classified into three main systems, which are *computational grid*, *data grid* and *service grid systems* (Hutton, 2012). Computational grid provides super-powered hardware resources to implement complex computational processes. Data grid provides the necessary hardware and software resources to provide firms the opportunity to share, store, and process their data. While service grid offers specific services that would be difficult to provide by local and personal computers (Hutton, 2012).

The concept of grid computing enabled several applications to utilise IT infrastructure. These applications include collaborative computing (human to human interaction), on-demand computing (grid resources are available upon request), data-intensive computing (huge data processing and analysis applications), distributed super-computing (merging the power and capability of several machines into one logical machine), and many more (Hutton, 2012, Bote-Lorenzo et al., 2004, Wilkinson, 2009).

Grid computing is one of the key factors of cloud computing (Marinos and Briscoe, 2009, Wilkinson, 2009), where cloud computing is driven as a business model from grid computing that uses remote hardware and software resources to generate extra profit cutting IT investment and operational costs (Wilkinson, 2009, Foster et al., 2008). This business-driven purpose led several technologies and solutions to appear in cloud computing that made it more distinct from original grid computing technologies to provide suitable solutions to everyday renewable business needs. Briefly, cloud computing added the concept of virtualisation and let users to pay for used resources only, while grid computing focused more on collaboration and geographically distributed shared physical resources. So, cloud computing is more likely to be service oriented than application or resource oriented as in grid computing (Wilkinson, 2009, Foster et al., 2008).

3.10 CHARACTARISTICS OF CLOUD COMPUTING

Cloud computing technologies are considered to possess several characteristics. The *National Institute of Standards and Technology* highlighted five main features of cloud computing, which are:

1- *On-demand-self Service* that allows customers to select the appropriate service, whether it is software, platform and/or infrastructure services, and pay for their usage only. In detail, cloud consumers might need to utilise some of the available IT resources in the market, such as servers, network storage, databases, CPUs for complex computational processes and more. Cloud computing allows customers to be able to configure services as required, such as user accounts, allocate storage capacity, and use virtualisation to suit their requirements with minimal need for other human-based assistance from the cloud provider's side in configuring the required service (Fox et al., 2009, Khurana and Verma, 2013, Dillon et al., 2010).

2- *Measured Service.* The systems of cloud computing have the ability to measure, monitor, report and control used resources automatically and provide accurate costing and invoices to customers. Each cloud-based service provides the ability to assign metrics to measure the amount of resources used and to calculate the cost of utilised services (Mell and Grance, 2011, Dillon et al., 2010, Cearley and Reeves, 2011).

3- *Rapid Elasticity.* Is having the ability to scale IT resources, to either expand or decrease quickly to respond to changing business conditions (Khurana and Verma, 2013, Herbst et al., 2013, Cearley and Reeves, 2011). In other words, elasticity is the degree of a system's ability to respond to changing workload in provisioning required resources to ensure required service and performance (Herbst et al., 2013). The concept of elasticity is adopted from the physical sciences that defines it as the ability of materials to return to their initial state after expanding or shrinking processes (Chiang and Wainwright, 2005, Herbst et al., 2013). This ability to control materials has been applied in cloud computing as one of the crucial concepts to provide the ability to expand or shrink resources as required without any need to hire unnecessary resources (Plummer et al., 2009, Herbst et al., 2013). Cloud computing service consumers are able to add or remove any of the IT resources at any time as required without any major investments in their own IT resources. In addition, consumers do not need to contact service providers nor to change their contract to benefit from resource elasticity. After that, the new capabilities are up and running (Khurana and Verma, 2013, Dillon et al., 2010). Elasticity provides many advantages to business organisations and customers of cloud computing, however there are three distinct benefits, which are:

- *Linear Scaling*; where the performance remains the same among users.
- *On-demand utilisation*; where clients can allocate resources as they need to use them, and where there is no need to place some resources in a standby situation (Mell and Grance, 2011).
- *Pay-as-you-go*, by paying only for the resources that are used, which could provide a major cost saving in IT installation and operations (Fox et al., 2009, Mell and Grance, 2011).

4- *Resource Pooling.* The traditional IT infrastructure model provides services to a single consumer/company, and the resources are assigned to serve a single entity. With cloud computing approach, cloud-based technologies are able to serve several customers and organisations. Resources are pooled together using the Multitenancy model coupled with virtualisation technologies that allow allocation of IT resources by sharing them dynamically among consumers (Mell and Grance, 2011, Khurana and Verma, 2013, Dillon et al., 2010). Resource pooling is also able to provide a high level of *Quality of Service* (QoS) at a competitive cost by reducing the tasks of IT management and administration, with a high commitment to service efficiency. Furthermore, this technology permits independence of resource location. This feature helps service providers select the most appropriate locations for their services whilst prioritising the most important factors of their businesses, such as cost savings, security and safety (Mell and Grance, 2011, Khurana and Verma, 2013).

5- *Broad Network Access*, is the availability and ability to access services among different platforms and devices, such as PCs, tablets, and mobile phones (Harding, 2011, Alliance, 2011, Dillon et al., 2010). This feature should be built between service providers and their customers. This approach might involve other players such as telecommunications operators. Such broad network access can increase the users of cloud services which would in turn improve their business (Harding, 2011, Alliance, 2011).

6- *Infinite computing resources* are available to be utilised by cloud consumers upon their requests and needs. Utilising cloud computing provides the opportunity to setup the entire required amount of computing resources without worrying about resource shortages or limitations (Fox et al., 2009).

7- *Minimal Management Effort*, is the outsourcing of IT resources that moves most of the operational tasks to a third party - the cloud service provider; that gives organisations more ability to focus on their business processes (Mell and Grance, 2011).

8- *Web-Browser based service*. Most cloud-based applications are accessible and used via web browsers. This is applicable for all provided service models, SaaS, PaaS, and IaaS (Jadeja and Modi, 2012) unless the application provider decides to use a specific application, such as mobile phone applications alone or in association with using a web browser.

3.11 CLOUD COMPUTING ADVANTAGES

Cloud computing brings several advantages to business organisations. Some of these benefits are briefly described as the following:

1- The ability to empower innovation trends in organisations from the IT side, by providing several solutions with the distinct reduction of IT obstacles. In addition, cloud-based solutions helps to simplify internal operations, and provides new sources of business innovation in the firm including collaboration, connection and data sharing (Marston et al., 2010, HBR, 2014).
2- The direct access to hardware infrastructure remotely via the internet and treating IT as operational expenses rather the need to invest in IT resources, and with each client being separated from others virtually on the same physical resources by balancing clients consumption load among resources (Marston et al., 2010).
3- Providing better utilisation of distributed resources over the internet to give researchers and businesses the opportunity to perform high-scale computing processes and calculations that would be difficult to perform on premise for reasons including hardware limitations. Utilising cloud computing many forms of operations to be performed remotely with a theoretically similar response as if they worked in front of the machine (Sadiku et al., 2014), with the consideration of other factors such as internet line speed.
4- The scalability of IT resources, where enterprises are able to scale resources up and down depending on their requirements (Dubey and Wagle, 2007, Astri, 2015), which is one of the main features of cloud computing, such as pay-as-you-go, that allows users to pay for used resources only (Leavitt, 2009).
5- Reducing IT investment and operational costs, that results in utilising IT resources with minimal cost (Mudge, 2010, Astri, 2015, HBR, 2014, Tari et al., 2015). For investments, companies can rent required IT resources from the cloud provider instead of building dedicated IT centres (Sharif, 2010). This provides a lower cost option for small organisations to adopt and utilise cloud services in order to perform complex IT related activities, such as business analytics tools and intensive computing activities that were affordable only for large enterprises (Avram, 2014). Also, organisations can cut operational costs of servers, licenses, energy, staff, and other IT resources by authorising a third party - the cloud provider to perform such tasks (Choo, 2010, Marston et al., 2010). This financial saving can help SMEs manage their limited budgets by saving IT service cost and scale up their capital to empower their business (Miller, 2008).

6- Cloud computing opens the door for developing countries who are still behind in utilising the latest IT resources, instead of relying on their limited resources (Marston et al., 2010, Avram, 2014).
7- Cloud computing enables organisations to apply and use the latest and up to date IT solutions, including end-user applications, storage and computation processes with a minimal knowledge. The provided services helps to facilitate utilisation even if users do not possess expertise in IT especially in using off the shelf cloud solutions without even knowing the physical location of data centres (Jadeja and Modi, 2012, Dikaiakos et al., 2009).

3.12 BROAD RESEARCH AREAS IN CLOUD COMPUTING

In order to achieve cloud computing potential, it is necessary to explore and understand several related issues. There is a great deal of research in cloud computing from the technical perspective (Hamdaqa et al., 2011, Sarna, 2010, Petcu et al., 2013, Cito et al., 2015). However, there is a need to study this phenomena from the business view (Marston et al., 2010). There are several fields of research in cloud computing that can be applied within a specific region or country. For example, at the Australian level, Dr. Renato Iannella; principal scientist of National ICT Australia; suggested research to build Australian cloud services to place all local data under Australian control and protection in order to mitigate the fear of data migrating overseas, which could be affected by foreign laws and policies (Choo, 2010). Organisations in Australia have to comply with the Australian government's *Privacy Act,* an Australian law that sets the rules with regard to the handling of individual information including disclosure, storage, use and collection of personal information (Privacy Act, 1988b). The government in Australia issued a specific privacy act for cloud computing (DoC, 2014). The document released stated that the cloud service provider must notify customers regarding what type of information is going to be collected, stored, secured, disclosed and ultimately disposed of (DoC, 2014). However, this privacy act is applied on large enterprises, but not on most SMEs. The Australian government stated some exceptions, where the SME must comply to the privacy act if any of these exceptions were valid in the business (Privacy Act, 1988b). Some examples of SMEs who must comply with the privacy act in Australia is if the firm is a health service provider or trading in personal information, such as selling mailing lists[3].

[3] For more details regarding the exceptions that must SMEs comply to the Australian privacy act, please visit: https://www.oaic.gov.au/agencies-and-organisations/faqs-for-agencies-orgs/businesses/small-business

Generally, with regard to the *economics* of cloud computing, there is a need to show how cloud enablers can add economic value as well as what the most suitable pricing strategies are. Different pricing strategies are used in cloud computing, such as flat rate, payment per use or a combination of payment strategies (Marston et al., 2010). Decisions on the most appropriate pricing strategy require an analysis of each method to ensure reaching the desired goals when SMEs adopt cloud computing. This includes the relationship between quality and investment as well as to find best practices in this field.

Cloud computing regulation is one of the common research areas as it plays a considerable role in several other research areas (Ashrafa, 2014, Kshetri, 2013), from the governmental level, such as the Australian government privacy act; down to the lowest level in organisations, such as budgeting. Cloud regulation also includes pricing, SLAs, security, international standards, risk assessments, adoption, and partnerships (Ashrafa, 2014, Kshetri, 2013).

With regard to the *adoption* of cloud computing, there are many issues that need to be addressed (Tarmidi et al., 2014, Lin and Chen, 2012). Implementing cloud computing requires an understanding of best practices and the development of risk assessment methodologies, such as security in hardware and software and policy in general (ENISA, 2009, Tarmidi et al., 2014). Moreover, such research might include economic aspects to develop a model in order to gain the highest financial benefits with minimal implementation and operational costs.

Issues relating to *strategy* could target clients to determine the most important factors in order to meet their business goals, maximise profits, issues of change management as well as staff training (Sosna et al., 2010), whilst targeting IT organisations that attempt to provide cloud services (Kshetri, 2013, Sosna et al., 2010).

Policy issues vary from managing the migration from on-premises to a third party in the cloud, setting a road map for migrating standards to cloud providers, and setting the rules of monitoring and auditing the cloud services locally and internationally (Kshetri, 2013). Having discussed some of the key issues surrounding the adoption of cloud computing, the next section addresses the Australian context more specifically.

3.13 CURRENT CHALLENGES FACING CLOUD ADOPTION

Cloud computing enables IT resources online to be used and paid for as needed (Garg et al., 2013). It is an important trend that utilises technologies to support competitive advantage to provide a noticeable improvement in business processes. Two of the key reasons for adopting cloud computing are business agility; by using IT to improve the business outcomes; and IT efficiency (Kim, 2009). Cloud computing opens the door for business organisations to reduce expenses, maintenance, and operations by outsourcing IT assets. This gives them opportunity to direct investment into their business activities (Garrison et al., 2012). However, there are a number of challenges when adopting cloud computing. In general, the challenges of adopting cloud computing can be categorised into four main groups, which are: *technical*, *organisational*, *policy* and *legal*, with a fifth general group that could be called *miscellaneous risks* that do not fall in to the previous three categories (Khajeh-Hosseini et al., 2012). Some examples of these challenges would include security, reliability, latency, control, performance, vendor lock-in, and privacy (Sultan, 2011). The following sections discuss some challenges in more details.

3.13.1 Technical Challenges

Data Privacy, *Security* and *Trust* concerns are other data related dilemma that hinder the expansion of cloud computing in a significant number of businesses (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010). Clients wonder if cloud service providers can provide better or even the same level of data privacy and data security compared with the in-house model. Moreover, they have several questions about who can access their data, and how to insure privacy from the staff side of the cloud service provider (Zhang et al., 2010, Tari et al., 2015, Kshetri, 2013). In addition, the publicity of cloud computing services make it a target for a significant number of threats, including malicious attacks which could be one of the main challenges against the spread of cloud computing (Tari et al., 2015, Chen et al., 2010). In common with IT networks and digital technology, cloud service providers and third parties are continuously inventing many solutions to ensure sufficient data security and privacy, such as using advanced cryptographic methods, where the traditional techniques are not adequate in the cloud environment to make information readable for authorised users only (Van Dijk and Juels, 2010, Kshetri, 2013).

Integration with legacy systems is a technical challenge that some companies face, especially those who have old or complicated systems that could generate extra stress on IT staff and the entire organisation (Ross and Blumenstein, 2015). This issue could create several operational and data-related problems relating to data quality, consistency and accuracy.

Lack of cloud standards is another technical threat that inhibits cloud growth. There are no clear interfaces between platforms from different service providers (Armbrust et al., 2010).

Consequently, cloud clients may face several problems when they decide to move to another cloud provider. However, some of the main industrial cloud players such as Microsoft and Google have commenced solving this issue through developing different solutions to move data to and from their systems (Marston et al., 2010).

Multi-tenancy and Cyber-attacks are one of the major technical issues in cloud computing. While data from different clients are stored in a single multi-tenant server, the server needs to run at the maximum protection level to ensure security. Also, if one of the virtual environments faces attack, the server must provide complete protection to the other virtual tenants (Choo, 2010) as well as protect physical resources as hackers are trying to reach all of the cloud's clients in the victim's server (Alliance, 2011).

Data location is one of the issues that creates fear over cloud adoption. Cloud computing technologies are used to save, manage, and control data remotely stored in unknown and distant places from the enterprise's geographical location. However, some business organisations could choose the geographical location of their data, such as companies that request cloud service providers store their customers' information in a specific location (Sultan, 2011, Sahandi et al., 2012).

Integration between the cloud based solution and legacy systems or between different cloud based applications would be one of the concerns facing cloud computing (Jamsa, 2012).

3.13.2 Technical-Organisational Challenges

Data Availability is one of the main technical and organisational issues in cloud computing. Organisations need to gain the highest availability of their businesses online, and they might not accept faults that could hinder their work. Such availability issues are connected to *Cloud Computing Regulation* in order to set rules to avoid unexpected cases (Choo, 2010, Tari et al., 2015, Moreno-Vozmediano et al., 2013).

3.13.3 Organisational Challenges

Lack of Data Control could be considered a major legal and organisational deal in adopting cloud services to the business. Organisations may refuse to take advantage of cloud services, because they feel their valuable data is owned and controlled by a third party, namely the cloud service provider (Armbrust et al., 2010, Marinos and Briscoe, 2009). Also, the sense of controlling data by others leads companies to think they lack flexibility compared with an on-premise option to edit or change their applications (Miller, 2008, Leavitt, 2009).

Ambiguous Coordination of cloud adoption by stakeholders is another case that might hinder the adoption process (Garrison et al., 2012), where cloud consumers might have less awareness regarding the involved stakeholders in the provided service.

Inadequate Knowledge of cloud computing could affect utilisation of the cloud. This includes both business and technical awareness (Garrison et al., 2012). In addition, limited knowledge could make it more difficult to develop and deploy applications on the cloud that requires more knowledge than a standard development (Ross and Blumenstein, 2015).

Insufficient Understanding between the organisation, client, cloud vendor including service scope, implementation and extent also plays a role (Garrison et al., 2012).

3.13.4 Political and Legal Challenges

Cloud computing regulation is a critical political and legal issue from the business perspective. It is required in order to regulate dealing with cloud computing on local, national and international levels to ensure availability, accessibility and privacy under any possible conditions (e.g. natural, financial or political), to avoid any unexpected consequences, such as the failure of data privacy which could lead to administrative, local, national, or even international problems. Therefore, cloud stakeholders are required to set clear Service Level Agreements (SLAs) highlighting all possible issues (Alliance, 2011).

Countries national compliance requirements and laws also plays a significant impact on utilising cloud services that could also restrict some cloud-based business strategies. For example, the Australian Privacy Act restricts some types of data from storing or migrating overseas. However, the U.S. government has full rights to access any type of data stored within its borders without permission (Gershater, 2012, DoC, 2014). This is a crucial issue where many of the main players in cloud computing industry are U.S. companies, such as Microsoft[4], Amazon[5], Google[6], and Salesforce[7]. This problem had a severe impact even on cloud service providers who started to lose a significant amount of money and customers in a continuous threat (Stern-Peltz and Armitage, 2013). As a quick response from most of cloud service providers to keep their positions in the cloud industry by improving performance and

[4] http://news.microsoft.com/facts-about-microsoft/
[5] https://www.amazon.com/gp/help/customer/display html/ref=footer_cou?ie=UTF8&nodeId=508088
[6] https://www.google.com.au/intl/en/about/company/facts/locations/
[7] https://www.salesforce.com/company/legal/intellectual.jsp

overcoming the privacy issue, they have built many data centres around the world including Australia, such as Microsoft[8] and Amazon[9].

3.13.5 Miscellaneous Challenges

Increasing carbon footprint is an environmental-based concern relating to fast expansion of cloud computing (Marinos and Briscoe, 2009, Brown, 2008). The increasing demand on cloud-based service requires a continuous growth of cloud service providers' data centres to ensure the quality and efficiency of the provided services. This expected expansion is likely to maximise carbon emission (Miller and McIsaac, 2006). The trend of increasing the carbon footprint goes opposite to the public interest in reducing the carbon footprint. Studies in this space have gained prominence as *Green Computing* focusing on three main parameters, which are people, profit, and planet (Williams and Curtis, 2008, Marinos and Briscoe, 2009, Kliazovich et al., 2012, Kliazovich et al., 2013). The increased concern regarding the impact of cloud computing and internet-based services on the environment led many researchers to focus on minimising this impact (Gai et al., 2016, Sarkar and Misra, 2016, Kapur and Dutta, 2015).

3.14 IDENTIFYING THE GAP

There has been significant growth in the cloud computing market over the last few years. Gartner Group (2013) reported that the global cloud services' market was valued at $110.3 billion in 2012, and was predicted to grow 18.6% to $131 billion in 2013. The IaaS market was $6.1 billion in 2012 and this number was forecast to be $9 billion by 2013. At the same time, the Gartner report also noted the major sectors of the cloud computing market. Advertising in the cloud was classified as a top investment sector in the cloud by 48 per cent of the total market in 2012. Moreover, the cloud investment is estimated to rise to $677 billion from 2013 to 2016, where around $310 billion is dedicated for advertising. The second largest industry in the cloud is the BPaaS market by 28%. SaaS comes in third at 14.7%, followed by IaaS by 5.5%, and cloud security and management at 2.8%, while the last sector was the PaaS at only one percent (Anderson et al., 2013). The importance of the cloud computing market could add value to the Australian economy by improving productivity via most business sectors with business sizes from micro to large enterprises.

[8] https://azure microsoft.com/en-us/regions/
[9] https://aws.amazon.com/about-aws/global-infrastructure/

A survey undertaken in 2010 conducted in 636 companies in five countries (USA, UK, China, Japan, and Australia) showed that 88% of IT decision-makers agreed that cloud computing would be a priority in their organisations. Cloud computing was identified as important for achieving eight key objectives, which are e-industry regulatory change, disaster recovery, improving capability and availability, minimizing IT investment in infrastructure, enhancing IT control, business agility, mitigating IT maintenance and management as well as improving IT productivity. Business agility was identified by 75% of interviewees as the most important contribution of cloud computing. The second most important contribution at 56% was reducing IT infrastructure investment. The third most important at 53% was decreasing IT maintenance and management resources. Other cloud contributions included improving capability and availability (50%), improving IT productivity (46%), disaster recovery (40%), enhancing IT control (32%) and industry regulation (17%) (CIO and IDG, 2011).

A recent industry report (2015) investigated the use of cloud computing by Australian SMEs' operators. The report stated 40% of computer operators use cloud computing (MYOB, 2015). It is difficult to ascertain the adoption rate of cloud computing services for SMEs in Australia; however industry reports suggest the adoption rate is around 1 in 5 or 20% (MYOB, 2012).

The *Organisation for Economic Co-operation and Development (OECD)* supports the uptake of cloud computing by SMEs because of the importance of cloud computing becoming the fifth important utility (after water, electricity, gas, and telephony) (Buyya et al., 2009). Compared to other OECD countries, the adoption of cloud computing by Australian SMEs appears to be significantly lower. For example, Flood (2013) predicts 75% of American businesses and 61% of British businesses utilise cloud services (Flood, 2013). Another example, South Africa (not a member of the OECD), has 52% of SMEs (including micro businesses) using cloud services (Hinde and Belle, 2012). Moreover, *the 34th Annual Society for Information Management's (SIM) IT Trends* academic study on 484 American organisations. There were 260 responses to this study showed that 81% of the studied organisations are utilising from the cloud. The same study presented responses of 483 senior IT leaders who revealed that cloud computing is the third most significant IT investment in U.S. organisations after business intelligence and CRM systems. Also, the study stated a substantial increase in the priority of cloud computing investment in the U.S., where what was 17th priority in 2009 became 3rd priority in 2013 (Kappelman, 2013).

It is predicted that the Australian market of cloud computing will reach US$3.33 billion in 2016. KPMG[10] forecasted the potential effect of the rapid revolution of utilising cloud services that could boost US$3.32 Billion annually to the Australian economy (Senarathna et al., 2014).

As discussed in a previous section, the Australian government is trying to avoid or mitigate preventing SMEs gaining sufficient access to all of required IT resources (CSC, 2014), classified as important in driving business innovation and productivity, explained in chapter 2.

The current gap is identified as the importance of utilising cloud computing by SMEs to achieve competitive advantage. This significance provides impetus to study the influences as drivers and success factors of adopting cloud services by Australian SMEs as well as possible challenges that could act as barriers against adoption. However, the adoption rate of cloud computing by Australian SMEs is not clear in the research to date due to a lack of academic studies in this area. Therefore, the approximate adoption rate of cloud computing by Australian SMEs is explored first in this research.

3.15 RESEARCH QUESTION

The literature above leads to the overarching question herewith:

> *What are the adoption rates, critical success factors and challenges for Australian SME adoption of cloud computing to achieve competitive advantage?*

The lack of research in this area might restrain organisational trend of utilising cloud computing for Australian SMEs that might cause loss of several business opportunities that related to this utility. The overarching question seeks to examine the impact on the adoption of cloud computing on SMEs.

Under the umbrella of this question, there are several investigative sub questions that must be solved in order to answer the main research question (Recker, 2013). The first question explores the current adoption rate of cloud computing for Australian SMEs during this study, that is from the years 2013 to 2016, but particularly in the data collection years of 2015 and 2016. The second question investigates the effects of organisation resources as critical success factors on utilising cloud computing for Australian SMEs.

[10] A research and consulting enterprise. For further details, please visit: https://home kpmg.com

Like most new technologies and as described in the literature, there are several challenges that organisations face in utilising cloud computing. The third question investigates the possible issues that could hinder SMEs utilisation of cloud computing in the Australian context.

Therefore, the research sub-questions are:

- *What has been the adoption rate of cloud computing for Australian SMEs during the period 2015-2016?*
- *What are the potential benefits of cloud computing utilisation to improve business capabilities and achieve competitive advantage?*
- *What are the potential challenges of cloud computing utilisation that the Australian SME sector faces?*

3.16 CONCLUSION

Cloud computing technology was formed from several existing and new technologies, such as grid computing and virtualisation. Cloud service consumers need to have at least a brief understanding of cloud computing and its related concepts, such as service delivery and deployment models. The main cloud service delivery models are classified in three categories, which are SaaS, PaaS and IaaS. While cloud deployment models consist of four types, which are public, private, hybrid, and community.

The characteristics and the advantages of cloud computing has the potential to increase individual, organisational, and national productivity. However, like any other technology, there are some associated challenges act as barriers.

The literature shows a clear gap in our knowledge on the adoption rate of cloud computing for SMEs in the Australian context and how cloud computing can be used to achieve competitive advantage. This research aims to explore three issues. For the first case, the study will attempt to address the issue of the lack of academic studies to show the approximate rate of Australian SMEs adoption of cloud computing by exploring adoption rates in this critical sector. The second goal of this study is to identify the influences of utilising cloud-based services as critical success factors in adopting cloud computing amongst Australian SMEs. The last phase of this study attempts to investigate the challenges that hinder the adoption of cloud service or appear during operating these services.

The research will provide insights to both researchers and practitioners by establishing the adoption rate of cloud computing adoption in SMEs in the Australian context. The research will determine the critical factors that lead to successful deployment of cloud-based services, and by examining the challenges in the Australian business environment.

To summarise, some industry based studies show limited utilisation of cloud services for Australian SMEs' sector, and the academic literature shows the absence of clear academic studies of the adoption rate of cloud computing for this important sector. The main pillars of this research are studying the adoption rate; to estimate the approximate rate of Australian SMEs utilisation from cloud computing; and to explore the critical success factors, and challenges.

What was here to provide a clear picture regarding the situation of cloud computing as it currently exists. While the previous chapter discussed the business case, this chapter discussed technical issues. The chapter concluded by discussing the gap needing further research based on the analysis in the previous and current chapters.

Chapter Four: Theories and Epistemologies

4.1 INTRODUCTION

The previous chapters provided insights regarding cloud computing and its significance to SMEs and the national economy. Chapter 2 discussed the importance of utilising cloud services bringing benefits to different levels from inside the local firm up to the level of national productivity. After highlighting the significance of adopting cloud computing technologies, chapter 3 explained the technical concepts to provide some understanding of cloud computing. The research questions were identified before concluding the third chapter. The purpose of chapter 4 is to highlight the most commonly used theories and epistemologies in similar studies. This chapter provides a brief description of different philosophies. Some of these concepts will be used in the methodology chapters of this research. This chapter starts by discussing the conceptual research process model that summarises all main stages in the study. This is followed by a discussion on common social research orientations - basic and applied research. Three academic research purposes are outlined followed by social research epistemologies. Before the end of this chapter, the most commonly used theories in similar studies will be discussed in order to select the appropriate theory to this study. The contribution of this research starts at the end of this chapter by developing an appropriate framework from adopted theories to investigate the research questions posed.

4.2 RESEARCH PROCESS MODEL

The process model is used to represent the stages of the research being those of questions, research design, the required data, and the use of the collected data to answer the research questions (Punch, 2005).

The pre-empirical stage of this research started by selecting the area of study that is the use of cloud computing in business organisations. The main research question was "*What are the adoption rates and critical success factors for Australian SME adoption of cloud computing to achieve competitive advantage?*"

The following sections in this chapter provide more details regarding the theoretical concepts used here.

4.3 RESEARCH ORIENTATIONS

Research broadly may be of two main social research orientations, which are *basic* research (or scientific research) and *applied* research (Jackson, 2014, Hall, 2008). The majority of basic research is conducted in laboratories and universities to gain knowledge regarding specific issues that could be a starting point to develop the solutions, while applied research finds immediate applicable answers as solutions to the studied issue (Jackson, 2014). It is also expressed that basic research trying to explore if there is any relationship or casual effect exists. The applied research studies the same, but with considering parameters and variables as part of the conducted study (Hedrick et al., 1993). In line with other such research, this research seeks to examine critical success factors (CSFs) affecting cloud adoption in SMEs. With that in mind, let us briefly examine the following table (4.1) which summarises most of the characteristics of basic vs. applied research (Neuman, 2010, Jackson, 2014, Hall, 2008).

Table 4.1: Basic vs. Applied research methods

	Basic Research	Applied Research
1	The audience are scientific communities	The audience are field professionals
2	Source for innovating ideas.	Solving the raised questions
3	Used to accept or refuse theories	Based on theories
4	Long-term studies (it might need years or decades to be completed).	Short-term studies (it might solve issues for month or few years).

This research project follows an applied research orientation in order to find the roadmap and needs of successful utilisation of cloud computing for Australian SMEs for several reasons. It targets some of the active practitioners in Australian SMEs, including:

1- Chief Information Officers (CIOs) – i.e. the head IT person in any firm.
2- Chief Executive Officers (CEOs).
3- Decision Makers – those with any IT decision making authority.
4- IT Department managers.

The study is designed to examine three questions that are raised regarding the utilisation of cloud computing in Australian SMEs to improve business productivity and achieve competitive advantage. These questions are "*What has been the adoption rate of cloud* *computing for Australian SMEs during the period 2015-2016? What are the potential benefits of cloud computing utilisation to improve business capabilities and achieve competitive advantage? And what are the potential challenges of cloud computing utilisation that the Australian SME sector faces?*"

In addition, the study was conducted over a period of two years (2015-2016), which is considered a short-term study following an applied research orientation.

4.4 RESEARCH PURPOSES

Research usually begins with a question or group of questions that need to be solved. It is common in scientific studies that researchers state their goals and objectives to provide other researchers and investigators with more understanding regarding the nature and purpose of conducted research; this also helps to link the result to the objectives (Sue and Ritter, 2012).

Common research purposes are described in three categories, *Exploratory*, *Descriptive*, and *Explanatory* (Neuman, 2010, Sue and Ritter, 2012). Research is based on one or more of these (Sue and Ritter, 2012). The following points highlights most features of each research purpose (Neuman, 2010, Sue and Ritter, 2012):

1- *Exploratory* is used to explore new ideas from nothing or from a limited amount of knowledge. It generates new questions - "what questions" to address a specific issue (Neuman, 2010, Sue and Ritter, 2012). It is a type of research that is used to formulate problems, developing hypotheses, or clarifying a specific concept or phenomena (Sue and Ritter, 2012). Exploratory research tries to achieve more knowledge and familiarities regarding a specific issue without detailed explanation.

2- *Descriptive research* describes a well-known issue in more detail. The described objects could be people, tools, animals, products, or any situation. It creates new types or categories, and answers the "who" and "how" questions. In other words, descriptive research does not attempt to discuss reasons or answer "why" this issue happens (Neuman, 2010, Sue and Ritter, 2012). The nature of descriptive purpose in describing issues from collected samples; which could be quantitative or qualitative; requires mostly using some probability sampling concepts in order to analyse and present results (Sue and Ritter, 2012).

3- *Explanatory* studies reasons of occurrence for a well-known situation, by answering the "why" questions to connect cases with general principles (Neuman, 2010, Sue and

Ritter, 2012). In addition, the explanatory purpose helps to predict future trends of the issues studied (Sue and Ritter, 2012). This led some researchers and authors to consider another research purpose that is based on the explanatory approach, which is called a *predictive* research purpose (Pedersen et al., 2007). It usually depends on creating one or more hypotheses to specify and link the direction and nature of the research variables. It is also requires some statistical concepts to deal with collected data, which are mostly quantitative (Sue and Ritter, 2012).

From the previous chapters, the literature shows that SMEs are seeking to achieve competitive advantages. Cloud computing is important for assisting SMEs in achieving competitive advantage through improving productivity and efficiencies. It is appropriate as such to study available resources and challenges in adopting and utilising cloud services.

The limited information over the take-up rate of cloud computing as well as the success factors and the possible challenges of adopting cloud computing by SMEs in the Australian context positions this research as part of exploratory research in order to answer the discussed questions.

4.5 RESEARCH EPISTEMOLOGIES

In general, there are several social research methods (Neuman, 2010, Walliman, 2015). However, there are three main epistemologies (Neuman, 2010, Walliman, 2015) which are *positivist, interpretivist,* and the *critical social research method (or critical realism).*

1- *Positivism* assumes reality is a given and can be measured by its features and is mostly applied as observations, precision and the independence of values and theory (Neuman, 2010, Walliman, 2015, Bryman, 2015). It could be used to develop hypotheses to explain reality (Bryman, 2015).

2- *Interpretive* research starts with assumptions that might lead to reality. It is usually used to understand a phenomena, such as the influences of information systems (Walsham, 1993). Also the purpose of the interpretive approach is to learn how the world works by understanding people and knowledge (Neuman, 2010, Bryman, 2015).

3- *Critical Social Research* assumes there are some realities that need to be criticized in order to transform them to other forms (Neuman, 2010, Walliman, 2015). It attempts to understand the structure of social work to order to change or modify it (Bryman, 2015).

In this research project, the epistemology is interpretive, which starts with assumptions that might lead to reality. It is typically used to understand a phenomena, such as the influences of information systems on the organisation (Walsham, 1993). It has been selected for several reasons. Firstly, the nature of this research is to understand the cloud computing phenomena, by obtaining insights into successful cloud utilisation by Australian SMEs, which reflect the interpretive method. It is important to establish the existing level of adoption of cloud computing because there has not been any rigorous academic research to establish this. In addition, what is required is to establish the status of cloud computing adoption and related emerging themes. After collecting data, the reality then begins to form. At this point, a positivist epistemology will prove beneficial in order to analyse the collected data.

It is intended after understanding the developing questions and identifying the goals of this research, to develop a clear process of research progress by identifying and organising the expected stages of the research (Monette et al., 2013). Two of the most commonly used theories in this regard are the deductive and inductive theories (Bryman, 2012, Bryman, 2015, Walliman, 2006) or as some scientists prefer to call them deductive and inductive reasoning (Monette et al., 2013).

4.6 DEDUCTIVE AND INDUCTIVE THEORIES

The complete use of deductive theory consists of six stages. The first stage assumes theory is well known, and researchers will use that particular theory. Secondly, researchers will try to match their hypotheses with the selected theory. Thirdly, the data collection phase will collect the required data. The fourth stage analyses the collected data, followed by the fifth stage to confirm or reject the initial hypotheses from the second stage, while the last stage reviews theory according to the results of the conducted study (Tarski, 1993, Bryman, 2012, Bryman, 2015, Walliman, 2006, Newsome, 2015).

On the other hand, inductive theory usually aims to test one or more hypotheses. It is usually based on interventions or observations to carry out results. Researchers then build up a new theory or examine the validity of an existing theory (Tarski, 1993, Bryman, 2012, Bryman, 2015, Walliman, 2006, Monette et al., 2013, Newsome, 2015).

The main difference between deductive and inductive theory is that deductive theory starts with a well-known theory followed by a hypothesis. Inductive theory comes to build a theory from the available results. The process of this research is based on some stages of deductive theory that is used to show common features between theories and the research conducted (Bryman, 2012, Bryman, 2015, Walliman, 2006, Monette et al., 2013). However, this study will be based on assumption rather than on a hypothesis, as discussed in the next chapter.

4.7 ANALYSING THE MOST COMMON USED THEORIES IN SIMILAR RESEARCH

As concluded from the literature, this study proposes exploring the adoption rate of cloud computing, followed by examining the CSFs of cloud computing utilisation for Australian SMEs as well as challenges encountered. The study explored these influences in organisations' resources; including human resources, physical assets, and external; or surrounding; resources, such as the cloud service providers. These resources are expected to be drivers to help firms in getting the best from cloud computing to reach competitive advantage. Figure 4.1 illustrate this analysis.

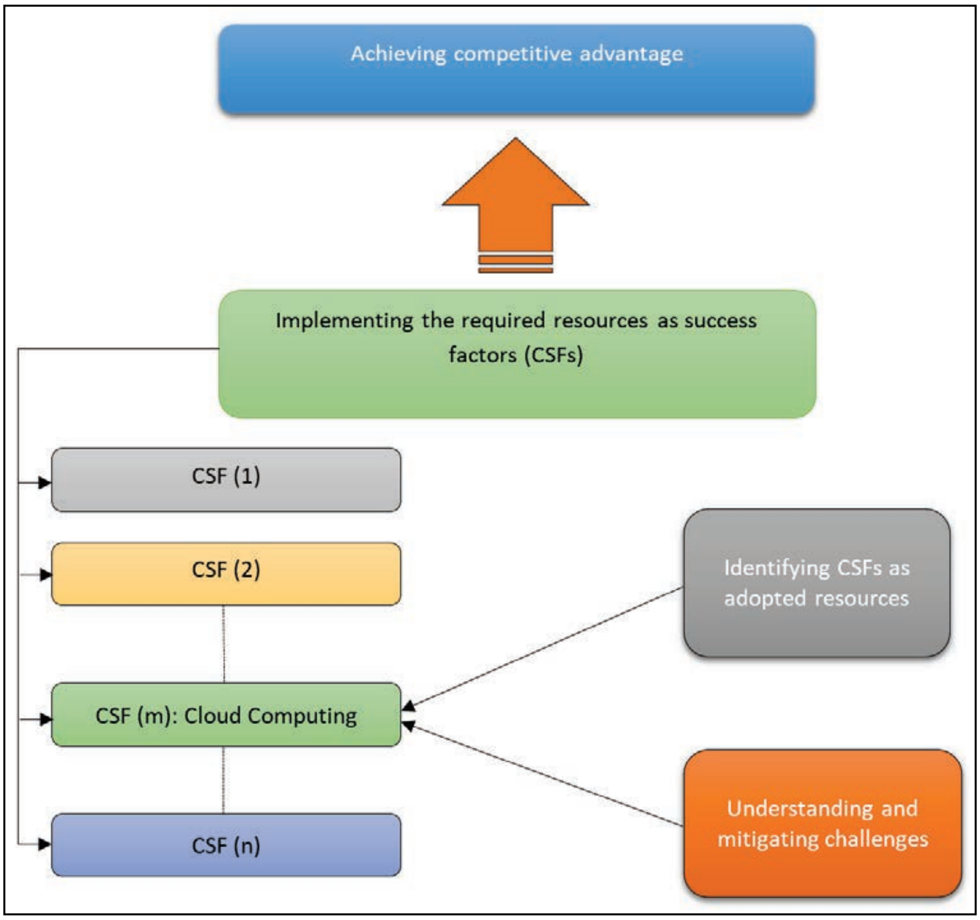

Figure 4.1: The need to explore influences and challenges of adopting cloud computing to achieve competitive advantage

Some research in cloud computing for SMEs focused on describing the research approach, such as the qualitative and quantitative approaches (Carcary et al., 2014, Mohlameane and Ruxwana, 2013, Ross and Blumenstein, 2015). However, some research relies on other theories (Carcary et al., 2014, Ross and Blumenstein, 2015). Analysing similar research examining cloud computing adoption, drivers, and the possible challenges shows that researchers tend to use different theories to reach their research goals. The following sections discuss common theories in this type of research, beginning with upper echelon theory.

4.7.1 Upper Echelon Theory

Upper Echelon Theory (UET) (Hambrick and Mason, 1984, Dwivedi et al., 2009a, Geyer, 2016) suggests top management characteristics and their strategic selection of organisation's resources play a significant role in affecting the performance of the firm. Top management characteristics include age, level of education, experience, work knowledge, financial position and psychological cognitive based values (Hambrick and Mason, 1984, Dwivedi et al., 2009a). The focus on the top management level is justified because of the top executive dominations of organisation's decisions (Geyer, 2016). On other words, UET believe that the power of the firm's executive level has a considerable effect on business outcomes (Geyer, 2016, Hambrick and Mason, 1984). While strategic selection would include acquisition, resource adoption and renewal, financial leverage, and response time (Hambrick and Mason, 1984, Dwivedi et al., 2009a).

UET was developed in more than one stage to reach better accuracy and outcomes (Geyer, 2016, House et al., 2013). It focused on demographical and background information of top management that included age, education, socioeconomic background, and functional position history (House et al., 2013, Hambrick and Mason, 1984). The narrow scope of the variables in the basic version of UET led to limited success of using this theory in scientific research (House et al., 2013). This limitation led to develop theory development in two streams. The first stream covered the relationship between business performance and the top management variables were added to the theory which included leadership behaviour and qualities (House et al., 2013, Finkelstein et al., 2009). The second stream focused on top management behaviour and decisions that lead to positive or negative business outcomes (Geyer, 2016, House et al., 2013, Finkelstein et al., 2009). This view of UET provided the opportunity to investigate three ability levels. The leader's ability to take decisions and actions, the business ability to stand among the possible actions, and the possibility of the surrounding environment to change business conditions (Geyer, 2016, House et al., 2013, Finkelstein et al., 2009). Figure 4.2 illustrates UET components in some detail and some of the affected factors.

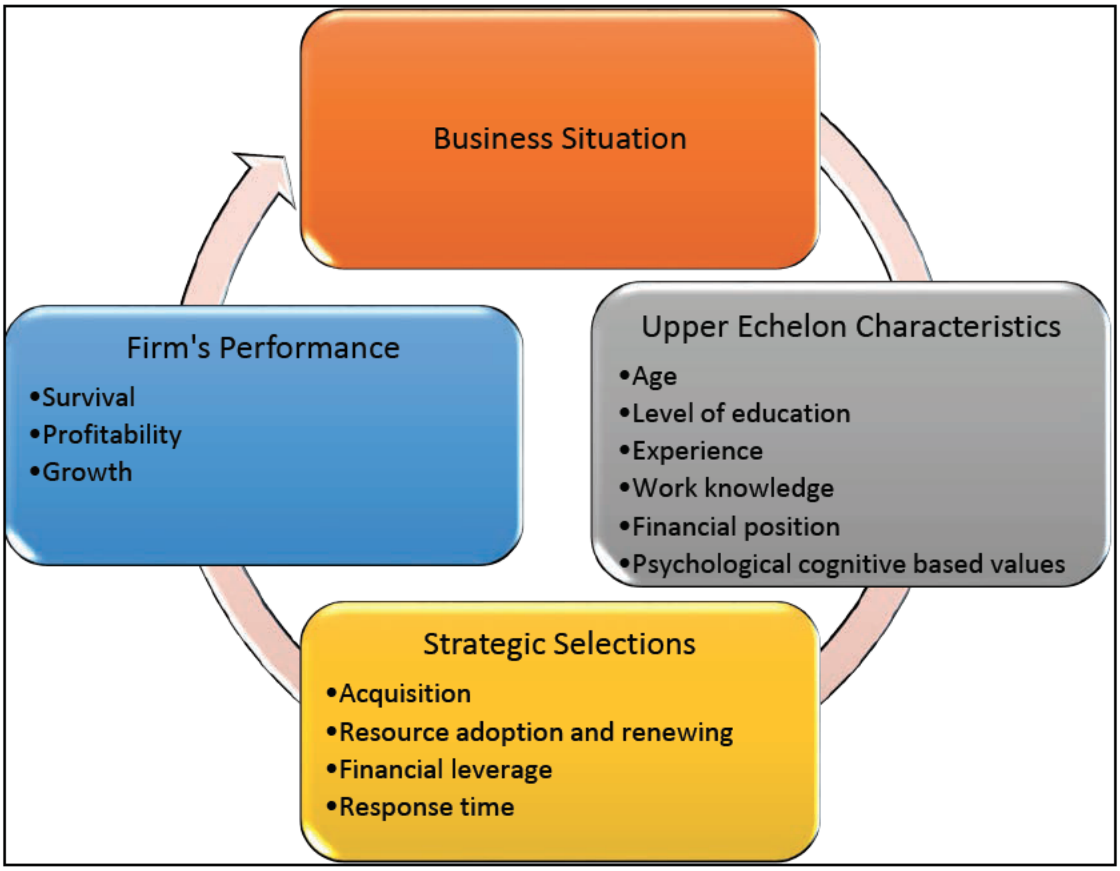

Figure 4.2: UET Components with some factors. Source: (Hambrick and Mason, 1984)

UET is used widely by researchers who focus on senior management and an organisation's performance, including the adoption of new technology (Dwivedi et al., 2009a, Nishii et al., 2007, Jones et al., 2011, Patzelt et al., 2008, Karake, 1995, Li et al., 2006, Norburn and Birley, 1988). Studying organisation resources in general is however not limited to senior management, where other important factors need to be studied, such as technical and relational factors (Garrison et al., 2012, Ryan and Loeffler, 2010) including for example trust between the firm and the cloud service provider (Garrison et al., 2012, Cousins and Menguc, 2006). Information technology resources are one of the main technical resources that add value to the firm, if utilised properly and if they have distinct features that are difficult to copy or adopt by other competitors (Ryan and Loeffler, 2010). The limited scope of this theory encourages analysis of other approaches such as diffusion of innovation as a theory.

4.7.2 Diffusion of Innovation Theory

Diffusion of Innovation (DOI) theory is one of the most commonly used theories in studying the adoption of IT solutions (Yigitbasioglu, 2015, Conrad, 2009, Hong and Zhu, 2006, Grandon and Pearson, 2004), including the adoption of cloud computing (Tarmidi et al., 2014, Lin and

Chen, 2012, Wu et al., 2013, Oliveira et al., 2014, Tehrani and Shirazi, 2014). The philosophy behind this theory is to explore what, why and how to spread new technologies and ideas among communities (Lin and Chen, 2012, Rogers, 2003, Rogers, 1995). It consists of five factors as variables to study and evaluate a specific situation. These five factors are: a. amount of effort of change, b. the nature of social systems, c. available communication channels, d. type of innovation decisions, and e. the expected factors of the planned innovation (Lin and Chen, 2012, Rogers, 2003, Rogers, 1995), as shown in figure 4.3.

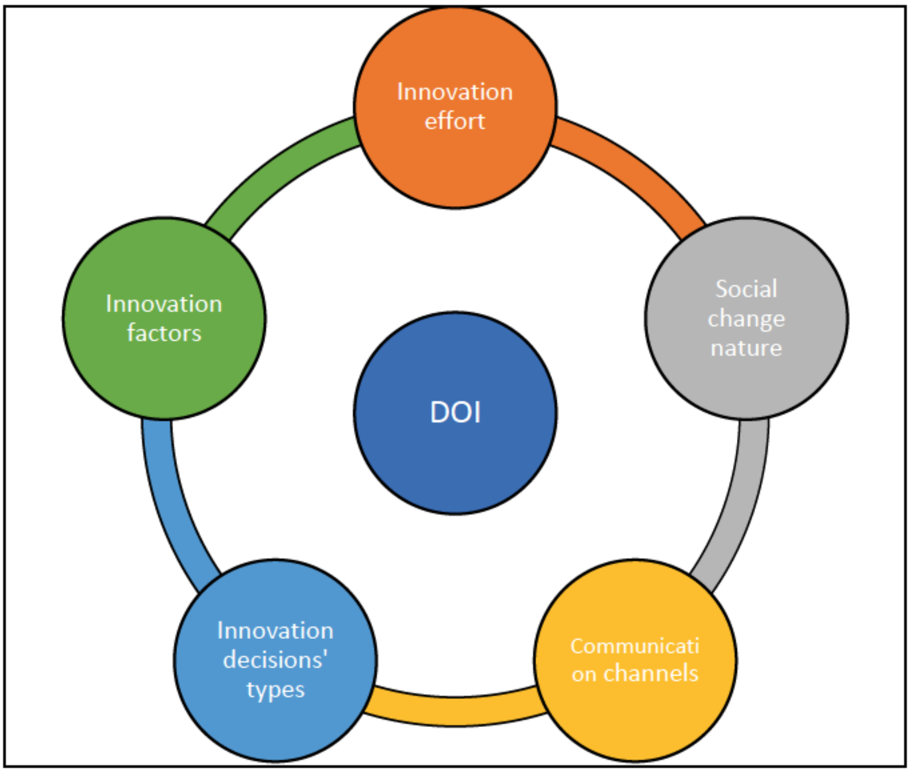

Figure 4.3: The five factors of the Diffusion of Innovation theory

The theory argues that the more accurate identification of the innovation's variables as factors will give better prediction of the innovation in the attempted adoption. The attributes of this prediction that include business and people, have significance in influencing the adoption and achieving business goals. These attributes are observability, trialability, compatibility and relative advantage (Lin and Chen, 2012, Rogers, 2003, Rogers, 1995). Observability studies the level of monitoring the effect of the innovated technology. The greater ability to monitor gives more possibility to adopt technology by the firm (Bouchard and recherche, 1993). Trialability is related to the ability level of trying the innovation before adoption; this could break down fear and build up clients' confidence toward the attempted adoption, as they will know and prepare for possible opportunities and challenges prior to adoption (Teo et al., 1995). Compatibility is an important variable to investigate the ability level of the new system to engage and integrate with the environment in the firm including the other systems, business processes and structure (Grandon and Pearson, 2004). Lastly, relative advantage explores the level of benefits that could be gained from the adopted innovation to the firm including flexibility, agility, improving business process, ease of use, and process cost savings (Grossman, 2009, Leavitt, 2009).

Research suggests that using DOI theory in cloud computing research could be related to expecting that cloud based resources are better for the organisation compared to in-house IT utilisation (Bush et al., 2010, Wu et al., 2013). Therefore, DOI theory is recommended if studying one or more of the five factors above, or to compare cloud computing resources with in-house solutions.

4.7.3 Technology Acceptance Model (TAM)

The concept of TAM is to investigate the level of accepting, behaving and using a new technology by its users (Davis et al., 1989, Yigitbasioglu, 2015, Autry et al., 2010, Paul Jones et al., 2013). It is also applied when researchers perceive that the owner is the main decision makers in small firms (Dwivedi et al., 2009b, de Guinea et al., 2005, Premkumar, 2003). TAM focuses on connecting the perceived usefulness (*PU*) and the perceived ease of use (*PEOU*) as primary factors in TAM studies (Gangwar et al., 2015, Au and Zafar, 2008, Davis et al., 1989, Davis Jr, 1986, Venkatesh and Davis, 1996) as in figure 4.4:

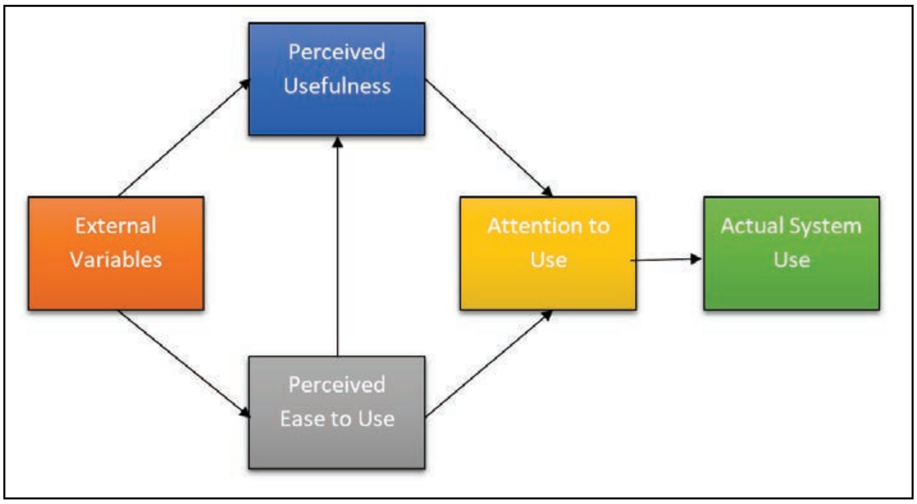

Figure 4.4: Technology acceptance model 1. Source: (Venkatesh and Davis, 1996)

The TAM concept makes this model one of the popularly used to investigate applying new technologies from the user perspective (Venkatesh and Bala, 2008, Verkasalo et al., 2010, Pookulangara and Koesler, 2011, Paul Jones et al., 2013) and in cloud computing (Behrend et al., 2011, Wu, 2011). However, the limited scope of TAM; focusing on users only led some researchers to combine it with other theories or frameworks such as the TOE framework (Gangwar et al., 2015), as will be described later in this chapter.

Using TAM brings several benefits to both cloud service providers and consumers in understanding users and their needs (Wu, 2011). An enhancement to TAM's scope - TAM2 and TAM3 were implemented as extensions to the basic TAM framework to investigate organisations' adoption of technologies in more detail, by specifically identifying external variables (Venkatesh and Bala, 2008, Gangwar et al., 2015). In TAM2, seven variables were identified and attached to the *perceived usefulness* component. These variables were experience, voluntariness, subjective norm, image, job relevance, output quality and result demonstrability (Venkatesh and Davis, 2000). TAM3 extended TAM2 by attaching two components to the *perceived ease to use* component, which are *Anchor*, and *Adjustment*. The Anchor component consists of four variables, which are perceptions of external control, computer playfulness, computer anxiety, and computer self-efficiency. The adjustment component contains two variables, which are perceived enjoyment, and objective usefulness (Venkatesh and Bala, 2008). The following figures 4.5 & 4.6 show TAM2 and TAM3 consequently.

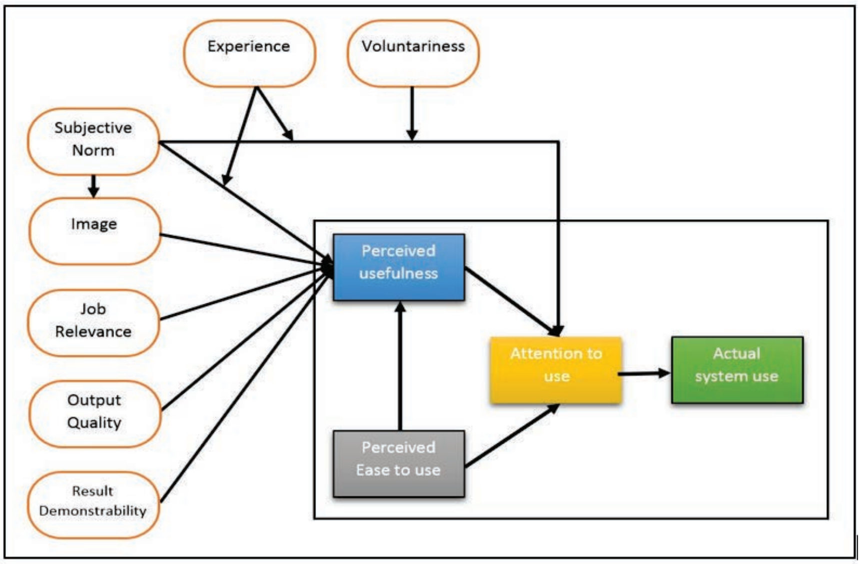

Figure 4.5: TAM2. Source: (Venkatesh and Davis, 2000)

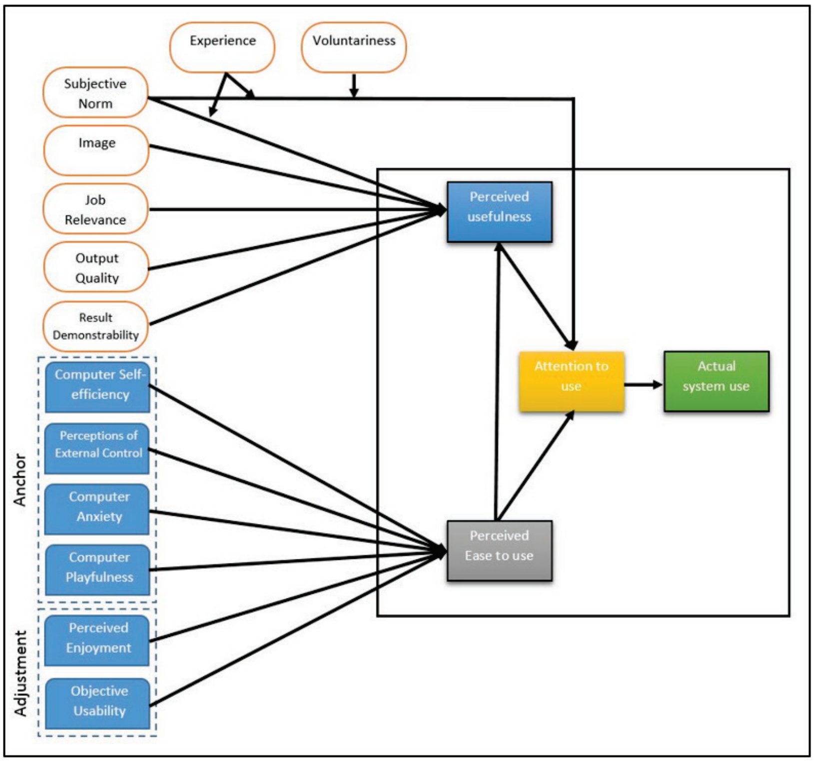

Figure 4.6: TAM3. Source: (Venkatesh and Bala, 2008)

4.7.4 Resource Based Theory

Resource Based Theory (RBT) or Resource Based View (RBV) of the firm is one of the most used approaches for the sort of research covered here (Carcary et al., 2014, Garrison et al., 2012, Yigitbasioglu, 2015, Caldeira and Ward, 2003). RBV is used to examine available resources or develop new resources to achieve competitive advantage and uniqueness in the market (Grant, 1991, Wernerfelt, 1984, Dwivedi et al., 2009b). The philosophy of *RBV* focuses on available resources and capabilities to achieve competitive advantage to reach strategic goals. Resources could add different levels of value to the firm to be competitive (Grant, 1991, Taher, 2012, Wernerfelt, 1984, Yigitbasioglu, 2015). These resources could be internal, or external but have an effect on the organisation (Dwivedi et al., 2009b, Caldeira and Ward, 2003).

The concept of RBV highlights a firm's capabilities by treating most of an organisation's resources as CSFs to be competitive and reach strategic goals, including human and IT resources (Dwivedi et al., 2009b), which ultimately leads to improvement in productivity and the national economy. Cloud computing provides one of the innovative IT solutions as a source of competitive advantage (Garrison et al., 2012, Ross and Blumenstein, 2013). A weakness of RBV appears in assuming that all of the resources under consideration are working as they are supposed to be. This could be a limitation to not covering the challenges that could come from some of the resources and if the resource is not performing as needed. Therefore, RBV appears in much research to not be the perfect theory to use by itself without combining it with another theory, model, or framework (Dwivedi et al., 2009b, Caldeira and Ward, 2003). Delving more into RBV theory, there are four main components which are *resources*, *capabilities*, *competitive advantage* and *strategy*, as shown in the following figure (4.7).

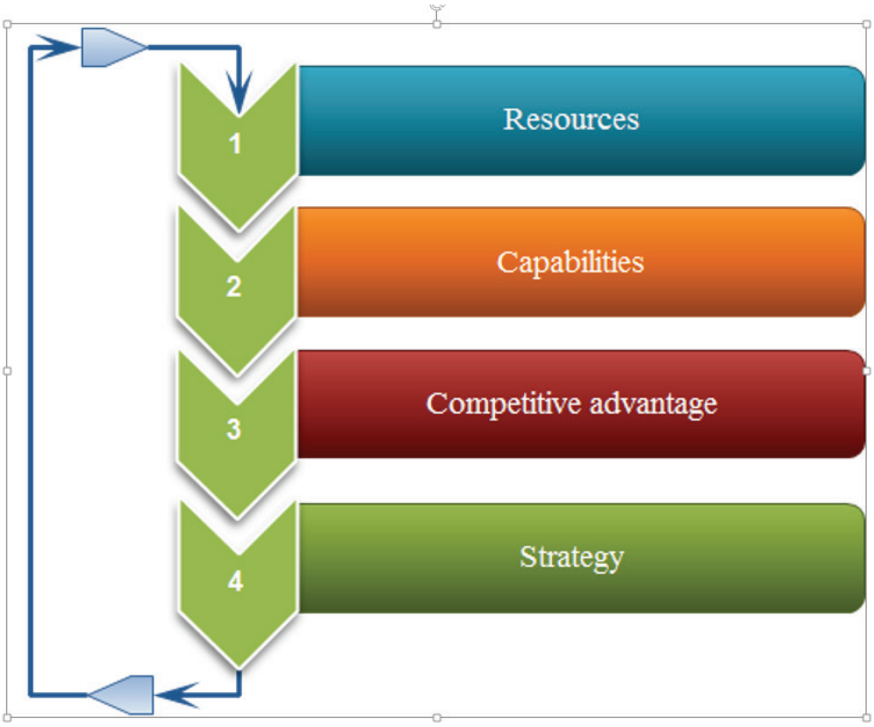

Figure 4.7: The components of the resource based theory

The first component is the organisation's *resources*, which could be defined as any service, object, or item required by the business organisation to achieve targeted goals (Stockdale, 2003). An example of the common important resources in the business is human resources, such as IT staff. Another significant resource in the firm is the financial resources, like the dedicated budget for utilising cloud services, premises such as offices; equipment such as the IT infrastructure; services and suppliers like cloud service providers. All available resources need to be identified to understand their strengths and weaknesses to develop a proper roadmap to make the most of possible benefits of these resources.

Organisational *capabilities* are considered as the second component that could be defined as the ability of the organisation to utilise its resources to perform tasks and reach competitive advantage in order to achieve the strategic goals. Capabilities should be identified according to the available resources. Also, what is required is to define the resources' input and the complexity for each capability (Grant, 1991).

The third component is *competitive advantage*. Competition is a critical factor in the success or failure of the business (Porter, 2008) especially when it comes to global competitiveness, as discussed in the literature. Therefore, what is required is to gain a competitive business position to ensure the successful continuation of the business. To achieve that, resource based theory requires studying the potential of resources and their capabilities in terms of gaining sustainable competitive advantage and the quality of their return according to business strategy. The last component is *business strategy*. This theory recommends selecting or refining business strategy according to the outcomes of the previous three factors (Grant, 1991).

4.7.5 Technology, Organisation, Environment (TOE) Framework

The philosophy behind TOE assumes that successful implementation and adoption of innovative technologies is influenced by three main factors, known as contexts; which are technological, environmental, and organisational (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013). The technological factor includes both internal and external technologies that are relevant to the organisation and used in running business processes. The organisational factor covers all possible drivers within the firm, such as communication channels, structure, size, and management. While the environmental context includes all external factors that could play a role in business outcomes, such as market situation, government regulation, and national IT infrastructure (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990). The following figure (4.8) shows the main factors of the TOE framework and their relationships in implementing a successful adoption.

The TOE framework is widely used by many researchers who examine the adoption of IT technologies (Oliveira and Martins, 2010, Yigitbasioglu, 2015, Yee-Loong Chong and Ooi, 2008, Dwivedi et al., 2009d) including cloud computing (Yigitbasioglu, 2015, Lian et al., 2014, Alshamaila et al., 2013). TOE framework covers many research aspects including technology adoption, drivers and success factors, and the possible challenges that could affect or slowdown the adoption progress (Lin and Lin, 2008, Gangwar et al., 2015, Wang et al., 2010).

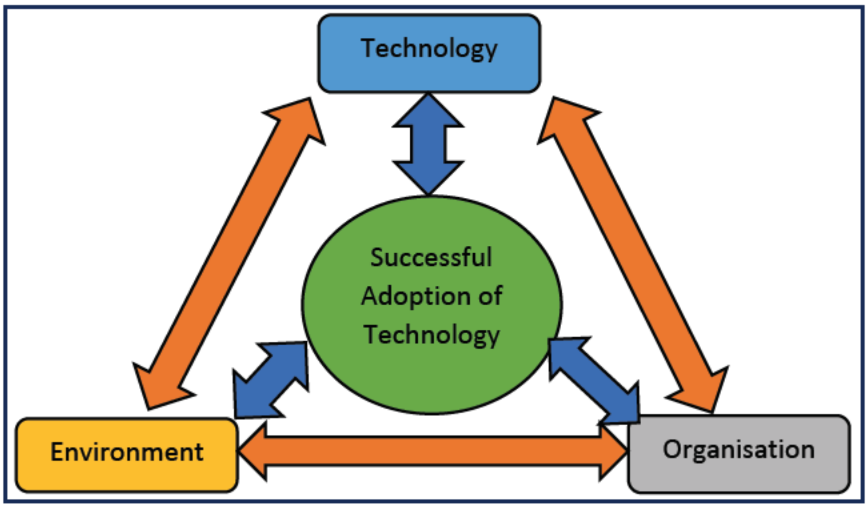

Figure 4.8: TOE Components

From SMEs perspective, TOE framework is used also to study the adoption of new technologies by itself, such as adopting cloud computing (Alshamaila et al., 2013) and adopting enterprise systems (Dwivedi et al., 2009c). In addition, several research combines TOE with another theory/model to study the adoption of technologies, including cloud computing (Awa et al., 2010, Awa et al., 2015, Soto-Acosta et al., 2015, Oliveira et al., 2014, Tehrani and Shirazi, 2014). For instance, in the adopting enterprise systems, the three components of TOE were used to cover most of the successful drivers in adopting enterprise systems. From the technology side, it covered relative advantage, complexity, compatibility, observability, and reliability. The organisational side included size, IS experience, top management, and organisational readiness. While the environmental context contained external IS support, industry, market scope, and competitive pressure (Dwivedi et al., 2009c). One research study used the three contexts to identify the drivers of adopting decisions in the north east of England (Alshamaila et al., 2013). A similar research framework to the adopting enterprise systems study, was used with few differences. The technical context contained relative advantage, complexity, compatibility, trialability and uncertainty. The environmental context covered exactly the same drivers, which are external IS support, industry, market scope, and competitive pressure. While the organisational side included size, IS experience, top management, and innovativeness (Alshamaila et al., 2013).

A similar framework was used to investigate the successful factors of adopting cloud computing to gain competitive advantage by combining it with RBV theory (Garrison et al., 2012). In this framework, critical success factors were classified into three groups, which were technical, managerial and relational. Similar to TOE, the technical context contains all of the used technologies by the organisation to run the business. These technologies include the local and the surrounding solutions. The managerial group focuses on management aspects within the firm. While, the relational context investigates the relationship between cloud service provider and consumers (Garrison et al., 2012).

4.8 SELECTING THE APPROPRIATE THEORY

In order to examine successful cloud computing utilisation, we need to explore the adoption rate of cloud computing by SMEs in Australia. It is appropriate as such after exploring the adoption rate to study success parameters such as critical success factors and challenges in adopting and utilising cloud services.

The aim and methodology of this research rests on four main points. (a) Exploring the approximate adoption rate of cloud computing by Australian SMEs. (b) Exploring the influences of utilising cloud services as critical success factors. (c) Investigating the possible challenges in adopting cloud computing by Australian SMEs. (d) Developing an applicable framework to investigate the status of using cloud computing by SMEs in order to achieve competitive advantage. The developed framework would be applicable anywhere globally, and not limited to Australia.

Based on the research objectives and the reviewed theories, the conceptual framework of this study is based on RBT or RBV, whereby the availability and capability of business resources are used to achieve competitive advantage in reaching strategic goals (Grant, 1991, Taher, 2012, Wernerfelt, 1984). The gap with regard to an organisations' need to increase productiveness and gain competitive advantage, could be filled by using RBT to explore the availability of an Australian SMEs' resources to achieve competitive advantage in the Australian business context through its use of physical assets, human resources, and external resources such as cloud service provision. The need to enhance a firms' competitiveness via cloud computing led to the use of RBT. It is assumed in this study that the availability of necessary resources could lead to successful utilisation of cloud computing which would help achieve competitive advantage. According to this assumption, SMEs resources were investigated as a factor of successful cloud computing adoption. In addition, according to RBT, the absence of these resources would present a challenge or barrier to cloud services which in the end could slow down business progress leading to reduced competitiveness. Such a view is illustrated in figure 4.9.

Figure 4.9 shows the main objectives in this study depending on the features of RBT. However, the literature showed earlier in this chapter that RBT has some limitations that led researchers to combine it with other theories, models, or frameworks (Dwivedi et al., 2009b, Caldeira and Ward, 2003).

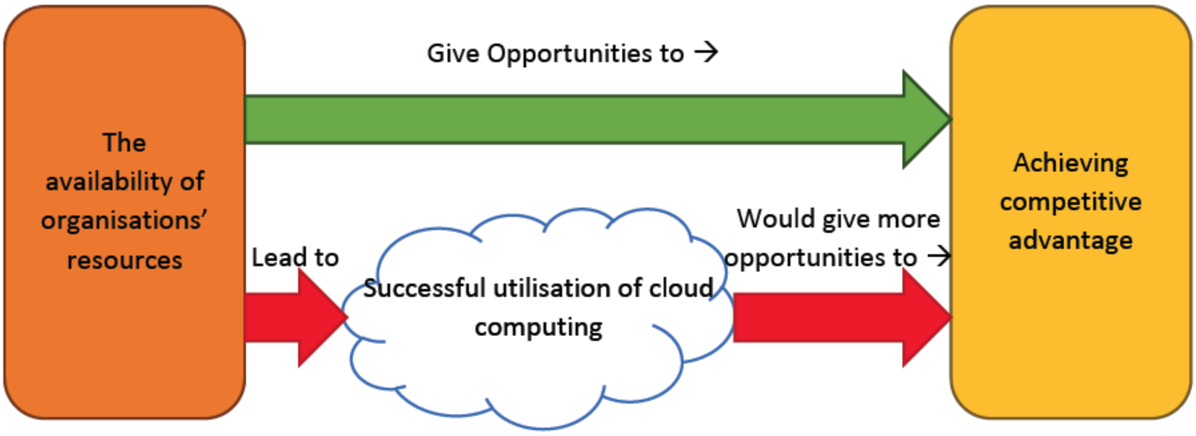

Figure 4.9: The conceptual framework, which based on RBT

This research aimed to examine the adoption rate and business resources to identify possible influences and challenges. Therefore, what is required here is to develop a framework from RBT and another model to elicit further identification of examined resources. After examining the theories discussed above, the TOE framework was used with RBT to reach the targeted goals of this study.

Figure 4.10 shows the conceptual framework of the study. The framework starts with examining the adoption rate of cloud computing by SMEs. Then, the TOE framework is used to identify the possible influences and challenges in three main components, which are technology, organisation, and environment. Each component consists of several factors that would act as drivers or challenges when SMEs utilise cloud services. Exploring those factors would increase the likelihood of implementing cloud computing successfully that could improve SMEs' capabilities to gain local and global competitiveness.

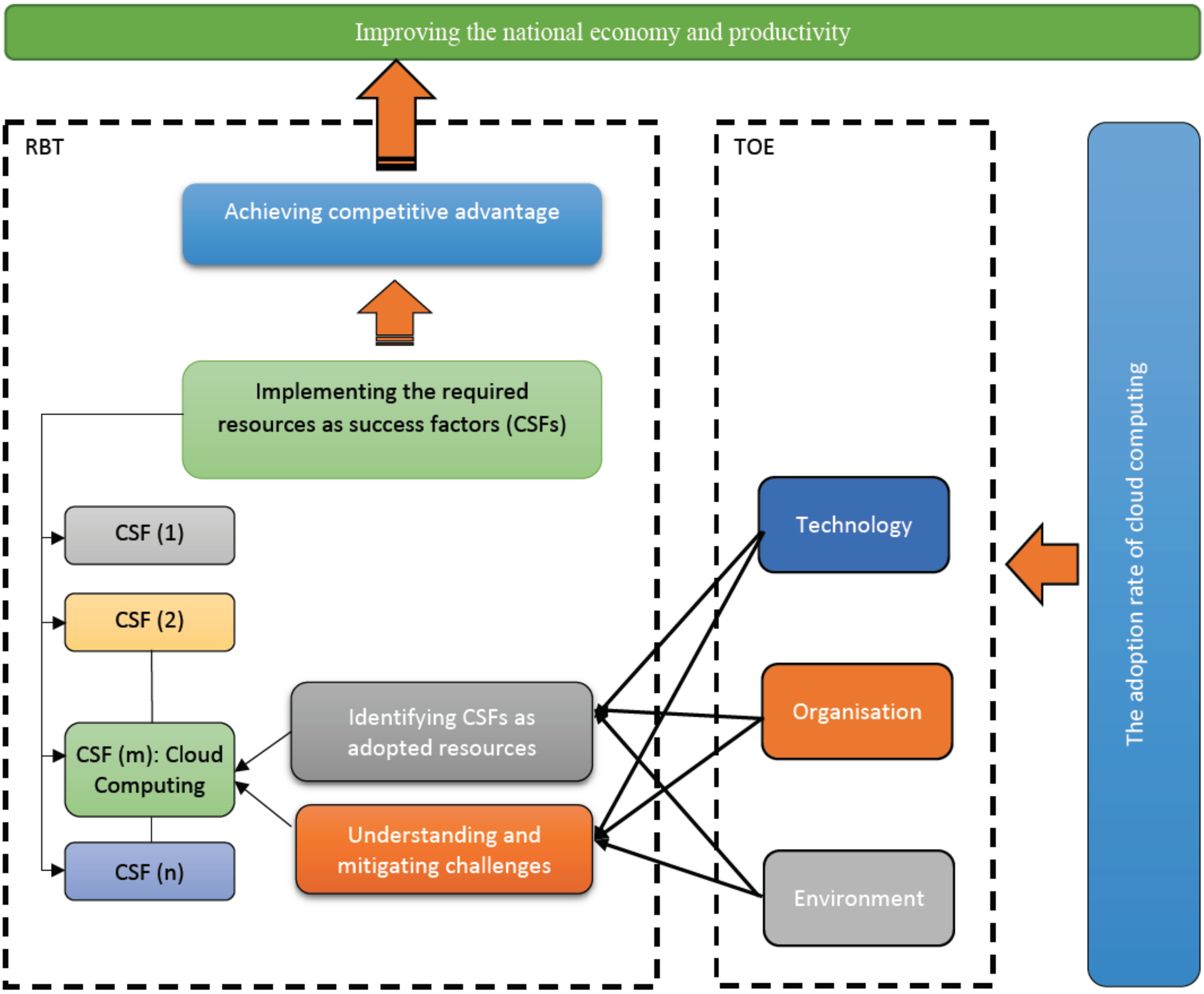

Figure 4.10: Research Conceptual Framework

4.9 CONCLUSION

Chapter 3 provided a foundation of relevant theories and the developed a research conceptual framework by combining the RBT and TOE theoretical frameworks to inform this study. The chapter began with outlining some philosophical concepts and concluded by discussing five theories and models. The chapter began with discussing the process model of the study briefly in order to solve the research question, which is: *What are the adoption rates, critical success factors and challenges for Australian SME adoption of cloud computing to achieve competitive advantage and increase national productivity?* The detailed process of this research will be described in chapter 5, which is the methodology chapter. Then we discuss the common research orientations, which are basic and applied orientations, and conclude that the applied orientation was used in this study. Exploratory, Descriptive, and Explanatory research purposes were discussed after the research orientation. The limited information regarding the status of adopting and utilising cloud computing by Australian SMEs led this research to follow the exploratory purpose. The epistemology of this study is based on the interpretive view by assuming that the availability of business resources as success factors and avoiding or mitigating the possible challenges would lead to a successful utilisation of cloud computing by Australian SMEs that lead to achieving competitive advantage and improving the national productivity and economy. Therefore, the study is following some of deductive theory's features by starting with selecting a proper theory(s). This discussion aimed to build the vision of linking identified gaps to one or more of these theories, as discussed. This chapter concluded by selecting RBT to target the ultimate goals of reaching global competitiveness and empowering the economy. In addition, Technology, Organisation, and Environment Model was linked to RBT theory to identify and categorise resources in more details.

The next chapter will discuss research methodology including sampling methods, research preliminary plan and the two phases of data collection, which will be discussed in detail.

Chapter Five: Methodology

5.1 INTRODUCTION

This research aims to show the significance of cloud computing utilisation in SMEs to improve productivity, and ultimately achieve competitive advantage. The absence of academic research in adopting cloud services for Australian SMEs was previously noted. This research addresses the need to identify critical success factors in cloud computing by SMEs, and also shows the need to have improved understanding of challenges in utilising cloud computing by SMEs in Australia. This research aims to provide a benchmark on the status of SME utilisation of cloud computing in the Australian context. Enhancing understanding in these areas provides insights into how SMEs can use cloud computing to improve their competitive position.

The previous chapter covered theoretical concepts in conducting information systems and social science research studies, describing research orientations, purposes, and epistemologies. Additionally, the previous chapter discussed the most commonly used theories in conducting similar studies. The chapter started by explaining deductive and inductive theories briefly, followed by providing a conceptual view of Upper Echelon Theory (Hambrick and Mason, 1984, Dwivedi et al., 2009a, Geyer, 2016), Diffusion of Innovation Theory (Yigitbasioglu, 2015, Conrad, 2009, Hong and Zhu, 2006, Grandon and Pearson, 2004), the Technology Acceptance Model (TAM) (Davis et al., 1989, Yigitbasioglu, 2015, Autry et al., 2010, Paul Jones et al., 2013), Resource Based Theory (Carcary et al., 2014, Garrison et al., 2012, Yigitbasioglu, 2015, Caldeira and Ward, 2003), and the *Technology, Organisation, Environment* (TOE) framework (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013). This background helps us understand the purpose of each theory in order to develop a research framework which in turn also acts as a contribution to the research presented here.

This chapter explains the methodology adopted for this research. The empirical stage started with determining the required data to examine the research question that followed by designing the data collection methods, which are an online questionnaire and semi-structured interviews. After that, the collected data will be analysed in order to test the hypothesis to confirm or reject it. The chapter starts by discussing the sampling method adopted, research design, the research preliminary plan, and research parameters and variables. After that the data collection and analysis techniques are described in more detail via two main stages - the *quantitative* phase in the form of surveys, followed by the *qualitative* phase in the form of semi-structured interviews.

5.2 SAMPLING METHODS

It is a fact in social research, there exists a difficulty in collecting data from everyone or every instance (Denscombe, 2014). Therefore, it is common that researchers collect data from a sample (portion) and hope the findings are applicable to the entire population (Denscombe, 2014). However, it is difficult to predict that collected data represents the wider population. In addition, sampling require careful selection, therefore researchers usually use one of two main sampling strategies - *probabilistic* or *probability* and *non-probabilistic sampling* techniques (Babbie, 2013, Denscombe, 2014, Hartas, 2015). Probabilistic sampling is a method of selecting samples of the population studied, where the researcher knows the selected sample will represent a cross-section of the population. This means that every element of the population is known and has a probability that more than zero will be included in the sample (Denscombe, 2014, Levy and Lemeshow, 2013). Non-probability sampling is conducted without knowledge of whether the collected samples represent the population or not (Hartas, 2015, Babbie, 2013).

5.2.1 Probability Sampling

Probability sampling includes several data collection methods including *Random, Systematic, quota, stratified, cluster and multi-stage sampling* approaches (Monette et al., 2013, Denscombe, 2014, Babbie, 2013, Hartas, 2015). Random sampling (Babbie, 2013) is a method of selecting a random and sufficient number of samples among the studied population. Selected samples should represent a cross-section of the population (Denscombe, 2014). The systematic method (Babbie, 2013) is a kind of random sampling, however researchers here use specific ideas or systems in collecting random samples. Stratified sampling (Denscombe, 2014) considers the equal opportunity for each sample to be selected in relation to its subset of the entire population, for example selecting samples from each age and gender category in the conducted study. The quota method (Denscombe, 2014) behaves similarly to the stratified method, but is usually used for marketing research by creating several categories or strata as these are referred to in market research. The main difference between quota and stratified research is that it is not important to conduct a strict random research method, where the researcher has the decision to select samples to fill the quotes, and indeed those samples might not be appropriate. In cluster sampling (Babbie, 2013), identifying relevant participating resources is critical and could start as a random selection. The collected samples will then be weighed against others using another approach. The multi-stage method (Babbie, 2013) selects samples from selected samples, in turn from other selected samples. This approach could be described as working from general to specific, where the selection sample process passes through several levels (Monette et al., 2013, Denscombe, 2014, Babbie, 2013, Hartas, 2015).

5.2.2 Non-probability sampling

Non-probability sampling is the opposite of the probabilistic approach. Elements do not have equal chance to be included in the sampling process, and it is crucial to define the characteristics of the elements included as it is not a random sampling. Researchers use the non-probability approach for several reasons (Denscombe, 2014), where the most common reasons are:

- Information insufficiency about the population to conduct probabilistic sampling.
- Unclear visibility to include an adequate number of samples in the study.
- Encountering major difficulties in contacting samples in order to use the probabilistic approach.

The non-probabilistic approach contains different sampling methods, including *purposive, snowball, theoretical,* and *convenience* sampling techniques (Bryman, 2012, Denscombe, 2014, Hartas, 2015). Purposive sampling (Denscombe, 2014) is based on selecting samples for a specific purpose that presents a specific event or relevance to the studied topic. Purposive sampling is also known as the *hand-picked* method. In the convenience technique (Bryman, 2012), the items involved are selected at the researchers' convenience, that is *first to hand* (Bryman, 2012, Denscombe, 2014, Hartas, 2015). The disadvantage of using the convenience method appears in the difficulty of generalising findings, as researchers do not know if the samples studied represent the population, but it could be very useful to provide guidance for future research in the area. The snowball method (Hartas, 2015) is influenced by social connections. Researchers start with a small number of samples and ask participants to suggest or connect them to other people included in the study. This approach is considered a kind of convenience sampling, but attracts more attention and interest from researchers. In theoretical sampling, researchers discover selected elements in several stages during development of grounded theory and use them to confirm or edit the theory developed (Bryman, 2012, Denscombe, 2014, Hartas, 2015).

The research presented here is based on convenience sampling. The main reason for using convenience sampling is due to major difficulties in collecting SME data. The difficulties encountered are described in more detail in the survey section of this chapter.

5.3 RESEARCH DIMENSIONS

Scientific research can be designed using several well-known concepts based on research methods and objectives (Bryman, 2015), including cross sectional, experimental, longitudinal, case study (Bryman, 2015, De Vaus and de Vaus, 2001), and comparative design (Bryman, 2015).

The *cross-sectional study* is one of the well-known research approaches. It attempts to study a few selected features of different cases in the same time frame (Rindfleisch et al., 2008, Neuman, 2010). Cross sectional studies usually include anywhere from 30 to 3000 cases (Neuman, 2010). Mostly, surveys and structured interviews are used in quantitative and qualitative studies in cross sectional research (Bryman, 2015). As such this approach is also called survey design research (Bryman, 2015) and can be used for exploratory, explanatory or descriptive studies, but is preferentially used in the latter (Neuman, 2010).

Experimental research is one of the less commonly used designs in social research (Bryman, 2015, De Vaus and de Vaus, 2001). Generally, researchers in experimental studies tend to control the conditions and relationships between variables included in the study (Herbst and Coldwell, 2004). These conditions involve the location, time and duration of the study (Cash et al., 2016). Experimental research could be considered basic with one variable or complex (statistical) with many variables (Herbst and Coldwell, 2004).

A *longitudinal study* examines parameters over a long period of time (Venkatesh and Vitalari, 1991, Rindfleisch et al., 2008), potentially as long as decades (Neuman, 2010). These features make longitudinal studies distinct from other methods, because of the over-consumption of time and related costs in conducting the proposed study (Bryman, 2015). The purpose of this type of research is very close to the experimental research concept, except that the longitudinal approach has only experimental groups without a control group (De Vaus and de Vaus, 2001).

Case study research (Yin, 2013) is the opposite to a cross sectional study. It aims to study many features in detail regarding locations, firms, events, individuals or groups in low numbers of cases. Most case study research tends to be qualitative, but not all (Neuman, 2010, Yin, 2013). This approach focuses more on comparing studied cases than studying each case independently (De Vaus and de Vaus, 2001). It is also considered a good source to provide rich in-depth data and to understand situations and generate theories (Neuman, 2010, Dodier et al., 1994).

The purpose of this research was to examine a large set of Australian SMEs in the same time frame, that is, the adoption of cloud computing in 2015 and 2016, to explore adoption rates, critical success factors, and challenges. Therefore, the research requirements led to a cross sectional design for this study.

5.4 RESEARCH PRELIMINARY PLAN

An important element is understanding the time frame of the study (Bryman, 2015, De Vaus and de Vaus, 2001). Designing the research dimension is usually based on six main factors, which are the number of studied groups, the pre and post-test phases, allocating cases to group methods, and the nature and number of interventions (De Vaus and de Vaus, 2001). This study targets Australian SMEs in all industry sectors nationally. The data collected includes an analysis of each of the major industry sectors including information technology, recruitment agencies, education, tourism, supply chain and finance.

5.4.1 Research Mixed Method

This research methodology is based on a mixed method of quantitative and qualitative approaches in the form of surveys and semi-structured interviews, used in similar studies to obtain insights for examining the research questions (Trigueros-Preciado et al., 2013, Teddlie and Tashakkori, 2009).

The design of the mixed method research uses one of the common approaches that include *Convergent Parallel, Explanatory Sequential, and Exploratory Sequential* methods (Creswell, 2013). In the convergent parallel method, researchers combine quantitative and qualitative data to provide a comprehensive study. This combination is conducted at almost the same time (Creswell, 2013, Teddlie and Tashakkori, 2009). The explanatory sequential method starts by conducting the quantitative stage first. This includes collecting and analysing the data, in order to design the qualitative stage of the research (Creswell, 2013, Teddlie and Tashakkori, 2009). The exploratory sequential mixed method works opposite to the explanatory method. It starts by conducting the qualitative stage in order to understand the views of the participants to design the quantitative study (Creswell, 2013). In some complicated designs, mixed methods tend to be iterative explanatory sequential or iterative exploratory sequential to reach a specific point in the conducted research (Teddlie and Tashakkori, 2009).

This research follows the sequential mixed method by starting initially by a quantitative survey to explore adoption rates and critical success factors with regard to adopting and utilising cloud computing by Australian SMEs whilst at the same time inviting participants to partake in planned interviews. The qualitative section focused on exploring success factors in more detail and the challenges that companies encountered before, during and potentially after adopting cloud computing.

5.5 RESEARCH EXPLANATORY FRAMEWORK

The main framework of this research was adopted from *Resource Based Theory* (RBT) (Grant, 1991, Wernerfelt, 1984, Dwivedi et al., 2009b). RBT assumes availability of organisational resources will improve capabilities of an organisation to gain competitive advantage and achieve strategic goals (Grant, 1991, Wernerfelt, 1984, Dwivedi et al., 2009b).

The exploratory nature of this research excuses the need of having a hypothesis, as a hypothesis expects or predicts relationships among events or variables (Cargan, 2007, Lehman et al., 2013), although the research has several parameters and variables to explore, as shown in the next section.

5.6 RESEARCH PARAMETERS AND VARIABLES

Research parameters are attributes or numeric values of the estimated collected data of the research population (Lavrakas, 2008). An example of a parameter from this research is whether cloud computing is useful or not. This parameter works in its simplest form to obtain true or false answers that would help to answer the research question itself.

Variables are defined as the studied concepts that accept more than one value (Neuman, 2010, Lehman et al., 2013). These values are called attributes of the variable that describe the features of a studied population (Neuman, 2010, Lehman et al., 2013). For example, gender is a variable that accepts different values (attributes) - male or female. Occupation is another variable that accepts several attributes, such as professor, doctor, engineer…etc. (Babbie, 2013). An example from this research is the type of service delivery model of cloud based service used by SMEs. One variable could be acceptance of *Software as a Service* (SaaS), *Platform as a Service* (PaaS), Infrastructure *as a Service* (IaaS) or another service delivery model.

Variables can be *independent* or *dependent*, (Denscombe, 2014, Neuman, 2010) or perhaps *intervening* (Neuman, 2010). Independent variables are able to affect the dependent variable (Denscombe, 2014, Bryman, 2015, Bryman, 2012), while intervening variables are a temporary or causal link between variables; they have an important but temporary dimension in the research (Neuman, 2010, Adler and Clark, 2014).

This research examines several variables through the first stage of the quantitative surveys and via the second stage of the qualitative semi-structured interviews. The survey phase examined the adoption rate of cloud computing and explored critical success factors as well as barriers to the adoption of cloud solutions to SMEs in Australia. The second stage investigated drivers and challenges in utilising cloud computing, as well as best practices through twenty (20) in-depth interviews with IT decision-makers.

Based on the literature review and conceptual framework developed in the previous chapters, the parameters and variables of this study follow the structure of the framework. The variables are based on the literature review. These variables are classified into three main categories based on the TOE framework, which are technology, organisation, and environment.

The survey included four sections to better structure the post-survey interviews to obtain insights on the possible drivers and challenges in adopting cloud computing by Australian SMEs. The adoption rate of cloud adoption was investigated in the survey and therefore was not included in the post-survey interviews. The detailed description of the parameters and variables are described later in this chapter under the survey and interview sections.

The next sections of this chapter explain phases 1 and 2 in more detail.

5.7 PHASE 1

The previous chapter showed the conceptual framework based on a combination of exploring the approximate adoption rate, the TOE framework, as well as RBT. Both phase 1 and 2 use the conceptual framework to guide the study.

The first phase used a structured survey to explore the adoption rate of cloud computing by Australian SMEs and to highlight the success factors and challenges. The survey design included screening questions to ensure that the respondent was within the Australian SME definition, which is including organisations that have from 1 to 199 employees (Clark et al., 2012).

The examined factors; as drivers and challenges; fit within the three categories of the TOE framework (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013), which is a main section of the research conceptual framework. The TOE based classification was used to understand the enterprise's resources to achieve competitive advantage that distinguishes a company from its competitors in line with RBT theory (Carcary et al., 2014, Garrison et al., 2012, Yigitbasioglu, 2015, Caldeira and Ward, 2003).

The technology perspective included IT capabilities and infrastructure required for providing an organisation with functionality, flexibility and scalability (Leavitt, 2009). These resources include the availability of technical knowledge and skills as well as physical resources - such as storage, communications, and networks (Misra and Mondal, 2011). The organisational perspective covers human resources; including business and IT personnel required for successful cloud computing. This perspective also included senior executive management to examine the effect of their support on the successful adoption of the cloud. The environmental perspective included the relationship with IT providers; this was based mainly on trust between the cloud consumer, the organisation that utilises the cloud and cloud providers (Garrison et al., 2012).

5.7.1 Quantitative Research Approach

The research project started with a quantitative study in the form of a survey, followed by a qualitative approach in the form of semi-structured interviews (Neuman, 2010). Quantitative methods are a group of techniques that use quantitative data to answer research questions by using statistical packages, tools and techniques to understand the results and to test relationships among variables under study (Recker, 2013, Creswell, 2013, Mahoney and Goertz, 2006). Quantitative approaches commonly consist of two pillars. Quantitative data represents the first phase of this research, which focuses on numerical analysis with a positivist philosophy concerned with a realist (reality that is fixed, objective and simple) and a objectivist ontology to describe reality (Recker, 2013).

In general, using quantitative research methods typically starts through generating theories and hypotheses, then developing research methods, followed by data collection. Data analysis is the next step followed by evaluation of the results. Scientific research is used to start developing a theoretical model (Recker, 2013, Creswell, 2013), however, quantitative methods are mostly applied to confirm well-defined theories (Recker, 2013, Creswell, 2013). These methods could be in several forms, such as surveys, lab and/or field experiments, case studies, archival analysis, and focus groups (Recker, 2013, Creswell, 2013).

The first phase of this research used a quantitative approach in the form of a survey. The entire process of this stage is shown in the following Figure 5.1.

Figure 5.1: Quantitative Research Process (adapted from (Recker, 2013)

Starting from conceptualisation, two theories were adopted to inform the study. These theories were discussed in-depth in the theory chapter. RBT (Grant, 1991) was used to examine the availability of organisational resource. These resources could potentially increase organisational capabilities that could lead to competitive advantage. (Grant, 1991). The TOE framework (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013) was used to classify factors into three main categories that are linked to input to the first element of RBT theory. The first element is to explore the availability of the organisational resources. The data collection phase at this stage was based on a quantitative survey designed as an online survey, which targeted a significant number of Australian SMEs. The very limited responses to the online survey led to a change in plan from online to onsite visits. The next section discusses the how the survey was conducted.

5.7.2 Survey

Survey research is one of the non-experimental quantitative research methods used to collect information about attitudes, actions, characteristics, and opinions of a large subset of organisations, units or people, called a population (Recker, 2013, Bryman, 2015). Surveys are used for *exploration*, *explanation*, or *description* (Recker, 2013, Bryman, 2015). Exploratory survey research is used to increase knowledge and awareness of a specific topic or phenomenon. It uses variables and measurements to obtain more details as well as to explore new opportunities and limitations about a topic. The second purpose of the exploratory survey is to test theories and to find relations among variables. In contrast, theory will not be tested in a descriptive survey which is used to explore opinions, trends, events, and situations of a well-known topic (Recker, 2013, Bryman, 2015).

5.7.3 Characteristics of the respondents

This survey focused mainly on possible IT stakeholders and decision makers in adopting and utilising cloud computing in Australian SMEs. Most of the factors examined needed to be answered by respondents who had sufficient knowledge of technical, organisational and environmental aspects of the organisation. Therefore, this survey targeted several classifications of IT professional, namely:

1- Chief Information Officers (CIOs) – i.e. the head IT person in any firm.
2- Chief Executive Officers (CEOs).
3- Decision Makers – those with any IT decision making authority.
4- IT Department managers.

During and after the survey, if the participant did not have sufficient knowledge to understand or answer any section of the survey - such as “the employee numbers in the firm” or “does the company use cloud computing technologies?”, then their responses were excluded from the data analysis in order to obtain more accurate results.

It was important to ensure that the respondent had the appropriate level of expertise to answer the questions in the survey. The study used the *Australian Computer Society* (ACS) classification of IT professionals to ascertain the level of technical expertise:[11]

- Associate: entry level individuals and students.
- Members: IT certified professionals or certified individuals on specific technologies.
- Senior Members: professionals who have practiced IT for at least 10 years including 5 years in a senior IT management position.
- ACS fellow: a member with a significant contribution to the Australian IT industry.

In order to ensure participants possessed the required level of knowledge to answer the questions, the associate level was excluded because associates are likely to have limited knowledge especially in organisational and environmental aspects. This was so that the data was collected from IT decision makers with regard to organisational adoption of cloud computing.

[11] https://www.acs.org.au/become-a-member/grades

5.7.4 Survey Research Procedure

The survey went through several iterations from analysing the literature, selecting relevant theories and finally developing the exploratory research framework. These steps were then followed by other stages, summarised in figure 5.2.

Phase	Task	Outcomes
1	Survey Components Development	Theoretical structure of the survey components and the relationships among them.
2	Measurement Development	Designing measurement factors to survey results.
3	Survey Design	Designing the first version of the complete survey.
4	Selecting data source	Several databases have been compared in order to use their contact information for contacting participants.
5	Survey Testing	Pre-test and pilot surveys have been run to check, refine, and to validate the questions.
6	Survey Distribution	The survey was firstly distributed online. The low response rate led to a change of plan by distribution based on on-site visits. Some 470 valid entries were collected.
7	Data Analysis	Discussed in detail in the quantitative data analysis chapter
8	Results	Discussed in detail in the quantitative data analysis chapter

Figure 5.2: Survey Research Procedure (adapted from (Recker, 2013)

5.7.5 Survey Components

The purpose of the survey was to investigate the parameters of adoption rates and critical success factors of utilising cloud computing from technical, organisational and environmental perspectives. The survey sections are shown in Figure 5.3.

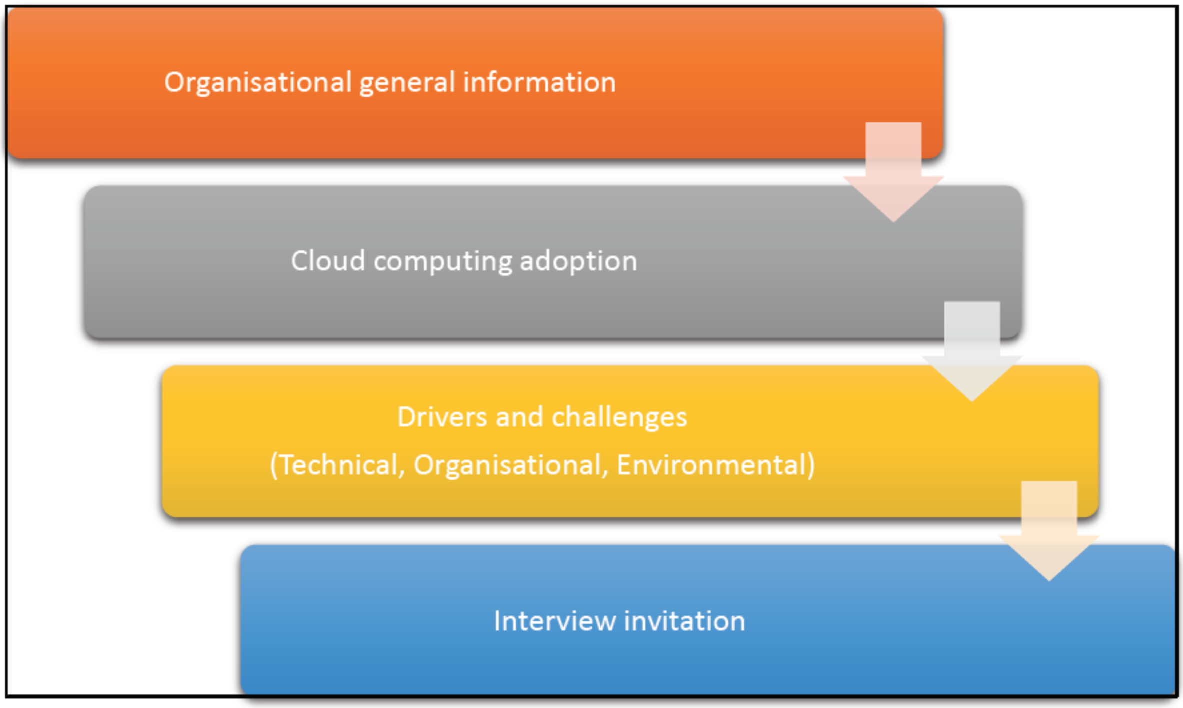

Figure 5.3: The conceptual view of the survey components

The first section of the survey was to confirm that the organisation met the Australian SME definition, for example the location, number of branches, and number of employees to confirm it is an Australian organisation consisting of 1 to 199 employees (Clark et al., 2012). The parameters and variables of this section are provided in table 5.1.

α Note: in table 5.1, the selected groups of staff numbers are based on definitions from the Australian Government (Clark et al., 2012):

- The first group (1-4 employees) represents micro organisations in the Australian context.
- The second group (5-19 employees) represents small organisations.
- Groups (20-50, 51-100, 101-150, and 151-199 employees) show medium organisations, divided into 4 groups to study trends more specifically in this large subset. The main reason for this classification is because some small organisations do not like to move toward cloud computing (Lin and Chen, 2012). Therefore, it was planned to divide

medium sized organisations into four groups to study the correlation between the organisation's size and the adoption rate.

- The last group (>=200 employees) represents large organisations, outside the scope of this research - therefore excluded before analysing the collected data.

Table 5.1: Parameters and variables of the first component

Parameters/Variables	Purpose	Answers
Number of branches	To examine the trend of cloud adoption - if the organisation has one office or more. As the firm size could affect the adoption (Low et al., 2011, Misra and Mondal, 2011).	Various
Location	To investigate the adoption rate based on the city's size (Behrend et al., 2011, Kuo, 2011, Senarathna et al., 2016)	Vary
Number of staff	To see trends of Australian SMEs, depending on number of employees (Low et al., 2011, Misra and Mondal, 2011).	(1-4, 5-19, 20-50, 51-100, 101-150, 151-199, or 200+) $^{\alpha}$.

The second section of the survey investigated the adoption status of cloud computing. This section asked technical background questions to investigate the status of cloud service use. This part of the survey was comprised of three components. To ensure that the respondent had sufficient technical understanding, one of the questions was to specify the name of the utilised service.

Before investigating the availability of cloud computing services in the organisation, each respondent was asked whether their company had its own data centre. This was to investigate the relationship between availability of data centres and the use of cloud services (Fox et al., 2009). Parameters and variables of this section are shown in table 5.2:

Table 5.2: Parameters/variables of the second component

Parameters/Variables	Purpose	Answers
Availability of data centres	The effect of existing data centres of cloud computing adoption.	(Yes/No)
Use of enterprise cloud services	Helps in answering the adoption rate question by showing the range of Australian SMEs utilising cloud enterprise services.	(Yes/No) + Specifying the product (optional)
Use of enterprise versions of consumer services	Show individual consumers' cloud services, including off-the-shelf services such as Outlook or Gmail. To better understand the degree of cloud computing.	(Yes/No) + Specifying the product (optional)

The third section of the survey sought to understand the adopted cloud service delivery model(s) – SaaS, PaaS, IaaS – and the cloud computing deployment model(s) – public, private, hybrid, community – to explore the most preferred solution by SMEs. The third section of the survey also explored drivers such as success factors and challenges to implementing successful cloud computing solutions that were categorised within the components of the TOE model. In the technology category, the explored factors were security and privacy (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010), setup time (Khurana and Verma, 2013, Dillon et al., 2010), performance (Victories, 2015, Alliance, 2011, Harding, 2011, Sadiku et al., 2014), availability (Harding, 2011, Alliance, 2011, Dillon et al., 2010), accessibility (Jadeja and Modi, 2012, Marston et al., 2010), scalability (Khurana and Verma, 2013, Herbst et al., 2013, Cearley and Reeves, 2011), better maintenance (Fox et al., 2009, Khurana and Verma, 2013, Dillon et al., 2010, Dikaiakos et al., 2009) and complexity (Jadeja and Modi, 2012). The organisational category included the cost; cost saving, setup and operational cost (Rafaels, 2015, Marston et al., 2010, Singh et al., 2015, Carroll et al., 2011, Victories, 2015, Girola et al., 2011); business process (Isom and Holley, 2012, Stammer and Wilson, 2013), business agility (Kim, 2009), operational time saving (Marston et al., 2010, HBR, 2014), business outcomes (Marston et al., 2010, HBR, 2014, Avram, 2014), and supporting business strategy (Isom and Holley, 2012). While the environmental category, the factors were hosting location, backup location, government regulation (Ashrafa, 2014, Kshetri, 2013, DoC, 2014, Gershater, 2012), trusted vendor, vendor services (Ashrafa, 2014, Kshetri, 2013), controlling the IP, and relationship with the customer (Marinos and Briscoe, 2009, Benkler, 2004). These factors were identified from the literature. Each factor could potentially act as a driver or a challenge. Therefore, all factors in the TOE were linked to both critical success factors and challenges in the RBT section of the developed framework.

Table 5.3 shows parameters and variables of the third section of the survey. This section examined factors in technical, organisational and environmental categories as drivers and challenges. This examination was to investigate successful adoption and use of cloud computing by Australian SMEs as resource enabling organisations to improve productivity and achieve competitive advantage.

Table 5.3: Parameters and variables of the third component

Parameters\Variables	Purpose	Answers
Service delivery model	To understand the preferred service delivery model.	(SaaS, PaaS, IaaS, or other)
Service deployment model	To understand the most preferred service deployment model.	(Public, Private, Hybrid, Community)
Key factors of utilising from the cloud	To investigate drivers of cloud computing.	A scale from 1 to 10 for each factor in the TOE section in the survey framework where 10 is very important and 1 is least important$^{\beta}$.
Challenges that avoid adopting cloud services	To investigate obstructions to cloud computing.	

β: the importance level could be the same among more than one factor – e.g. all of security, cost, accessibility could have a weighting of 7/10 in importance.

The survey section informed the research conceptual framework by adding the most common success and challenge factors in adopting and utilising cloud computing to each of the main three components of the TOE section, to comprise the following in figure 5.4:

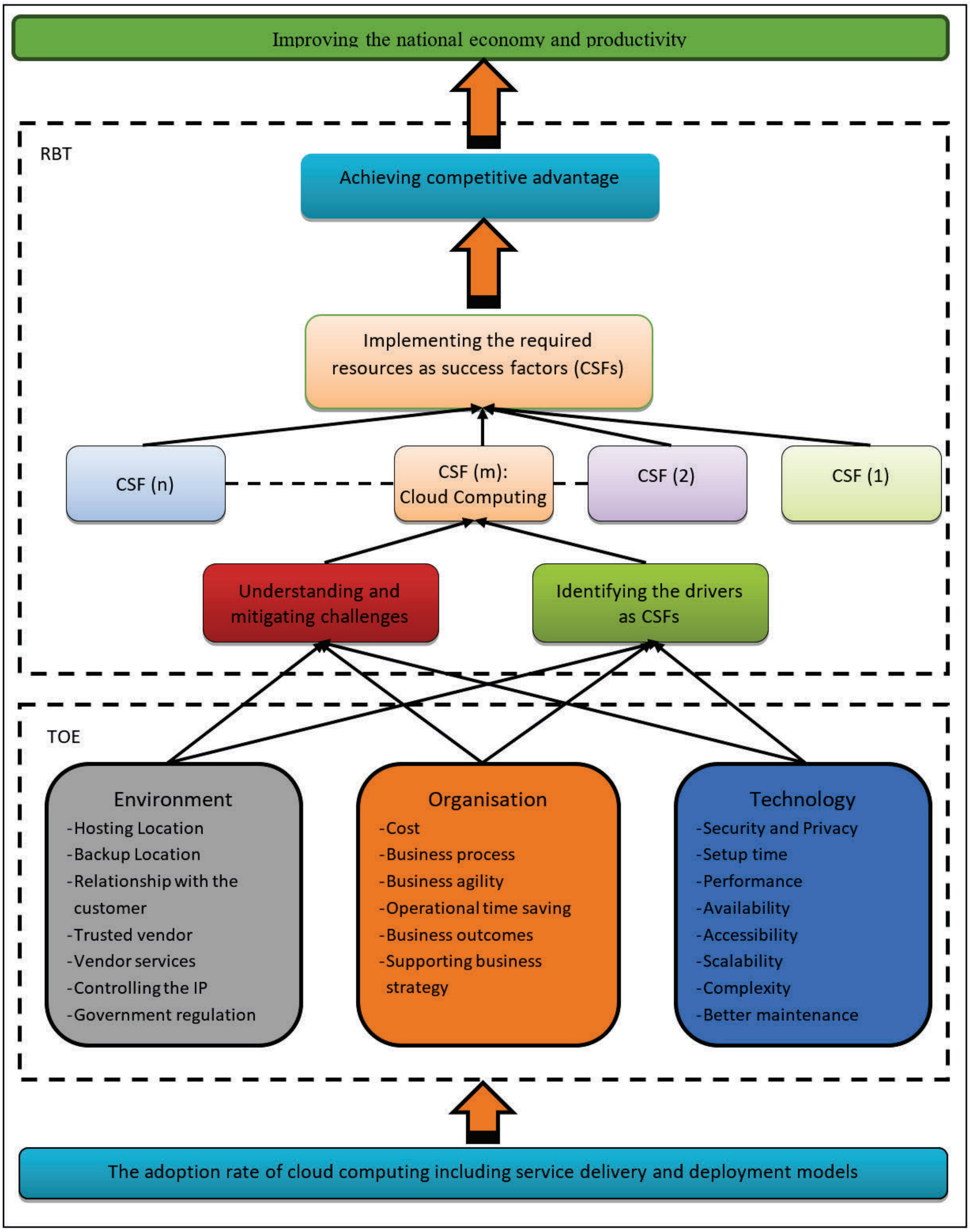

Figure 5.4: The research framework developed for the survey

5.7.6 Pilot survey

The instrument development pre-test stage was conducted to test the survey in general to determine the visibility and difficulty of its contents. Some 20 IT professionals tested the survey which included 3 from a large enterprise and 17 from local SMEs. Five of the 20 were IT managers and decision makers, seven were senior IT professionals, and eight were SME business owners. All comments received from the pilot were scrutinised to re-arrange, re-state, and re-define some of the written questions.

A pilot survey acted as the final stage of the initial survey. There are in general two methods of conducting a pilot survey, which are declared and undeclared pre-test (Grigoroudis and Siskos, 2009, Naumann and Giel, 1995). In the declared pre-test, participants will be informed that this is a pre-test stage (Grigoroudis and Siskos, 2009, Naumann and Giel, 1995). There is no limit or rule to follow in assigning the sample size of a pilot study, where the most important issue is to make sure the developed survey is understandable, well-structured and well-organised (Naumann and Giel, 1995, Stopher, 2012).

A pilot survey was conducted as a declared pre-test study via a paper-based survey with another 20 participants. This stage included 1 IT manager, 4 IT professionals, 9 SMEs owners, and 6 SMEs managers. The main purpose of this survey was to refine the main research questions, structure, and presentation before conducting the survey. This stage helped to finalise the contents and structure of the survey.

Participants from this stage mentioned that exploring challenges could include different factors as challenges, which might appear when exploring the drivers. This view was considered in the survey when studying the possible challenges from adopting cloud computing. From the research framework, it was suggested to restate some factors to deal with the nature of being a challenge rather that a success driver. Participants suggested to change factors from "*improving business outcomes*" to "*the business does not need any cloud service*" as they felt the first step in improving outcomes was admitting the business needed the cloud service. Although some SMEs might adopt cloud computing to assign the tasks of controlling their systems and IP address to a third party, non-adopters might resist doing so and they preferred internal control. Therefore, when it came to challenges, the factor "*controlling IP*" was re-written to "*in-house data control*". In addition, selecting a trusted vendor could be one of the utilising cloud computing drivers. However, non-adopters might not trust the idea of migrating fully or partially to the cloud. Therefore, the success factor of "*trusted vendor*" was changed to "*lack* *of overall trust*” when it came to challenges. Furthermore, some organisations might have different views in regard to security and privacy. This led to separating data privacy from security as two independent challenges.

The feedback from the pilot study also suggested adding some other challenges that an organisation might encounter in an attempt to adopt new technology - such as cloud computing. These challenges were added to the list, which were lack of understanding cloud computing, lack of technical resources, lack of executive support, lack of management support, communication & internet issues, implementation issues, operational issues, shortage of professional staff, lack of the provided services and international regulation.

5.7.7 Survey First Run

After refining the questions in the pilot stage, the survey was sent to more than 700 organisations via email. The goal was to ensure the survey was visible and executable. The second goal was to obtain a high response rate as well as satisfactory responses and obtain valuable comments. Unfortunately, the response rate was very disappointing with responses obtained from 3-4% of the entire sample. This issue required investigation (Fakieh et al., 2014).

Survey length plays an important role in the response rate. A marketing study (Deutskens et al., 2004) investigated response rates to online surveys and showed that the response rate to a short survey was 24.5% compared with 17% for a long survey. It is also far more likely for respondents to leave long surveys before completing them than is the case with short versions (Deutskens et al., 2004). Therefore, we expected to find many participants commenced but terminated somewhere through the survey. However, there were only 10 participants who completed a few questions and discontinued the survey permanently. The majority did not even attempt the survey.

Discussion

According to the effect of the survey length, it was assumed participants might consider the survey too long. The reasons behind this were that the invitation email was a bit long and did not convince email recipients to participate. Another drawback in the initial version was that there was no *opt-out* link to unsubscribe from the mailing list - this may have led some email servers to consider it spam and avoid delivering the invitation. Moreover, the invitation addresses a general audience with “Dear Sir/Madam”. Figure 5.5 shows the original version of the invitation.

ɔud Computing for Australian organisations Survey

Inbox x

Bahjat Fakieh <noreply@qemail 10:51 AM (3 minutes ago)

to bahjat.fakieh

Dear Sir/Madam,

You are being invited to participate in a research study about exploring the critical success factors and challenges of utilizing cloud computing for Australian small and medium organisations. This study is being conducted by Bahjat Fakieh, from the Department of Computing at Macquarie University as part of a PhD research project.

This research study targets Chief Information Officers (CIOs), Chief Executive Officers (CEOs), IT Decision Makers, IT Department managers and IT researchers. It would be appreciated to pass this invitation to the targeted group of your colleagues

The questionnaire will not take more than 10 minutes to complete.

If you could take a few minutes to complete the questionnaire, that would be much appreciated.

Please follow this link to the Survey:

This link

Figure 5.5: Invitation email. v.1

Therefore, the invitation email was refined in order to be more personal. Each invitation started with the first and last name of each participant. It was expected the personalised invitation would provide a positive impression to convince the recipient that he/she is the exact target of the invitation. For this next round, a new database contact list with individual rather than generic email addresses was used. Moreover, the invitation showed the expected time and pages to complete this survey to encourage completion.

5.8 DATA GATHERING PROCESS

Due to the nature of this study, a contact database to email companies to invite them to participate in the study was required. At the inception stage of this study, Macquarie University library had an online subscription to provide such a list. However, before distributing the survey the library subscription was cancelled. Other available free options were found with very limited sizes - roughly 100 to 300 valid emails. Therefore, a commercial contact database of email addresses was used to send electronic invitations. Access to the database required a payment for access to the email addresses. The main reason for using the paid option was due to response rate from the first run, which was around 3~4%. Based on a study that predicted the response rate of a long survey is about 17% (Deutskens et al., 2004), if the free database provided the same result, this would mean 300 x 17% = 51 participants only.

5.8.1 Subscription lists

The marketing research industry (Burns and Bush, 2013) in Australia has many paid options to provide contact lists to researchers and business organisations. The main features of the paid options are summarised in the table 5.4:

Table 5.4: Features of paid contact lists

No. of provided emails	1000+	
Payment options	Renting	Affordable, but provides limited trials only. Thereafter required to pay for each extra trial.
	Purchasing	Expensive, but allows ownership and unlimited use of database.
Targeted contacts	Generic	Provides list of generic business emails. Very high number of contacts in the sample space, but difficult to target specific groups.
	Specific	Ability to target specific groups, such as IT managers. However, number of contacts in the sample space significantly lower than generic lists.

5.8.2 Australian B2B database[12]

In the initial stage of this study, the online survey sought to use the *Australian B2B* database, accessible via (http://www.jpmmedia.com.au/australian-b2b/) containing a list of more than 47,000 Australian companies, of which more than 24,000 were SMEs. This database provided the ability to select certain criteria, such as number of employees, industry, and/or specific Australian states if required. Therefore, this database was planned to be used for phase 1 data collection (Business, 2014). This database would be perfect for targeting organisations in general by providing a large number of contacts. However, the generic contacts seemed less relevant in a study attempting to target specific groups, such as CIOs. Therefore, an alternative was sought.

[12] http://jpmmedia.com.au, Accessed at: 20-05-2013

5.8.3 Media M Group Database[13]

Media M Group is a marketing company that provided access to around 2,400 IT professionals/CIOs via both rent or purchase approaches in 2014.[14] The number of contacts in the sample is significantly lower compared to the generic option above (47,000). However, the experience from the first run of the survey led to expectations of a higher response rate if using this more specific list. Therefore, this option was selected to collect data, by renting the use of the database for three trials (the main invitation plus two reminders) through personally paying around AU$2,700.

5.8.4 Running the Online Survey

The survey was deployed online via *qualtrics.com*; a major electronic survey provider used for many purposes, such as academic research, market research, concept testing and employee feedback. *Qualtrics.com* is used widely in different fields, such as technology, health care, financial services, telecommunication, manufactures and travel. It is also used in 75 countries by more than 5,000 customers/organisations (Qualtrics.com, 2014). The main reason for using *Qualtrics.com* was the support provided by Macquarie University to use *Qualtrics.com* for free for educational and research purposes.

For an expected response rate of only 17% (Deutskens et al., 2004), responses of around 2,400 x 17% = 408 businesses were expected. Unfortunately, once again the response rate was very disappointing at only 1% - that is 24 companies.

5.8.5 Onsite Visit

This very low response rate led to yet another re-examination of alternative methods for collecting the data. The only available option seemed to be personal visits to businesses in combination with online invitations to other Australian cities. Around 1,000 businesses in 6 major Australian cities were visited from date to date in Sydney, Melbourne, Brisbane, Canberra, Wollongong and Newcastle, plus 11 surveys received an online invitation. According to the Australian Bureau of Statistics, the estimated resident population of each of the visited cities in 2015 is shown in Table 5.5 (ABS, 2016):

[13] http://www mediamgroup.com.au, Accessed at: 20-05-2013
[14] *Media M Group* recently changed its business direction - currently, they are focusing on the pharmaceutical industry.

Table 5.5: Population in the cities visited (source: (ABS, 2016))

City	Population (in Millions)
Sydney	4.9
Melbourne	4.5
Brisbane	2.3
Canberra	0.42
Newcastle	0.4
Wollongong	0.3

This data collection process took 8 months between distribution and collection, from January to early September 2014. All data was entered and uploaded to the *Qualtrics.com* database in order to obtain a reliable, unified and accessible format of the collected data whilst at the same time taking advantage of the Qualtrics cloud computing platform, meaning the data was handled by an external party.

After discussing the characteristics of the survey, the next section discusses phase 2 of the data collection.

5.9 PHASE 2

The qualitative approach followed the quantitative phase to delve further into the quantitative data to obtain rich, detailed data to answer the research questions. The findings from the first phase; which was discussed in chapter 6; informed and helped prepare questions for the qualitative phase. The survey included a question asking participants whether they would be willing to participate in semi-structured interviews. If they answered yes, they were contacted for interviews for phase two of the research. In phase 2, an exploration of the business case including the influences and challenges of adopting cloud computing were conducted via semi-structured interviews. Depending on the number and variety of the participated' industries, the targeted interviewees were selected from different industries, such as IT, finance and education in line with similar research approaches (Trigueros-Preciado et al., 2013).

The interviews were classified according to business location, such as metropolitan or country areas. Each organisation was studied from three different viewpoints based on the TOE framework that identified possible parameters as resources for successful cloud adoption to improve productivity, and gain competitive advantage in line with RBT theory. The challenges arising from interviews were classified within the three TOE categories, which are technical, organisational, environmental (Yigitbasioglu, 2015, Lian et al., 2014, Alshamaila et al., 2013).

The survey in the first phase provided further insights regarding possible challenges that could face Australian SMEs when adopting cloud based solutions. It gave the opportunity to design the interview by including the most common issues. A list of 24 expected issues were investigated after categorising them within the three main categories of the TOE framework.

The technical section of the survey discussed the possible technical challenges faced and how to overcome them. This included data security (Kuyoro et al., 2011, Arpaci et al., 2015, Kim et al., 2009, Trigueros-Preciado et al., 2013), data privacy (Kim et al., 2009, Arpaci et al., 2015, Leavitt, 2009, Senarathna et al., 2016), integration with legacy systems (Kuyoro et al., 2011, Kim et al., 2009), perceived loss of data control (Kuyoro et al., 2011, Leavitt, 2009), availability (Kuyoro et al., 2011, Kim et al., 2009, OAG, 2014), customisation (Kuyoro et al., 2011), quality of service (QoS) for these services (Kuyoro et al., 2011, Trigueros-Preciado et al., 2013, OAG, 2014), understanding technical concepts (Arpaci et al., 2015), and complexity (Low et al., 2011).

The organisational section investigated challenges from inside the organisation, such as senior executive management support (Low et al., 2011), cost and ROI (Low et al., 2011, Misra and Mondal, 2011, Kim et al., 2009, Trigueros-Preciado et al., 2013), skilled personnel to help in integrating and dealing with cloud based solutions (Arpaci et al., 2015), IT governance, organisational policy, assignment of measures of service (Misra and Mondal, 2011), the acceptance level from personnel to migrate from on-premise solutions to the cloud (Arpaci et al., 2015), and the fear of potential IT job loss (Khajeh-Hosseini et al., 2010).

The environmental view focused on challenges the organisation faces from outside. The challenges are cloud service performance (Kuyoro et al., 2011, Kim et al., 2009), location of data centres (Misra and Mondal, 2011), international regulation (Leavitt, 2009), vendor's regulation (Kuyoro et al., 2011, Leavitt, 2009), trust between the organisation and cloud vendor (Kuyoro et al., 2011), government requirements (Kim et al., 2009, OAG, 2014), copyright (Fox et al., 2009), and network bandwidth (Fox et al., 2009), which was also suggested by participants in the pilot survey to explore the effect of national internet bandwidth.

Information gathered from phase 2 provided the rich data required to obtain insights into how Australian SMEs utilise cloud computing technologies to achieve competitive advantage. A potential output as a conclusion to this research was the development of a framework that would potentially help SMEs adopt and use cloud computing as an enhanced solution to their business processes.

5.9.1 Qualitative Research Approach

Qualitative approaches tend to understand and investigate the meaning of groups and individual views regarding human or social issues (Creswell, 2013, Bryman, 2015). This approach focuses on the results of participants' issues that are translated to offer comprehensible meaning (Mahoney and Goertz, 2006). Usually, qualitative research consists of questioning participants, analysing and interpreting data, and generating themes in order to create a report or link it to the research framework (Creswell, 2013). Therefore, the data in the qualitative approach focuses on words rather than on numbers as in the quantitative approach, in order to find a link between theory and the research conducted (Bryman, 2015). The most commonly used designs in qualitative approaches are narrative research (Creswell, 2013, Mahoney and Goertz, 2006) to let individuals talk about their stories (Creswell, 2013, Mahoney and Goertz, 2006), phenomenology (Creswell, 2013, Bryman, 2015) to gain further insight on a specific phenomenon, grounded theory (Glaser and Strauss, 1998), ethnography (Creswell, 2013, Bryman, 2015), and case studies (Creswell, 2013, Bryman, 2015).

Usually, qualitative research tends to focus on a limited number of participants whereby it is small or micro in scale, while quantitative research includes a large population, that is large or macro scale (Bryman, 2012, Bryman, 2015). Both micro and macro scales appear in this study, as will be described later in this chapter.

5.9.2 Interviews

An interview is considered a conversation between people in order to collect descriptive data of a specific phenomenon (Peterson, 1997). A research interview is one of the most commonly used methods in collecting data for qualitative studies (Peterson, 1997, Alshenqeeti, 2014) in the form of verbal data that could be conducted via recorded-voice, live talk, presentation, conversation and focus groups (Remenyi, 2012), or even remotely through telecommunication technologies (Gilham, 2005) such as phone calls or video conference. However, many may not understand the conduct of interviews in the academic environment as they have only experienced interviews through media or employment interviews (Remenyi, 2012). Dealing with the collected interview data starts from the interview itself. It is highly recommended to record the session to ensure all gathered words are collected without missing anything (Seidman, 2013).

Research interviews can run in one of three ways - unstructured, semi-structured and structured (Gill et al., 2008, Bryman, 2015). The unstructured interview does not follow any theory with a minimal or no organisation. It could start with unexpected questions and could potentially take a long time to complete the interview. A semi-structured interview consists of many key questions to address issues in the study; this approach provides the interviewee and/or interviewer space to express additional views that would help in gathering required data. A structured interview is considered a verbal survey by organising all questions and possible answers with no possibility or space to discuss other aspects that could be related to the topic (Gill et al., 2008, Bryman, 2015). Therefore, the flexibility of interview types shows the unstructured approach is the most flexible but time consuming and difficult to manage. The semi-structured approach is less flexible, but could be well-managed and take less time. While the structured approach is completely managed, and takes the shortest time, but is not flexible and does not have the ability to gather extra data that could benefit the research.

This research study used the semi-structured interview approach by organising some structured questions and possible answers, and by giving participants the opportunity to express, or add any extra information that would be useful in refining the developed framework.

5.9.3 Characteristics of the participants

Participants in the interviews were invited after their participation in the survey. Therefore, their characteristics are the same as the survey respondents. All parties wishing to participate in the interview without participating in the survey, were excluded to ensure the interviewee already fitted the selection criteria. This exclusion was to ensure that the organisation has the required knowledge regarding the study, and the firms were already considered an SME.

The interview phase involved twenty selected participants from the first phase. Face-to-face, phone based or online interview methods were offered as alternatives to interviewees. All interviews were recorded and transcribed for research purposes.

5.9.4 Research Interview Procedure

The interviews cycled through several stages. The survey results covered the adoption rate and touched upon drivers and challenges in adopting cloud computing by SMEs in Australia. The survey results provided clear answers to most of the drivers in adopting and utilising cloud services. More leeway was thus provided to interviewees to express their opinions in open-ended questions to emphasise or add more drivers as success factors in cloud adoption. In addition, participants were asked if they received any tangible or intangible benefits or drawbacks from utilising cloud services in order to link the results of cloud utilisation to their expected views before organisational cloud adoption. However, the challenges component of the survey needed further focus on other factors, which were collected from the literature and suggested by survey participants informally through the interviews. Therefore, the second phase focused on refining and adding more challenges via the interviews. After that, these challenges were classified based on the TOE model to follow the structure of this research framework. Figure 5.7 illustrates the procedure in the qualitative semi-structured interview phase.

Phase	Task	Outcomes
1	Analysing the collected data from the conducted survey	Quantitative results and suggestions to develop more coherent interview questions.
2	Identifying more possible challenges of utilising cloud computing	24 possible challenges identified.
3	Classifying the challenges based on the TOE model	Fitting challenges into three different categories.
4	Designing the proposed interview	Several databases been compared to use contact information for contacting participants.
6	Conducting the interview	Interviews conducted among 20 interviewees.
7	Data Analysis	Discussed in detail in the qualitative data analysis chapter
8	Results	Discussed in detail in the qualitative data analysis chapter

Figure 5.7: Interview Research Procedure (adapted from (Recker, 2013).

5.9.5 Interview Components

The interviews in this research sought to obtain insights to success factors and barriers of cloud computing by Australian SMEs to improve the chance of implementing successful cloud computing for improving firm capability and in turn to reach competitive advantage which the RBT model accepts as true. Therefore, the interview design consisted of two main components.

The first component provided open end questions to explore interviewee's views to get more insights on the positive and negative factors of adopting cloud computing from the view of adopter SMEs of cloud computing. In other words, this component included the general question regarding the critical success factors and challenges of implementing cloud computing solutions for SMEs in general and specifically in Australia. Also, it explores tangible and intangible benefits and drawbacks of the cloud solution implemented by the SME.

The second component focused on exploring barriers in adopting the cloud by SMEs. These challenges were classified as follows in three categories based on the TOE framework. The list consisted of 24 structured possible issues, plus one option to state other possible challenges. The conceptual view of the interview components is shown in figure 5.8.

Figure 5.8: The conceptual view of the interview components

The technical component of the challenges covered thirteen common factors, which are security, availability, accessibility, performance, setup time, complexity, privacy issues, scalability, lack of understanding cloud computing, lack of technical resources, implementation issues, operational issues, and lack of professional staff.

The organisational component contained possible factors within the organisation. The list included seven other factors, which are: the business does not require any cloud services, setup and operational costs, business processes, agility, in-house data control, lack of executive support, and lack of management support.

The last component which is an environmental component, focused on factors from outside the firm. Again, seven elements were included - backup location, lack of overall trust, hosting location, communication and internet issues, lack of provided services, international regulations, and lack of government regulation. After that, participants were given the opportunity to address any other issues that would fit under any of the TOE categories.

5.9.6 Interview Data Gathering Process

Responses from the survey indicated about 40 participants were willing to be part of the proposed interview. However, after contacting them only twenty replied and participated. Each participant was offered the options of face to face, phone, or Skype at their convenience. Table 5.6 shows interviewees' sectors, positions, interview dates and method.

Table 5.6: Characteristics of the interviewees, date and methods of running the interviews

Sector	Position	Date	Interview Option
IT	IT Manager	20/04/2016	Face to Face
Education	Director of Information, Communication and Learning Technologies	25/04/2016	Phone
Museum	Managing Director	07/05/2016	Phone
Advertising & Marketing	IT Service, Support and Operations	20/05/2016	Phone
Business Service	Practice Manager	15/06/2016	Phone
Medical service	Business owner	23/06/2016	Phone
Financial advisory service	Business owner	25/06/2016	Phone
Training	Business Development Manager	10/07/2016	Face to Face
IT	Managing Director	13/07/2016	Face to Face
IT	CEO	17/07/2016	Face to Face
IT	CEO	22/07/2016	Face to Face
Project Management	Managing Director	30/07/2016	Face to Face
IT	Administrative Officer	03/08/2016	Face to Face
Education	Program Manager	06/08/2016	Face to Face
Non-profit Organisation	Accountant and IT Support	07/08/2016	Face to Face
Trade	Managing Director	11/08/2016	Face to Face
Education	Managing Director	13/08/2016	Face to Face
Education	Consultant & IT Support	15/08/2016	Face to Face
Consulting	Consultant & IT Support	17/08/2016	Face to Face
IT Consulting	IT Marketing Analyst	20/08/2016	Face to Face

5.10 CONCLUSION

The methodology chapter draws a roadmap of this research. The chapter explains the phases and steps in conducting the study in order to understand the benefits to SMEs in adopting cloud based solutions as a resource to improve their capabilities and productivity in line with RBT theory to gain competitive advantage and help improve the national productivity. Exploring better utilisation of cloud computing was implemented to answer the main research question:

W*hat are the adoption rates and critical success factors and challenges for Australian SME adoption of cloud computing (to achieve competitive advantage and increase national productivity)?*

The study had two main phases. The first phase was a quantitative survey with 470 valid responses in six major Australian cities, plus minimal online participation. The survey focused on exploring the approximate adoption rate of cloud computing by Australian SMEs. In addition, it highlighted most drivers and barriers to cloud services, which were added to the research framework. The second phase consisted of qualitative semi-structured interviews with 20 interviewees. The semi-structured interviews explored the influences and challenges of using cloud based solutions in depth by providing interviewees the ability to express and add any positive or negative factors to their company's process of adopting and using cloud computing. The interviews highlighted 24 possible technical, organisational, and environmental challenges based on the TOE framework by asking participants to discuss their experiences if they faced any of these issues. In the end, interviewees had the opportunity to add any other challenges to the list.

Chapter 6 now analyses the quantitative data from the surveys, followed by chapter 7 that analyses the qualitative data from the interviews. The results of these chapters will highlight the contribution of this research by exploring the approximate adoption rate of cloud computing by Australian SMEs in 2015-2016, giving insight into the drivers and challenges in adopting cloud computing by SMEs. The results will help develop the final cloud computing adoption framework for SMEs to provide businesses the opportunity to understand and consider the most common issues in adopting and using cloud computing by SMEs globally.

Chapter Six: Quantitative Data Analysis

6.1 INTRODUCTION

Chapters 4 and 5 (Theories and epistemology, and Methodology) explained theoretical concepts and the methodology used in this study. Recalling chapter 4 briefly, some of the most commonly used theories in similar information systems research were highlighted to select the most appropriate theory as a base to develop a research framework. The Resource Based Theory (RBT) and Technology-Organisation-Environment (TOE) frameworks were used to develop the explanatory framework used in this study.

The methodology chapter discussed the development of the research methodology in detail based on the theories and framework. The study had three main aims. The first aim was to explore the adoption rate of cloud computing by Australian SMEs between the years 2015 to 2016. The second aim was to explore parameters that influenced organisations to adopt cloud based solutions as a success factor to help improve business capabilities and outcomes, which could lead to improvements in attaining competitive advantage. The third aim was to address challenges facing SMEs in adopting and utilising cloud computing. Both influences and challenges were classified into three main categories based on the TOE framework – that is to say technological, organisational and environmental factors.

The methodology chapter explained the two phases used in the study. The first phase was in the form of a quantitative survey to explore the adoption rate and drivers and barriers in adopting cloud services for Australian SMEs. The second phase was in the form of semi-structured qualitative interviews to obtain rich data regarding the influences and challenges explored.

The aim of the chapter here is to analyse the quantitative data collected from the survey. There were four components, which were organisational general information, cloud computing adoption rate, drivers and challenges in technical, organisational, and environmental categories. The survey concluded with an invitation to participate in the second phase of qualitative interviews. The collected data was analysed using Microsoft Excel 2016[15].

[15] https://products.office.com/en-au/excel

The inception stage of the quantitative data analysis was informed by similar studies to develop an appropriate method for interpreting and displaying the collected data. Success factors and challenges can be explored using descriptive statistics, but are mainly supported by qualitative analysis (Zhou et al., 2010, Morin et al., 2012, Suo, 2013, Subashini and Kavitha, 2011, Smith and Jamieson, 2006, Bhuasiri et al., 2012, Nicho and Mourad, 2012, Verburg et al., 2013, Shaul and Tauber, 2013, Petter et al., 2013, Zhang et al., 2003, Somers and Nelson, 2001, Agboh, 2015, Dillon et al., 2010). This approach was used here in analysing and displaying the collected data. The following sections focus on displaying the quantitative data using descriptive statistics. The following chapter discusses the qualitative data to show further insight regarding the results of the quantitative phase. The next section outlines the background to statistical techniques followed by data analysis.

6.2 BACKGROUND

The population or as it is sometimes called the target population is the entire set of groups or elements studied (Mann, 2007, Mendenhall et al., 2012, Cowan, 1998). The probability of having a specific feature or occurrence in the population is usually denoted by the symbol *P(value)*, where the value represents the studied feature (Cowan, 1998). In this research, the value represents the number of SMEs in Australia. The *Reserve Bank of Australia* (2012) reported the total number of Australian businesses in 2011 was approximately 2,045,000 of which 96% were small businesses (Connolly et al., 2012, Kuruppu et al., 2013) with nearly 4% medium sized businesses and only 0.3% representing large enterprises (Connolly et al., 2012). Therefore, there are nearly 2 million SMEs in Australia.

When dealing with a very large population, researchers tend to study a subset of a few hundred or thousands of the population examined (Mann, 2007). This subset is known statistically as the sample of the population (Mann, 2007, Mendenhall et al., 2012, Cowan, 1998). Sampling techniques were used in studying similar phenomena in exploring the adoption of cloud computing (Carcary et al., 2014), which led to such use in this research.

Analysing the data may require calculating the average. The three most common methods to calculate the average are the mean, the median and mode, which are known as measures of central tendency (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). Each method is described as the following:

1. The *mean* is the most common method of calculating the normal average of several values. It is calculated by adding values of all participants and dividing them by the

number of the participants (Howell, 2016, Salkind, 2016, Ross, 2005). The mean of the population is denoted by μ. However, the samples' mean is usually represented by the symbol $\bar{X}$ to make it easy to understand the numbers given represent a subset of the population (Cowan, 1998, Ross, 2005). This calculation is represented by the following formula:

$$\bar{X} = \frac{\sum_{1}^{n} Xn}{n}$$

Where n is the frequency number.

2. The *median* is the second method for calculating the average using a different technique and is represented by *Md* for the samples (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). Calculating the median requires sorting the elements in ascending or descending order and taking the middle element as the median. If the subset has an even number of elements, the median is represented by the mean of the middle two numbers of the subset (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). The median average is commonly used if there is an extreme value(s) that could affect the average, such as:

   1, 2, 3, 4, 200

   So, calculating the mean here gives the average = 42, which does not represent the majority of samples accurately. While the median here is more useful in that provides the average = 3.
3. The *mode* is the third average calculation method, which tends to nominate the most common value in the sample as the average, and represented by *Mo* (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016).

Analysing data may require one to explore the distance of each value from the mean. The *standard deviation* shows the average distance, which represents the total distance of all items from the mean divided by the frequency number (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). Statistically, the standard deviation is denoted by the symbols s or σ, and calculated using the following formula:

$$s = \sqrt{\frac{\sum(X - \bar{X})^2}{n - 1}}$$

Where:

- X is the element value.
- $\bar{X}$ is the mean.
- n is the frequency number.

Exploring the relationship between variables might be needed to further investigate the data collected. The *correlation coefficient* is one of the most common techniques in analysing data (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). The correlation coefficient uses the symbol r, and its values fits in the range $+1 \geq r \geq -1$. The high absolute values or r represents a higher relationship. However, there is no relationship between variables if the r is equal to zero. The positive value of r represents *Direct* or *Positive Line Correlation*. It means that if the value of variable x increased, the value of y would possibly increase. At the opposite, the negative value of r represents the opposite relationship between variables. If the x value increases, the y value will decrease. This type is known as *Indirect* or *Negative Liner Correlation*. The probability of y increment/decrement depends on the absolute value of r. If it is very close to 1, there is a high chance for y to respond to x variation. If the absolute value of r is equal to 1, this gives a perfect relationship between variables and the chance of affecting y by x is 100% (Howell, 2016, Salkind, 2016, Ross, 2005, Gravetter and Wallnau, 2016). The next section examines the validity of the completed surveys followed by the data analysis phase.

6.3 ORGANISATIONAL GENERAL INFORMATION

The first component of the survey is the data validation stage. The main purpose of this section is to confirm that participating firms were ecologically valid using specific criteria including the company's general information, such as the location, number of branches, and number of employees to validate the participant is an Australian organisation and consist of 1 to 199 employees.

The research covered 1004 SMEs in six cities[16] - Sydney, Newcastle, Wollongong, Canberra, Brisbane and Melbourne, were visited via convenience sampling to distribute the survey in addition to a few online responses. This process came up with 534 participating firms. Each survey was tested to check the validity of the information. The first stage confirmed that the

[16] Please refer to section 5.8.5 in the methodology chapter for further details regarding those cities.

included entries were complete, as some participants did not fully complete the survey. All uncompleted surveys (25) were excluded leading to 509 in total, as shown in figure 6.1.

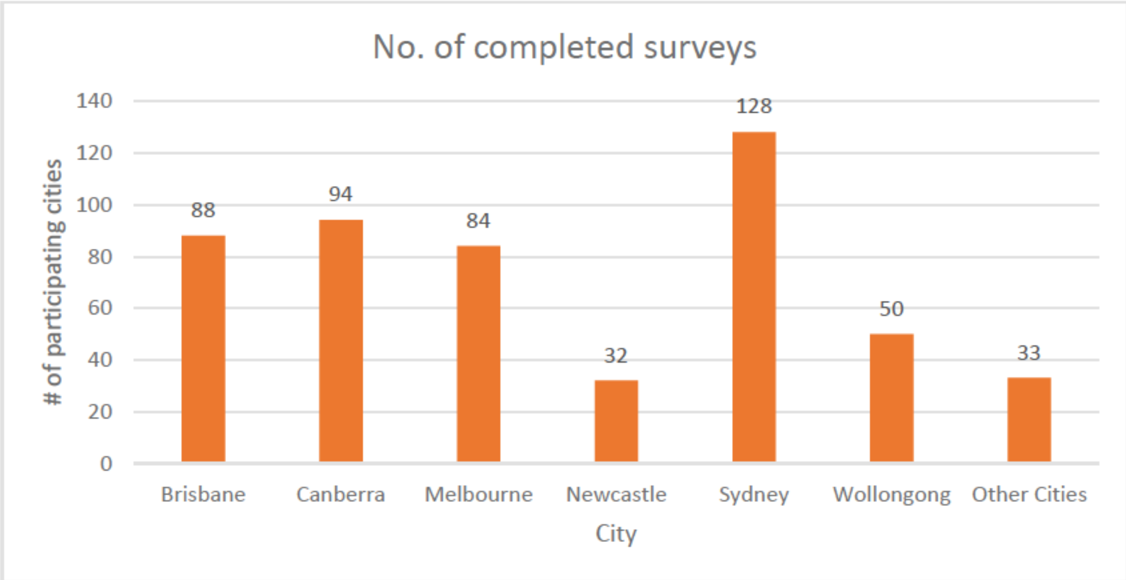

Figure 6.1: No. of Completed Entries from Each City

The completed surveys were investigated in a further filtration process to exclude large enterprises, which did not meet the SME classification. The result of this stage excluded another 29 companies plus 10 unknown sized companies to ensure the validity of the collected data, leaving 470 valid entries, which represents the sample size of this study.

Table 6.1 summarises the participating companies in four categories, large, medium, small (not micro) and micro organisations. The frequency table is implemented briefly here to understand the ratio of each participating sector in the survey conducted.

Table 6.1: Participating Companies by Size

Size	# of Employees	# of Companies (n)	% $(\frac{n}{470})$
Unknown (Excluded)	Unknown	10	N/A
Large (Excluded)	200+	29	N/A
Medium	20 to 199	165	35.10%
Small (Not Micro)	5 to 19	169	35.96%
Small (Micro)	0 to 4	136	28.94%

Note: including micro sized firms in small organisations will increase the percentage of both categories to 35.96 + 28.94 = 64.9%.

The number of participants from each city after final filtration, shows that Sydney businesses came first at 110, followed by Canberra 94, Brisbane 87, Melbourne 76, Wollongong 50, Newcastle 32, and other cities with 21 as shown in figure 6.2. The same figure shows the percentage of participating organisations according to sample size (470).

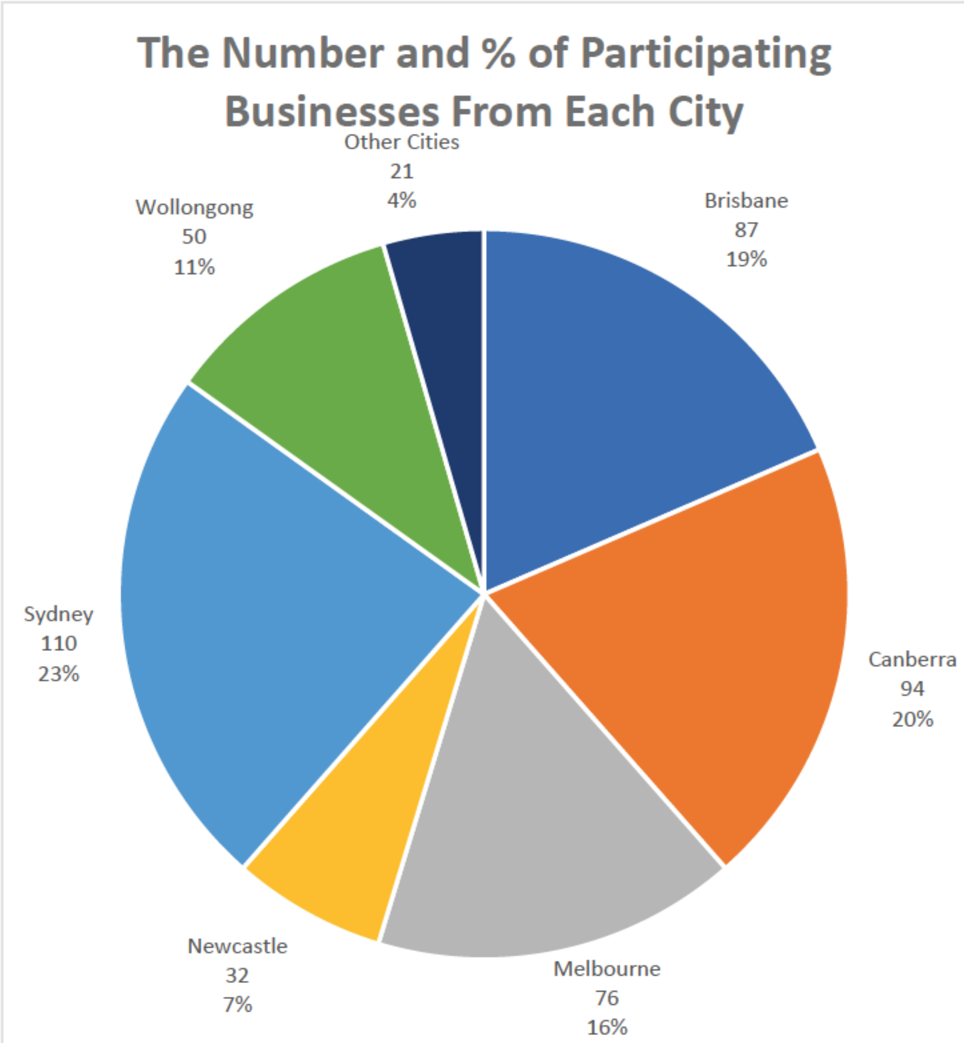

Figure 6.2: The number and Percentage of Valid surveys from each city

The next sections of this chapter analyse the data using the conceptual framework discussed in the previous two chapters.

6.4 EXPLORING THE ADOPTION RATE OF CLOUD COMPUTING

6.4.1 APPROXIMATE ADOPTION RATE

Recalling the research conceptual framework showed the first component sought to explore the approximate adoption rate of cloud computing by Australian SMEs. More specifically, the study covered the years 2015 and 2016.

According to the parameters and variables discussed in the methodology chapter, calculating the average using the mean seemed the best option here, as the expected values will use cloud computing or not. Examining the approximate use of cloud computing by Australian SMEs showed that 48.7% of investigated companies (229 of 470) utilised cloud enterprise services, such as *Microsoft Azure*, *Amazon Web Services* (AWS), *Salesforce*, and *MYOB*. This result was analysed in more detail according to the size of businesses. Table 6.2 and figure 6.3 show the adoption rate for each sector. Micro-sized organizations appeared less interested in adopting enterprise cloud services as only 44 out of 135 businesses equal to 32.6% utilized cloud computing. Small organizations (not micro) scored the top rate using cloud enterprise services at 56.3%, 98 out of 174 businesses. Medium organizations were 54%, 87 out of 161 businesses.

Another aim of this study was to examine the use of enterprise versions of consumer products/services via any of the public internet service providers (ISPs) such as Hotmail, Facebook, Twitter and LinkedIn. The results showed that cloud based consumer's products are attractive for two thirds of the sample population.

Table 6.2: The use of enterprise cloud services/products in each sector

Size	Frequency No	No. of "Yes"	No. of "No"	% "Yes"	% "No"
Micro	135	44	91	32.6%	67.4%
Small	174	98	76	56.3%	43.7%
Medium	161	87	74	54.0%	46.0%
Total	470	229	241	48.7%	51.3%

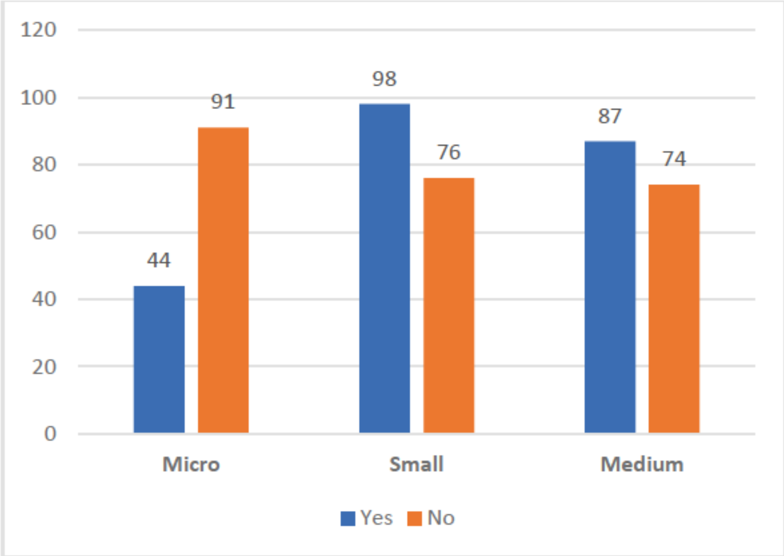

Figure 6.3: Enterprise Cloud Services/Products used in each sector

Table 6.3 and figure 6.4 show that 318 of 470 companies (67.7%) are using these types of services for running their businesses. In closer detail, the ratio appears very close when comparing the use based on an organization's size. The study shows 64.4% of micro businesses use online consumer services; this ratio represents 87 of 135 businesses involved. This ratio increased slightly when it came to small but not micro, and medium sized organizations - equal to 69% and 68.9% respectively, representing 120 out of 174 small, and 111 of 161 medium businesses.

Table 6.3: Using Online Consumer Services by Each Sector

Size	No. of "Yes"	No. of "No"	Total	% Yes	% No
Micro	87	48	135	64.4%	35.6%
Small	120	54	174	69%	31%
Medium	111	50	161	68.9%	31.1%
Total	318	152	470	67.7%	32.3%

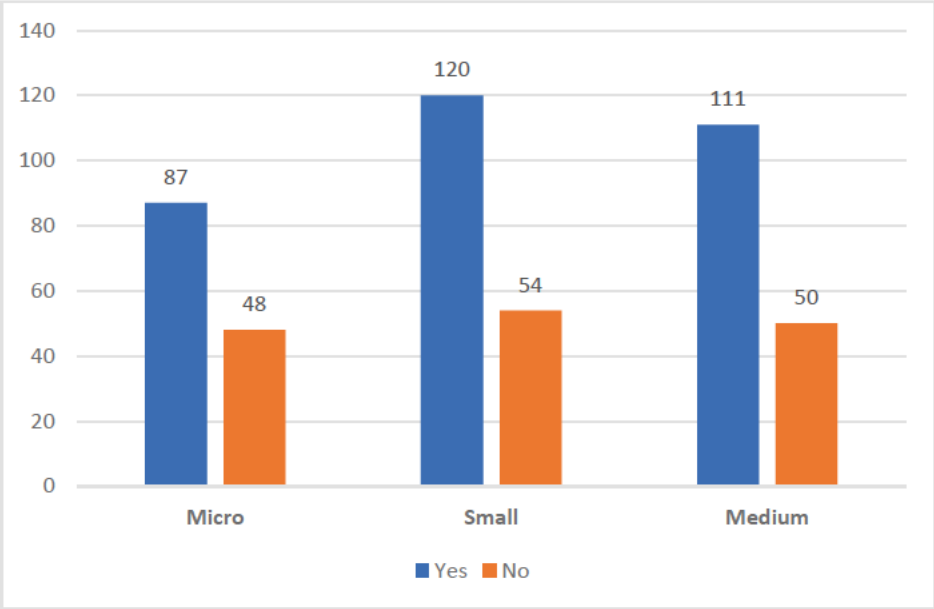

Figure 6.4: Using Online Consumer Services by each sector

Using online cloud based storage services – such as OneDrive[17], Google Drive[18], and Dropbox[19] – by Australian SMEs was examined in this study. The results showed that 253 out of 470 organisations – 54% of the sample – were using online storage services. More specifically, table 6.4 and figure 6.5 represent small organisations as the highest users of online cloud based storage services by 63%. Medium and micro sized forms followed with 50% and 47% respectively.

Table 6.4: Using Online Storage by Each SMEs' Size

Size	Total	Frequency of Yes	% Yes	Frequency of No	% No
Micro	135	63	47%	72	53%
Small	174	110	63%	64	37%
Medium	161	80	50%	81	50%

[17] Cloud based storage service from Microsoft. For more details, please visit: https://onedrive.live.com/
[18] Cloud based storage service from Google. For more details, please visit: https://www.google.com/drive/
[19] Cloud based storage service from Dropbox. For more details, please visit: https://www.dropbox.com/

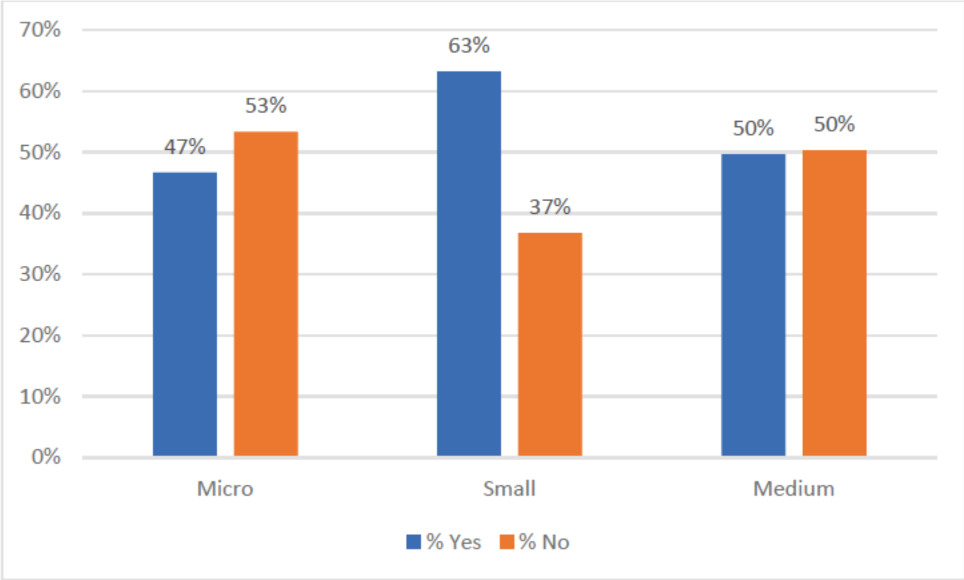

Figure 6.5: Using Online Storage by Each SMEs' Size

6.4.2 USING CLOUD COMPUTING SIMULTANEOUSLY WITH ON-PREMISE DATA CENTRES

Investigating the availability of data centres in the organisations explored was from two viewpoints. Firstly, we examined the direct effect of organization size on having data centres on-site as shown in table 6.5 and figure 6.6. The study showed that some participating organisations had at least one computer used as a server in their business, and a few had a small data centre. From 470 explored firms, 171 organisations have a data centre in different sizes from one server to a complete data centre, while 299 possessed no centralized computer(s) on the premises. Starting from medium to small, 161 medium sized organizations responded to the survey. The results showed that 63.4% (102 medium companies) had data centres. This parameter diminishes when business size decreases. The result showed 56 out of 174 small companies, but not micro, possessed data centres, reflecting 32.2% of this sector, while only 9.6% of micro businesses (13 out of 122), used data centres.

Table 6.5: The Availability of Data Centres in Each Business Size

Size	Yes	No	Total	% Yes	% No
Micro	13	122	135	9.63%	90.37%
Small	56	118	174	32.18%	67.82%
Medium	102	59	161	63.35%	36.65%
Total	171	299	470	36.38%	63.62%

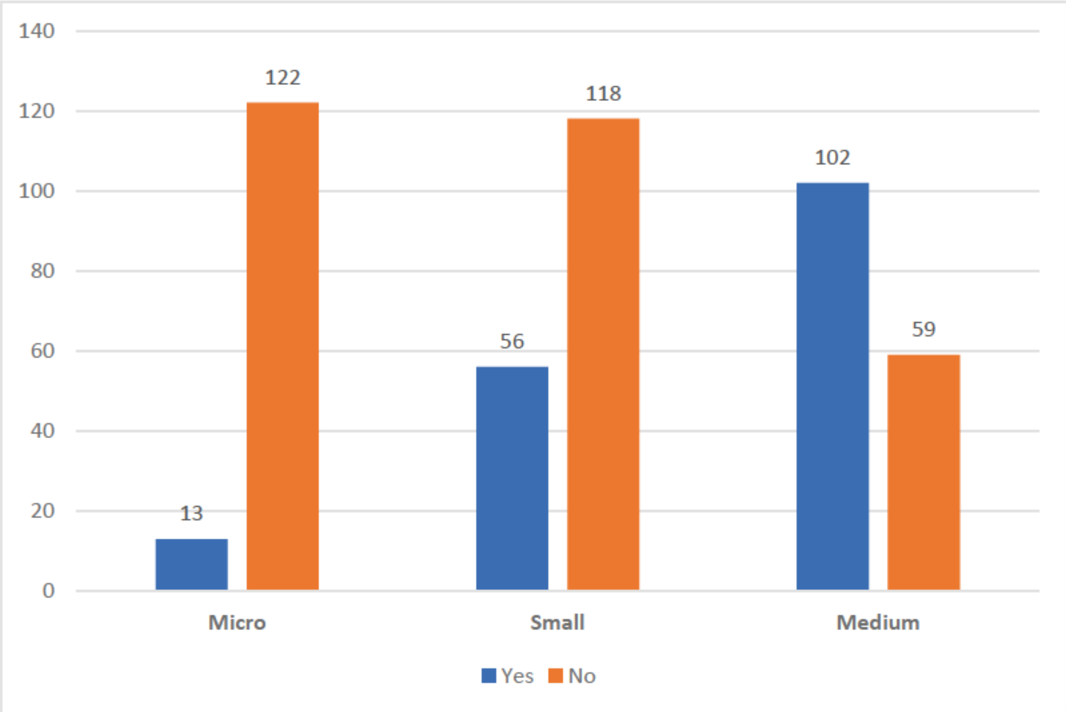

Figure 6.6: Availability of Data Centres in Each Business Size

The correlation between a company's size and owning a data centre was calculated using the function CORREL(range1, range2) in Microsoft Excel. As expected from the previous figure, the result showed a strong direct (positive) correlation, which was equal to 0.91.

The second view in regard to data centres was discovering the relationship between having on-premises data centres and using enterprise cloud computing by Australian SMEs, such as *MS Azure, MYOB cloud*, and *salesforce*. This study showed that 55.5% of businesses who have a data centre (95 out of 171) were also relying on enterprise cloud computing, while 44.4% depended mainly on their in-house resources. Calculating the correlation, as in the following table (6.6), showed the limited effect of having data centres in adopting enterprise cloud services. None of micro, small, and medium organisations had a direct relationship.

Table 6.6: Relationship between owning Data Centres and adopting Enterprise Cloud Service

Size	Having Data Centre		Using Enterprise Cloud		Correlation
	Yes	No	Yes	No	
Micro	13	122	44	91	0.3623032
Small	56	118	98	76	0.1106132
Medium	102	59	87	74	-0.184112

6.4.3 ADOPTION RATE PER EACH CITY

Exploring the adoption of enterprise cloud products based on the cities examined revealed Melbourne held top place. The analysis showed here that around 59.2% of businesses in Melbourne utilized cloud services; representing 45 of 76 companies. Canberra had the second top position at 52.2%. Brisbane, Sydney, Newcastle, and Wollongong were 49.4%, 47.3%, 43.7% and 35.3% respectively. Figure 6.7 and table 6.7 show these results in more details.

SMEs in Australian capital cities were more interested in adopting cloud computing than regional centres. This study included four capital cities, which were Sydney, Melbourne, Brisbane and Canberra, plus two regional cities - Newcastle and Wollongong. The previous results put capital cities first, followed by the two regional cities.

Table 6.7: Enterprise Cloud Service Adoption in Each City

	Brisbane	Canberra	Melbourne	Newcastle	Sydney	Wollongong	Others
Yes	43	49	45	14	52	18	8
No	44	45	31	18	58	33	12
Total	87	94	76	32	110	51	20
% Yes	49.43%	52.13%	59.21%	43.75%	47.27%	35.29%	40.00%
% No	50.57%	47.87%	40.79%	56.25%	52.73%	64.71%	60.00%

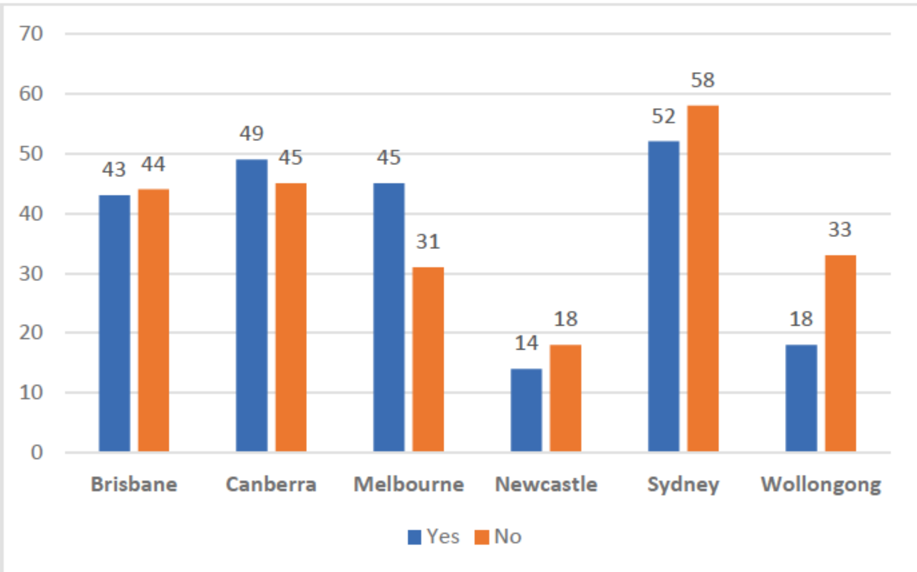

Figure 6.7: Cloud Computing Utilization Rate in Each City

6.4.4 THE ADOPTION RATE PER BUSINESS ACTIVITY

The data collected was analysed according to business activity. Businesses are classified by 27 different business sectors that covered the adoption rate of each sector as shown in table 6.8 and figure 6.8.

The result of the cloud computing utilization rate by each business sector reveals that recruitment agencies appeared to top the list scoring 81.8% equal to 18 out of 22 businesses investigated. The IT and engineering sector came second using enterprise cloud computing services by 78% representing 39 of 50 businesses. There were only seven wholesale businesses in this study, 5 of which utilized the cloud. Business consulting and finance were 62.8% and 57.9% respectively. A significant number of responses were collected from three sectors: medical services, health and beauty, and retail - equal to 93 surveys. However, these sectors had low cloud computing adoption rates of 33.3%. Education businesses with 43 surveys, had an adoption rate of 39.53%.

Note: A company was excluded from this section because they selected "other sector" in the survey without determining it.

Table 6.8: Enterprise Adoption by Business Activity

Business Sector	Yes	No	Total	% Yes	% No
Recruitment Services	18	4	22	81.8%	18.2%
IT & Engineering	39	11	50	78.0%	22.0%
Wholesale	5	2	7	71.4%	28.6%
Consulting	22	13	35	62.9%	37.1%
Finance	40	29	69	58.0%	42.0%
Research and Testing	2	2	4	50.0%	50.0%
Travel	2	2	4	50.0%	50.0%
Migration Service	5	5	10	50.0%	50.0%
Legal Services	16	17	33	48.5%	51.5%
Real Estate	5	7	12	41.7%	58.3%
Education	17	26	43	39.5%	60.5%
Manufacturing	3	5	8	37.5%	62.5%
Trade	7	12	19	36.8%	63.2%
Buildings and public works	6	11	17	35.3%	64.7%
Entertainment	1	2	3	33.3%	66.7%
Hospitality	4	8	12	33.3%	66.7%
Health and Beauty	10	20	30	33.3%	66.7%
Medical services	10	23	33	30.3%	69.7%
Retailer	9	21	30	30.0%	70.0%
Government	1	3	4	25.0%	75.0%
Primary Producer	1	3	4	25.0%	75.0%
Distributing	1	4	5	20.0%	80.0%
Import/Export	2	8	10	20.0%	80.0%
Environmental Non-Governmental Organization	0	1	1	0.0%	100%
Mining	0	1	1	0.0%	100%
Transport	0	1	1	0.0%	100%
Philanthropy	0	2	2	0.0%	100%

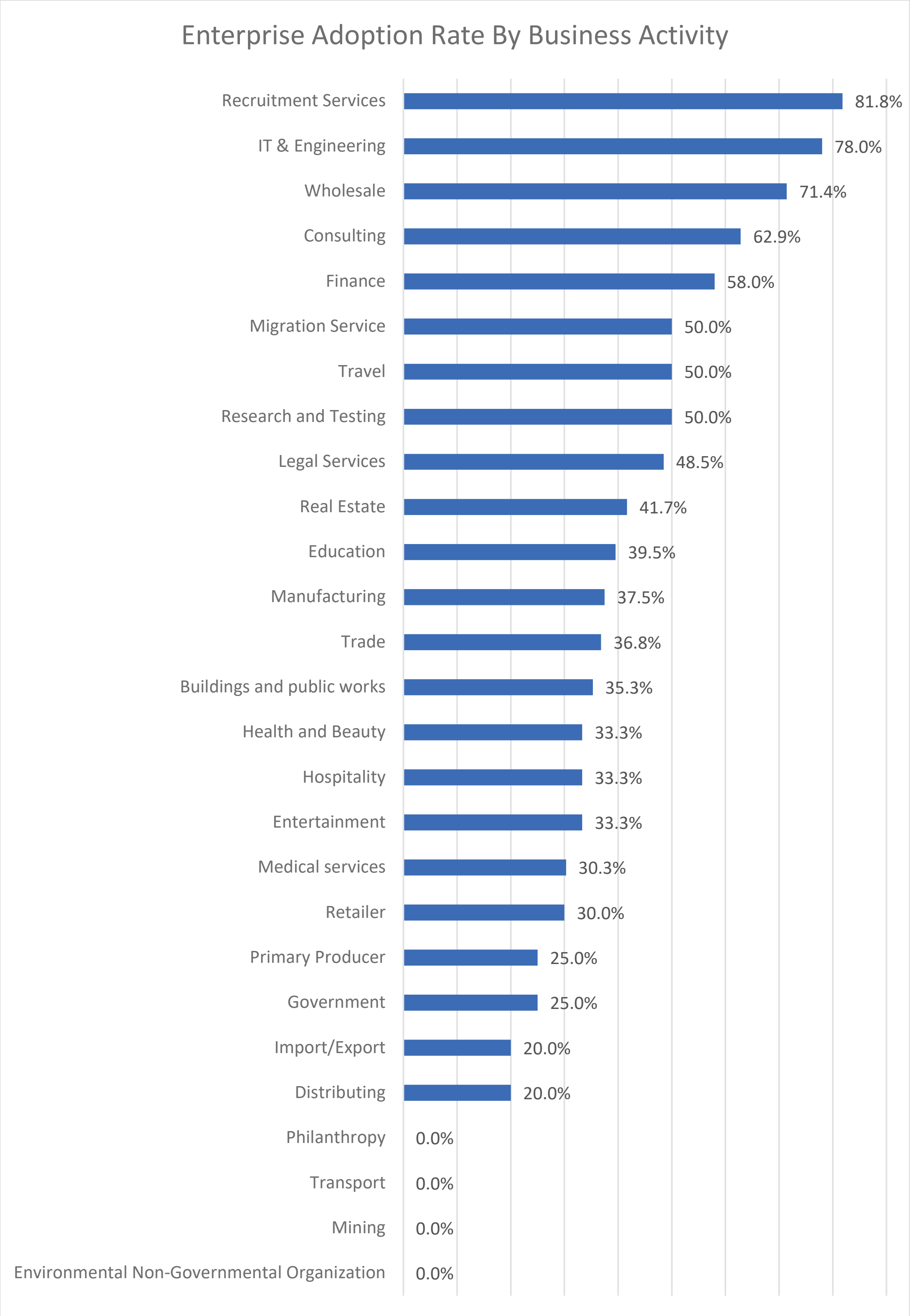

Figure 6.8: Enterprise Adoption Rate by Business Activity

6.4.5 THE ADOPTION RATE OF SERVICE DELIVERY MODELS

Another aspect examining the data focused on an important component in adopting cloud computing, which is the type of service delivery model - SaaS, PaaS, and IaaS. The majority of SMEs used one model, but a few utilised more than one type. The data showed that the 229 SMEs utilising cloud services, 217 firms equal to 95% used SaaS as their preferred model. SMEs were less interested in adopting PaaS and IaaS. PaaS was utilised by 38 SMEs equal to 17% and IaaS by 22 SMEs equal to 10%, as illustrated in table 6.9 and figure 6.9 below.

Table 6.9: The adopted service delivery models by Australian SMEs (based on 229 firms)

Service Delivery Model	Number of SMEs	The % from 229 SMEs
SaaS	217	95%
PaaS	38	17%
IaaS	22	10%

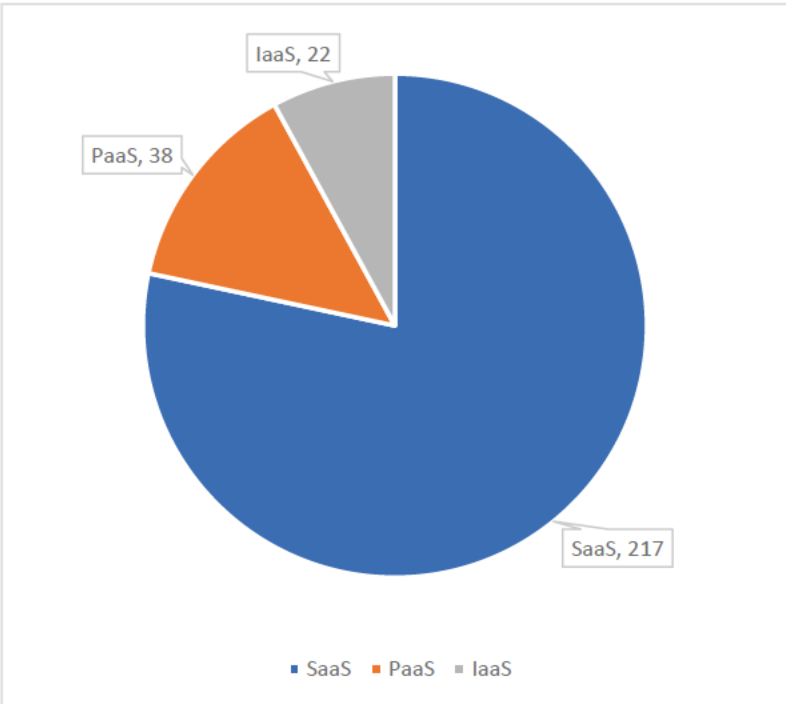

Figure 6.9: The adopted service delivery models by Australian SMEs (based on 229 firms)

As summarised in table 6.10 and figure 6.10, the results showed the majority of Australian SMEs were utilising cloud services to run their business activities, 219 out of 229, around 96%. Utilising cloud computing by SMEs for development and testing were used by only 46 and 39 firms equal to 20% and 17% respectively.

Table 6.10: The main purpose of adopting cloud computing by SMEs

Adoption purpose	Number of SMEs	The % from 229 SMEs
Development	46	20%
Testing	39	17%
Production	219	96%

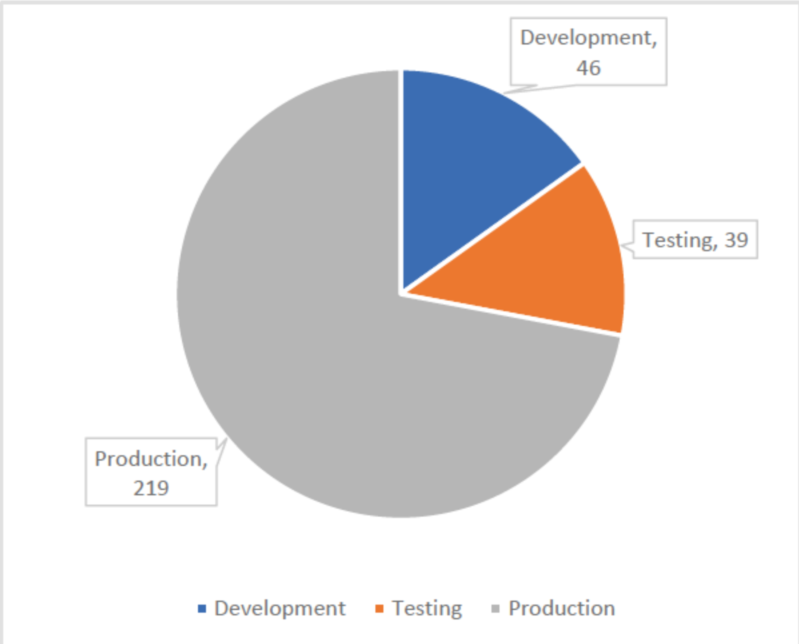

Figure 6.10: The main purpose of adopting cloud computing by SMEs

6.4.6 THE ADOPTION RATE OF SERVICE DEPLOYMENT MODELS

Exploring the preferred deployment models by Australian SMEs, 229 organisations utilised enterprise cloud services. Calculating the total number of SMEs that utilised private model resulted in 182 firm (79%) utilised this model. Hybrid cloud came next with 48 companies, around 21% of the sample. On the other hand, SMEs seemed disinterested in adopting public or community deployment models - only 8 public and 4 community deployment that equal to 3% and 2% respectively. As shown in table 6.11 and figure 6.11.

Table 6.11: The Utilised Service Deployment Models by SMEs

Size	Micro	% Micro (out of 44)	Small	% Small (out of 98)	Medium	% Large (out of 87)
Public	1	2%	0	0%	7	8%
Private	39	89%	82	84%	61	70%
Hybrid	4	9%	17	17%	27	31%
Community	0	0%	0	0%	4	5%

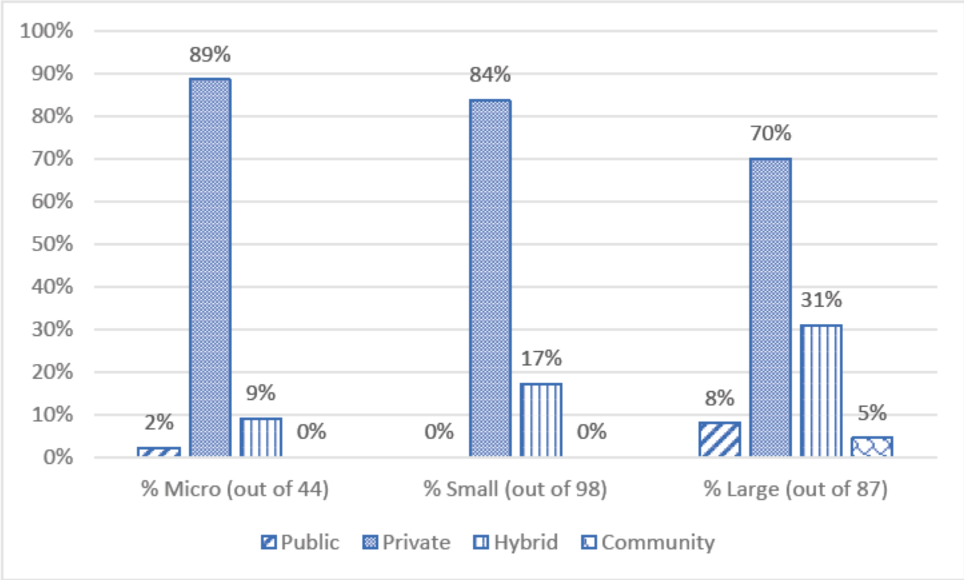

Figure 6.11: Utilised Service Deployment Models

Section 6.4 explored the approximate adoption rate of cloud computing from different views in order to fill the gap of the first component of the research framework which aimed to explore the approximate adoption rate of cloud computing by Australian SMEs in 2015-2016.

The second component of the research conceptual framework was developed to explore possible drivers, as key success factors in adopting cloud services by Australian SMEs. This included the challenges that could act as barriers or disruptors to prevent or delay SMEs utilisation of cloud computing. Section 6.5 below focuses on drivers that lead to the successful adoption of cloud services that ranked by 229 SMEs.

6.5 EXPLORING THE DRIVERS OF ADOPTING CLOUD COMPUTING

Considering cloud computing as one of the organisation's resources for success (Mohlameane and Ruxwana, 2013, Mutula and Van Brakel, 2007) would result in reaching competitive advantage and enhance the productivity as the theory of RBT (Grant, 1991, Taher, 2012, Wernerfelt, 1984, Yigitbasioglu, 2015). Therefore, the factors of the successful adoption and utilisation of cloud computing were explored.

Recalling the second component of the research framework, which is based on the TOE framework that fits drivers and challenges within environmental, organisational, or technological categories (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013). As discussed in chapter 5, factors within each of the main TOE categories were adopted from the literature. The technological factors were security and privacy, setup time, performance, availability, accessibility, scalability, better maintenance and complexity. The organisational factors included cost including cost savings, setup and operational costs; business process, business agility, operational time saving, business outcomes, and supporting business strategy. The environmental category factors were hosting location, backup location, relationship with the customer, trusted vendor, vendor services, controlling the IP, and government regulation. Participating organisations were asked to rank each of these factors from one to ten, where 10 was very important and 1 was not important. The results were summarised: total score, mean, median, mode, and standard deviation were calculated for each factor.

The result of adopting cloud computing drivers from Australian SMEs perspectives based on 229 participating firms are shown in Table 6.12 and figure 6.12. Using the median or the mode may not lead to a desirable result. Using the accumulative score and the mean represent that the participating 229 SMEs elected saving of the operational time at the top of the list that would lead SMEs to utilise cloud computing by scoring 1868 out of 2100 points among 21 factors with average mean = 8.16.

Seeking better security from the cloud was ranked as the second most important driver scoring 1819 with a mean of 7.94. This was, followed closely by the SMEs desire to improve their business outcomes by adopting cloud based with an average mean of 7.93 and scored 1815 points. Next important was saving operational budgets with 1782 points and a mean of 2.84.

Using the TOE framework, the data showed that Australian SMEs were more interested in organisational factors followed by technical factors. However, they seemed less interested in environmental factors. Improving the relationship with customers was the first environmental factor in the list that ranked as the thirteenth important driver of adopting cloud computing by scoring 1220 with a mean of 5.33. In addition, the least five factors ranked by Australian SMEs were environmental, - that is backup location, hosting location, vendor services, controlling the IP by the vendor, and government regulation that scored 1051, 1017, 1009, 766, and 592 with averages of 4.59, 4.44, 4.41, 3.34, and 2.59 respectively.

Table 6.12: Drivers of Adopting Cloud Computing by Australian SMEs

Factor	SMEs' Rank	Score	$\bar{X}$	*Md*	*Mo*	s	TOE
Operational time saving	1	1868	8.16	9	10	2.61	O
Security	2	1819	7.94	9	10	2.94	T
Improving business outcomes	3	1815	7.93	9	10	2.90	O
Cost	4	1782	7.78	9	10	2.84	O
Accessibility	5	1733	7.57	9	10	3.13	T
Performance	6	1723	7.52	9	10	3.03	T
Business process	7	1699	7.42	8	10	2.88	O
Availability	8	1687	7.37	9	10	3.14	T
Supporting business strategies	9	1513	6.61	8	10	3.29	O
Better maintenance	10	1431	6.25	8	1	3.43	T
Scalability	11	1261	5.51	6	1	3.43	T
Setup time	12	1254	5.48	6	1	3.18	T
Improving the relations with customers	13	1220	5.33	6	1	3.46	E
Agility	14	1214	5.30	6	1	3.39	O
Trusted vendor	15	1144	5.00	5	1	3.50	E
Complexity	16	1084	4.73	5	1	3.22	T
Backup location	17	1051	4.59	4	1	3.28	E
Hosting location	18	1017	4.44	4	1	3.18	E
Vendor services	19	1009	4.41	4	1	3.35	E
Controlling IP	20	766	3.34	1	1	3.03	E
Government regulation	21	592	2.59	1	1	2.55	E

Where:

- $\bar{X}$ → Sample mean
- *Md* → Median
- *Mo* → Mode
- s → Standard Deviation
- TOE → Classifying factors under technical (T), organisational (O), or environmental (E).

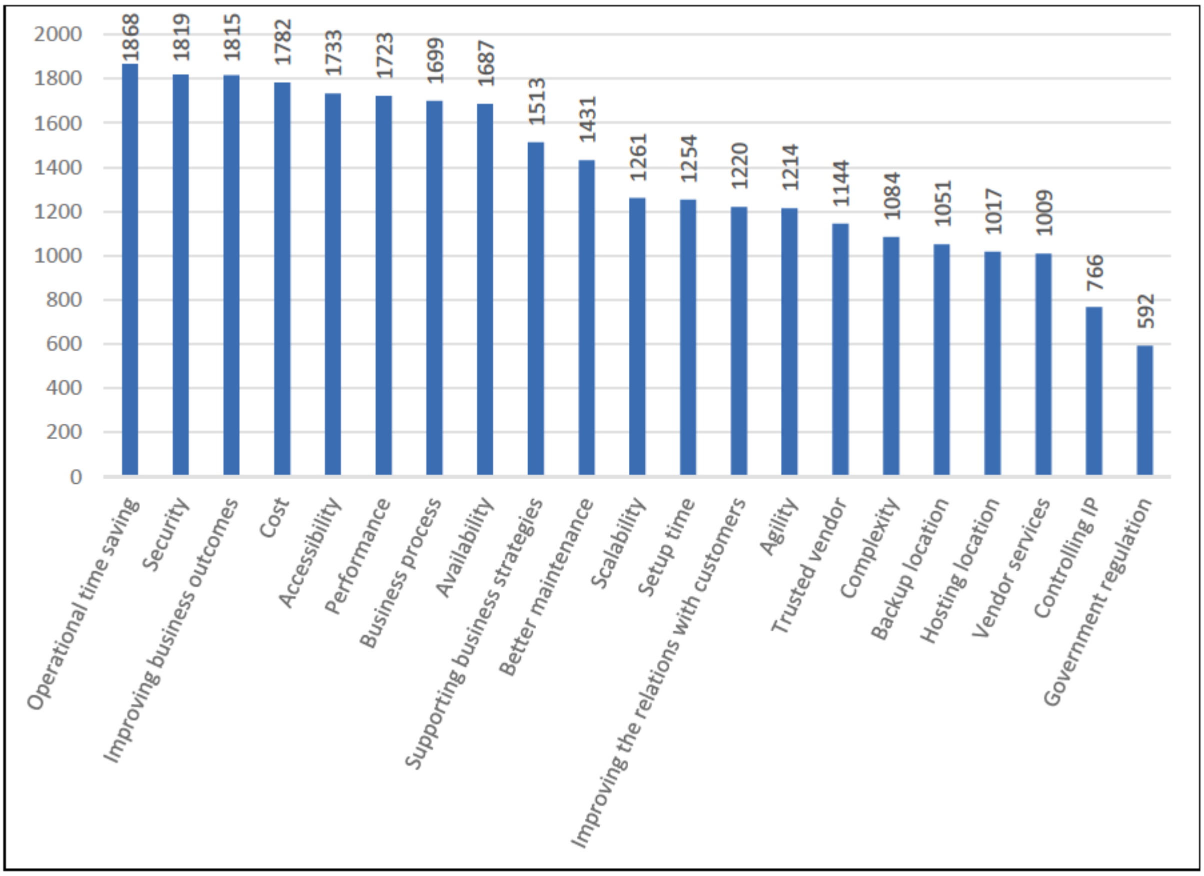

Figure 6.12: Drivers of Cloud Computing adoption by Australian SMEs

Looking more closely at table 6.13, seeking better security, having more accessibility and better performance were the most targeted technical goals. Reducing the operational time, improving business outcomes, and saving overall cost were the top three organisational drivers and within the top four drivers that Australian SMEs were looking for cloud computing to address. Improving relations with customers came first on the environmental list, followed by seeking a trusted vendor.

Having explored the most important drivers of adopting and utilising cloud computing by a sample of Australian SMEs, the following section looks at companies that didn't adopted cloud computing. The section explores the challenges that prevent SMEs from taking steps towards the cloud environment and the likelihood of adopting cloud services in the future.

Table 6.13: Drivers' rank within each category of the TOE Model

Factor	Category Rank	Rank	Score	$\bar{X}$	s	Category
Security	1	2	1819	7.94	2.94	Technology
Accessibility	2	5	1733	7.57	3.13	
Performance	3	6	1723	7.52	3.03	
Availability	4	8	1687	7.37	3.14	
Better maintenance	5	10	1431	6.25	3.43	
Scalability	6	11	1261	5.51	3.43	
Setup time	7	12	1254	5.48	3.18	
Complexity	8	16	1084	4.73	3.22	
Operational time saving	1	1	1868	8.16	2.61	Organisation
Improving business outcomes	2	3	1815	7.93	2.90	
Cost	3	4	1782	7.78	2.84	
Business process	4	7	1699	7.42	2.88	
Supporting business strategies	5	9	1513	6.61	3.29	
Agility	6	14	1214	5.30	3.39	
Improving the relations with customers	1	13	1220	5.33	3.46	Environment
Trusted vendor	2	15	1144	5.00	3.50	
Backup location	3	17	1051	4.59	3.28	
Hosting location	4	18	1017	4.44	3.18	
Vendor services	5	19	1009	4.41	3.35	
Controlling IP	6	20	766	3.34	3.03	
Government regulation	7	21	592	2.59	2.55	

Where:

- Category Rank → The quantitative rank of the factor by 229 adopter Australian SMEs within a category of the TOE model.
- Rank → The quantitative overall rank of the factor by 229 adopter Australian SMEs among all the explored factors.
- $\bar{X}$ → Sample mean
- s → Standard Deviation
- TOE → Classifying factors under technical (T), organisational (O), or environmental (E).

6.6 EXPLORING THE CHALLENGES THAT AVOID ADOPTING CLOUD COMPUTING BY AUSTRALIAN SMEs

Exploring the challenges that face Australian SMEs in adopting cloud services used the conceptual framework outlined in previous sections. The TOE model was used to classify the challenges using the technological, organisational, or environmental categories. The challenges from the technical category challenges included accessibility, availability, complexity, implementation issues, lack of professional staff, lack of technical resources, lack of understanding cloud computing, operational issues, performance, privacy issues, scalability, security and setup time. The organisational category challenges included business agility, business process, in-house data control, lack of executive support, lack of management support, setup and operational cost, and business needs to utilise cloud services. The environmental category challenges included backup location, communication & internet issues, hosting location, lack of government regulation, lack of overall trust, lack of provided services, and international regulations.

The data collected in this section covered 241 organisations that did not utilise cloud computing. Participating SMEs were asked to rank each of these factors from 1 to 10, where 10 means very important, and 1 is not important. After collecting and summarising results; the total score, mean, median, mode, and standard deviation were calculated for each factor.

The most significant challenges in adopting cloud computing by Australian SMEs appear in table 6.14 and figure 6.13. As with exploring drivers in the previous section, using the median or mode may not lead to a clear result, because median calculation requires sorting the ranked values for each element and pick the value of the middle location, which is not helping to solve the research questions. Mode calculation might lead to some clues, where it picks the most elected value for each factor. However, calculating the average using the mean would help here to get better exploring of these factors. Therefore, the total score and the average mean were used to rank the challenges based on the 241 participants.

Although the average of the highest ranked challenge was not as high as the top ranked driver, the results show that the believe of operating SMEs without any need to use cloud computing was the most ranked factor by the non-adopter organisation by scoring 1513 out of 2700 with an average mean of 6.38.

The firms ranked the cost of adopting and operating cloud computing as the second top challenge that could stood against adopting cloud services by scoring it 1371 with an average of 5.69. The fear from security in the cloud computing environment was the third challenge scoring 1339 with an average mean of 5.56.

Using the TOE framework, Australian SMEs believed that organisational factors were the most important category followed by technical factors. However, SMEs were much less interested in environmental factors even considering barriers that avoided the adoption of cloud technologies. Table 6.14 shows the top ranked factors were either organisational or technical, while the least were environmental.

Table 6.14: The Ranked Challenges in Adopting Cloud Computing by Australian SMEs

Factor	SMEs' Rank	Score	$\bar{X}$	*Md*	*Mo*	s	TOE
The business does not need any cloud services	1	1531	6.38	8	10	3.80	O
Setup and operational Cost	2	1371	5.69	7	1	3.98	O
Security	3	1339	5.56	7	1	3.99	T
Availability	4	1270	5.27	5	1	3.93	T
Accessibility	5	1259	5.22	6	1	3.87	T
Performance	6	1201	4.98	5	1	3.87	T
Business process	7	1159	4.81	5	1	3.66	O
Setup time	8	983	4.08	3	1	3.27	T
Complexity	9	911	3.78	2	1	3.21	T
Privacy issues	10	902	3.75	1	1	3.58	T
Agility	11	822	3.41	1	1	3.09	O
Backup location	12	817	3.39	1	1	3.15	E
Scalability	13	815	3.38	1	1	3.17	T
In-house data control	14	814	3.39	1	1	3.30	O
Lack of overall trust	15	786	3.27	1	1	3.23	E
Hosting location	16	764	3.17	1	1	2.98	E
Lack of understanding cloud computing	17	733	3.05	1	1	3.14	T
Lack of technical resources	18	687	2.86	1	1	3.13	T
Lack of executive support	19	683	2.84	1	1	3.04	O
Lack of management support	20	673	2.80	1	1	3.06	O
Communication & internet issues	21	644	2.68	1	1	2.79	E
Implementation issues	22	639	2.66	1	1	2.77	T
Operational issues	23	629	2.62	1	1	2.69	T
Lack of professional staff	24	614	2.55	1	1	2.77	T
Lack of provided services	25	612	2.55	1	1	2.74	E
The international regulations	26	497	2.07	1	1	2.37	E
Lack of government regulation	27	486	2.02	1	1	2.12	E

Where:

- $\bar{X}$ → Sample mean
- *Md* → Median
- *Mo* → Mode
- s → Standard Deviation
- TOE → Classifying factors under technical (T), organisational (O), or environmental (E).

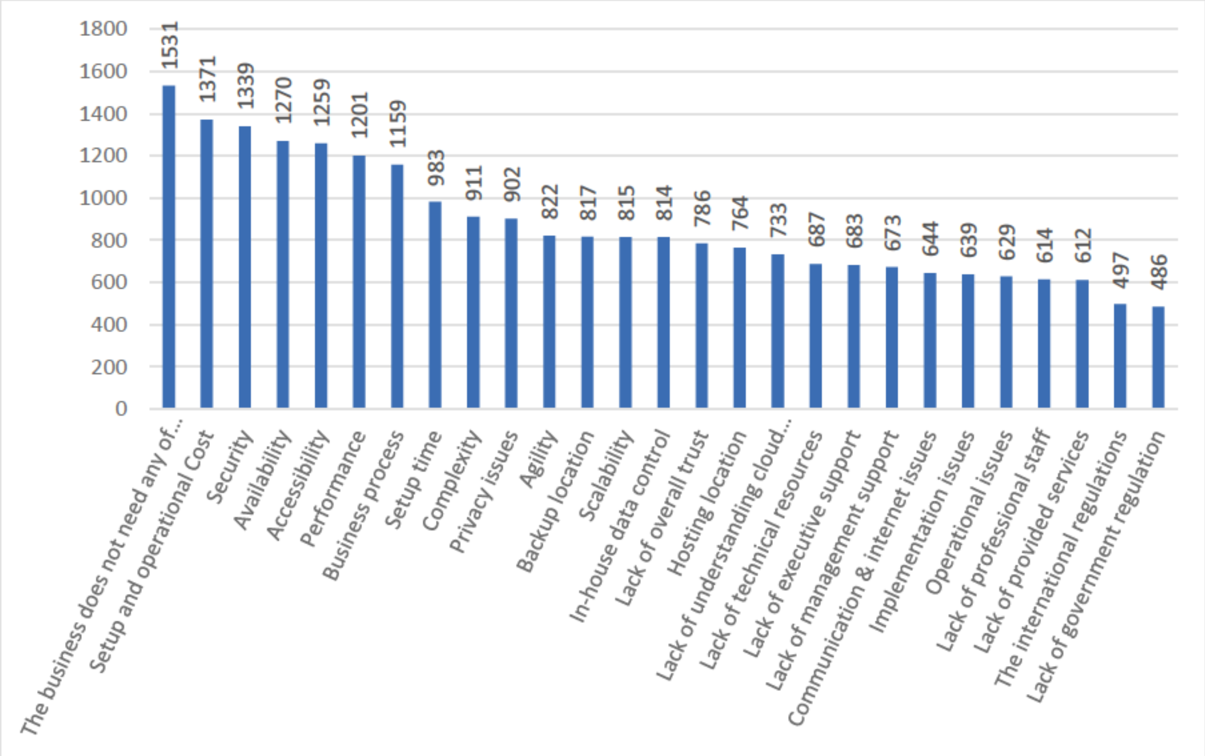

Figure 6.13: Challenges in adopting Cloud Computing by Australian SMEs

Table 6.15 shows the big security concern of non-adopters placed cloud security as the greatest technical barrier stopping them moving to cloud computing. In addition, they believed services provided are not guaranteed to be available and accessible with desired performance. This led them to classify availability, accessibility and performance after security concerns scoring 1270, 1259, and 1201 respectively. The organisational category shows that the ability to run required tasks without the need of cloud computing as the top barrier avoiding investment in adopting and utilising cloud computing. This belief led to the second ranked organisational factor, which is interest in saving expenses rather than paying to setup and operate cloud based solutions. Linking the technical to environmental challenges showed that technical fear of cloud security was reflected in ranking concerns of backup geographical locations and lack of trust in the cloud environment as the top two environmental factors scoring 817 and 786 respectively.

Table 6.15: Challenges' rank within each category of the TOE Model

Factor	Category Rank	Rank	Score	$\bar{X}$	s	Category
Security	1	3	1339	5.56	3.99	Technology
Availability	2	4	1270	5.27	3.93	
Accessibility	3	5	1259	5.22	3.87	
Performance	4	6	1201	4.98	3.87	
Setup time	5	8	983	4.08	3.27	
Complexity	6	9	911	3.78	3.21	
Privacy issues	7	10	902	3.75	3.58	
Scalability	8	13	815	3.38	3.17	
Lack of understanding cloud computing	9	17	733	3.05	3.14	
Lack of technical resources	10	18	687	2.86	3.13	
Implementation issues	11	22	639	2.66	2.77	
Operational issues	12	23	629	2.62	2.69	
Lack of professional staff	13	24	614	2.55	2.77	
The business does not need any of the cloud services	1	1	1531	6.38	3.80	Organisation
Setup and operational Cost	2	2	1371	5.69	3.98	
Business process	3	7	1159	4.81	3.66	
Agility	4	11	822	3.41	3.09	
In-house data control	5	14	814	3.39	3.30	
Lack of executive support	6	19	683	2.84	3.04	
Lack of management support	7	20	673	2.80	3.06	
Backup location	1	12	817	3.39	3.15	Environment
Lack of overall trust	2	15	786	3.27	3.23	
Hosting location	3	16	764	3.17	2.98	
Communication & internet issues	4	21	644	2.68	2.79	
Lack of provided services	5	25	612	2.55	2.74	
The international regulations	6	26	497	2.07	2.37	
Lack of government regulation	7	27	486	2.02	2.12	

Where:

- Category Rank → The quantitative rank of the factor by 241 non-adopter SMEs within a category of the TOE model.
- Rank → The quantitative overall rank of the factor by 241 non-adopter SMEs among all the explored factors.
- $\bar{X}$ → Sample mean
- s → Standard Deviation
- TOE → Classifying factors under technical (T), organisational (O), or environmental (E).

After exploring barriers that act as challenges against adopting cloud computing, the non-adopter organisations were asked if they would adopt cloud computing in the near future where 1 meant not at all, and 10 meant definitely yes. The data showed unbiased future trends from the 241 SMEs explored giving a mean of 4.65 out of 10. This result means that future trend of adopting cloud computing by the current non-adopters in the explored sample is unclear. In other words, the non-adopter SMEs did not have a clear future plan whether to adopt cloud computing or not.

6.7 CONCLUSION

This chapter analysed the quantitative data using descriptive statistics. It started by exploring the approximate adoption rate among 470 SMEs in six Australian cities, which are Sydney, Melbourne, Brisbane, Canberra, Newcastle, and Wollongong. The adoption rate of cloud computing by Australian SMEs in 2015-2016 was 48.7%. According to the sample, the top industries in adopting and utilising cloud services were recruitment agencies, IT & engineering, wholesalers, consulting, and finance.

Using the TOE model as a lens, exploring the most important drivers and challenges highlighted Australian SMEs are more interested in organisational followed by technical factors. However, they were far less interested in environmental factors.

Exploring cloud computing adoption drivers as critical success factors among 229 SMEs showed a clear trend toward operational time savings (mean of 8.16 out of 10). This led to open-ended questions in the interviews conducted asking participating SMEs about the most important drivers and reasons for their views to support the quantitative results. However, the views of adopting cloud computing challenges varied among the 241 non-adopter SMEs, where the top barrier was the belief the business does not require any cloud services (mean average of 6.38 out of 10), followed by SMEs concerns of cloud computing implementation costs. In order to explore these challenges from a different viewpoint, SMEs adopting cloud computing were asked if they encountered any of the aforementioned challenges in order to highlight possible solutions to non-adopter SMEs that could aid them in using the cloud. In addition, cost related concerns were explored in more detail by asking participants to discuss the relationship between estimated and actual costs of adopting cloud computing.

Chapter Seven: Qualitative Data Analysis

7.1 INTRODUCTION

The previous chapter explained the quantitative findings from the 470 included participants. The collected data was analysed via the developed explanatory framework underpinned by RBT theory as well as the Technology, Organisation, Environment (TOE) framework to investigate drivers and challenges of adopting and utilising cloud computing including the approximate adoption rate of cloud services by Australian SMEs. The drivers and challenges were classified as technological, organisational or environmental. After completing the survey, participants were asked if they were willing to participate in a semi-structured interview to develop richer insights into the survey results. The quantitative stage produced 20 participating SMEs who agreed to participate in a follow-up interview. The aim of this chapter is to analyse the qualitative data from these 20 interviews.

This chapter begins by giving brief qualitative research concepts to help understand the qualitative analysis process via the following three sub sections. The next section will discuss the research questions. Then, it will be followed by a section summarising the drivers and challenges to highlight the factors discussed by interviewees. Each factor from the quantitative data phase is examined from two viewpoints - as a driver and as a challenge.

7.1.1 Qualitative Research

The nature of qualitative research focuses on words and phrases rather than numbers (Bryman, 2015). The data which are words and phrases, are collected from different sources. One of the main sources are interviews (Merriam and Tisdell, 2015) as used in this research. Other sources of qualitative data include observation, focus groups and text documents (Merriam and Tisdell, 2015, Bryman, 2015).

Interviews may be unstructured, semi-structured or in structured form (Merriam and Tisdell, 2015, Boeije, 2010). The unstructured form provides interviewees free space to express their views without limitation (Merriam and Tisdell, 2015). The structured interview is considered an oral survey, asking specific questions and looking for answers from the pre-defined answer pool (Boeije, 2010). The semi-structured interview gives limited space by asking about specific points and looking for one of a number of pre-determined answers such as yes/no questions, giving opportunity to add unstructured extra information (Merriam and Tisdell, 2015). Semi-structured interviews were used in this study to ask interviewees to discuss specific factors; which were collected from the quantitative stage; and give interviewees the opportunity to add extra factors as drivers or challenges to explore any additional factors; if they exist.

7.1.2 Qualitative Data Analysis

Analysing qualitative data requires using one or more of the scientific approaches, such as Grounded Theory (Glaser and Strauss, 1998, Glaser and Strauss, 2009, Glaser, 1978) and Thematic analysis (Boyatzis, 1998, Vaismoradi et al., 2013, Cassell and Symon, 2004), which is used in this research.

In the grounded theory, researchers investigate the collected data to recognise the significance, identify themes or features; which is known as qualitative data coding; and the drive a theory (Glaser and Strauss, 1998, Glaser and Strauss, 2009, Glaser, 1978). Thematic analysis is a method of identifying pre-defined patterns from qualitative data through themes to help analyse data and highlight results (Rohleder and Lyons, 2014, Tuckett, 2005, Bryman, 2015). The main reason for using thematic analysis was to examine the concluded factors from the literature. Those factors were discussed on other countries, but not in Australia.

7.1.3 Qualitative Data Analysis Tools

The possibility of researchers having a considerable amount of data to analyse or having a large number of themes that would hinder their analysis of data, led several IT enterprises to develop computer aided products to assist in analysing data, including creating themes, assigning contents to themes, analysing and grouping data, generating graphs and reports. Some examples of these products are NVivo[20] - used in this study, ATLAS.ti[21], HyperRESEARCH[22], MAXQDA[23], Qiqqa[24], Quirkos[25] and many more. Nvivo was chosen to analyse the data because it covers the required solutions to analyse the collected data and it is supported by the university. This support made it easier to get the software and the required tutorials.

[20] http://www.qsrinternational.com/what-is-nvivo
[21] http://atlasti.com
[22] http://www researchware.com/products/hyperresearch html
[23] http://www maxqda.com
[24] http://www.qiqqa.com
[25] http://www.quirkos.com/index html

NVivo qualitative analysis software was used to store, organise, code, and analyse the interview data. The themes identified from the quantitative phase were developed - as nodes in NVivo, and all transcribed interviews were assigned to these nodes. The software also helped to keep track, linking each text within the node to its source which was the interview. During the analysis stage, new themes from the qualitative semi-structured interviews were added to the themes list. The layout of NVivo including some of the nodes are shown in figures 7.1 and 7.2.

After a brief discussion to introduce the stage of the qualitative data analysis, the following section will discuss the interview questions.

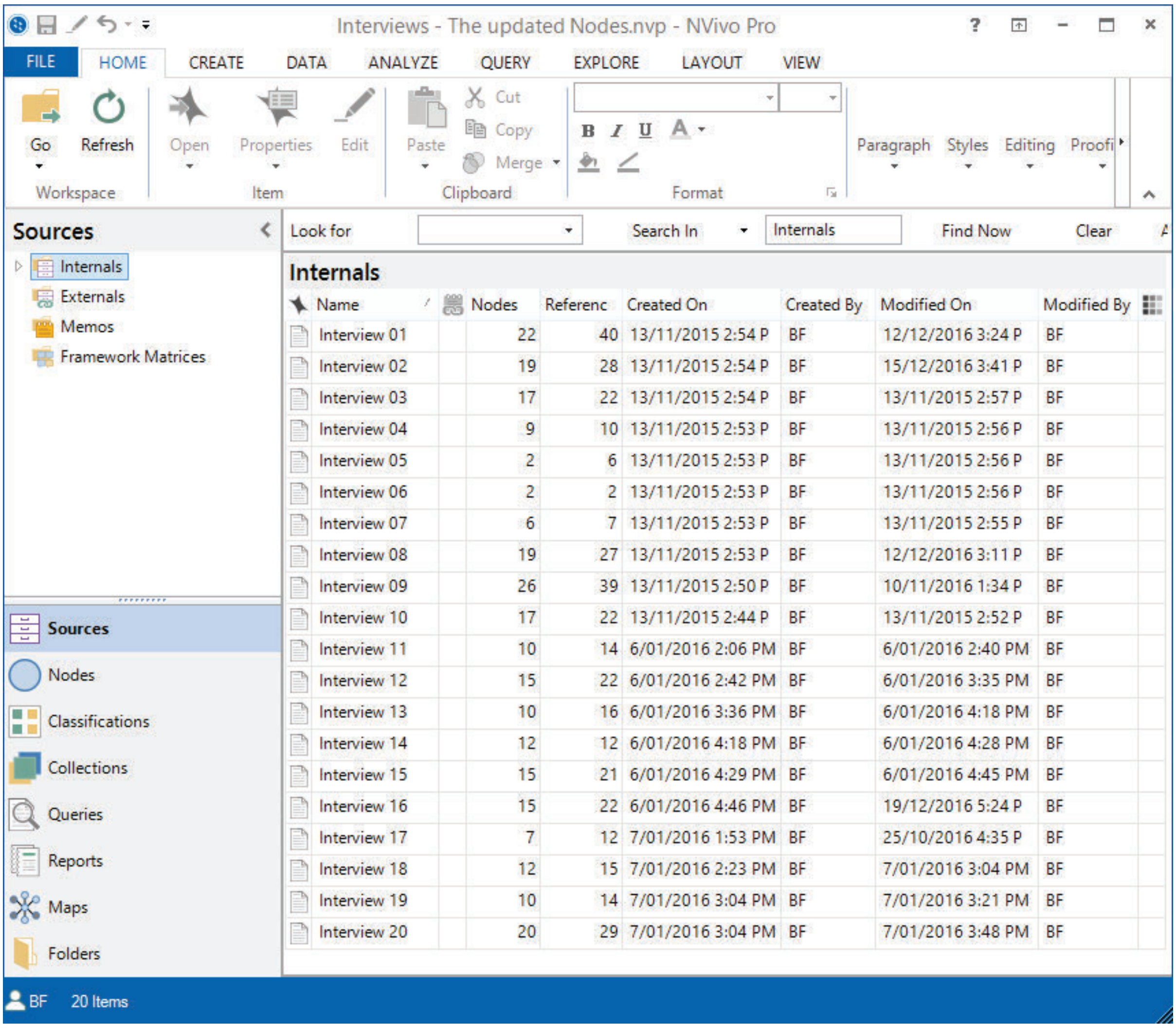

Figure 7.1: The transcribed interviews were stored in NVivo

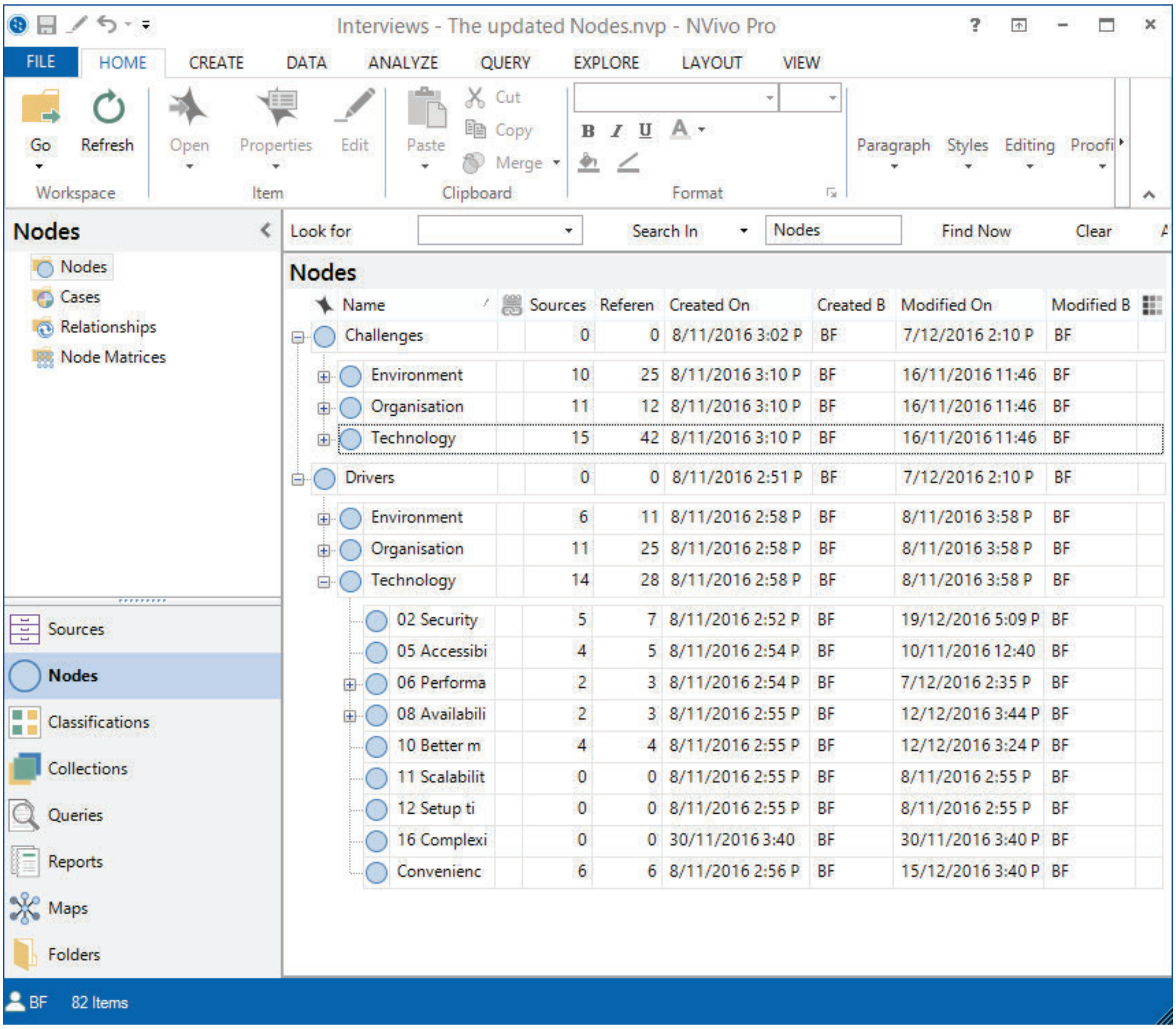

Figure 7.2: Some of the developed themes in NVivo

7.2 INTERVIEW QUESTIONS

The adoption rate of cloud computing by SMEs was explored in the quantitative stage of this research as discussed in chapter 6. The nature of the investigated parameter which asked participating organisations if they utilise cloud computing or not, did not require further explanation to be part of the proposed interview. However, the success factors and challenges could posit several different questions, to gain greater understanding of every factor requiring investigation from different viewpoints.

7.2.1 Interview Question Design

The quantitative results discussed in the previous chapter formed the basis of the qualitative interview questions. The factors, as drivers and challenges, were included as questions in the semi structured interviews. The purpose was to obtain an in-depth understanding of the factors identified in the quantitative phase as well as additional insights. Using the research framework, the drivers and challenges were classified according to the TOE model. The classification of the drivers and challenges is discussed in further detail in section 7.4.

7.2.2 Drivers

The survey as discussed in chapter 6, resulted in 229 SMEs utilising cloud computing who ranked 21 factors as success factors which encouraged them to move toward cloud adoption. The drivers that led to the adoption by SMEs of cloud computing were investigated to understand the most significant reasons for being success factors. As the interview list consisted of 20 interviewees, it was expected during design of the interview questions that this group of 20 may not possess all 21 success factors within their organisations. Therefore, the interviews began with open-end questions for interviewees to share their views on the important factors of success for cloud adoption. The interview process began by asking a general question to specify the critical success factors in adopting cloud computing for SMEs. In order to help interviewees to recall more factors, they were asked if there were any tangible or intangible benefits for adopting cloud computing by SMEs, and if there were any unexpected outcomes. The interview questions are in the appendix.

7.2.3 Challenges

The second part of the interview was to investigate the challenges of utilising cloud computing for SMEs. The result of the quantitative study in the previous chapter highlighted 27 challenges as barriers preventing non-adopter SMEs from utilising cloud computing based on certain fears as well as other factors. As with the drivers, the challenges were investigated from the cloud adopters' perspective in open-end questions that were used in collecting the required qualitative data to either emphasise the concerns of the non-adopter SMEs from one side, or to clarify best practices in dealing with these issues, if they occurred. Similar to the drivers' section, interviewees were asked to discuss the tangible and intangible challenges as well as unexpected challenges. Additionally, to ensure all challenges hindering non-adopters from going ahead to a cloud based environment were discussed to make the vision clearer to non-adopters (after being presented with results of this study), the last question of the interview asked interviewees about each of the highlighted challenges to see if any were relevant to their organisation. In addition, the second ranked challenge that prevented Australian SMEs from adopting cloud computing, was paying higher costs for adopting cloud services. Therefore, this factor was investigated in a separate question to include the possible cost related barriers. Discussing the benefits and challenges included budget related issues that might help non-adopters re-evaluate their top ranked challenges. The next section outlines the interviewee's role and their industry sector.

7.3 INTERVIEWEES

The interviewee details were provided in-depth in chapter 5. The purpose of this brief section is to give each interviewee a specific symbol to be used in the analysis process of the interviews, which is shown in table 7.1, last column.

Table 7.1: Research Interviewees

No.	Sector	Position	Symbol
1	IT	IT Manager	I_1
2	Education	Director of Information, Communication and Learning Technologies	I_2
3	Museum	Managing Director	I_3
4	Advertising & Marketing	IT Service, Support and Operations	I_4
5	Business Service	Practice Manager	I_5
6	Medical Service	Business Owner	I_6
7	Financial advisory service	Business Owner	I_7
8	Training	Business Development Manager	I_8
9	IT	Managing Director	I_9
10	IT	CEO	I_{10}
11	IT	CEO	I_{11}
12	Project Management	Managing Director	I_{12}
13	IT	Administrative Officer	I_{13}
14	Education	Program Manager	I_{14}
15	Non-profit Organisation	Accountant and IT Support	I_{15}
16	Trade	Managing Director	I_{16}
17	Education	Managing Director	I_{17}
18	Education	Consultant & IT Support	I_{18}
19	Consulting	Consultant & IT Support	I_{19}
20	IT Consulting	IT Marketing Analyst	I_{20}

The next section will provide a summary of drivers and challenges discussed by the 20 interviewees.

7.4 THEMATIC ANALYSIS

As discussed earlier in this chapter, the main purpose of the interviews was to further investigate the quantitative results from chapter 6. The themes in the qualitative stage were assigned from the result of drivers and challenges in the quantitative analysis which explicated 21 drivers and 27 challenges. The data analysis from the qualitative interviews produced two additional drivers and two additional challenges.

7.4.1 Drivers of Adopting Cloud Computing by SMEs

Starting with the factors encouraging SMEs to utilise cloud computing in Australia, table 7.2 provides a summarised thematic analysis illustrating the significance of each factor if it was considered a driver in adopting cloud computing. As in the previous chapter, these factors were classified according to the TOE model as being a critical success factor to gaining competitive advantage while improving business productivity, underpinned by Resource Based Theory (RBT). Among 23 drivers as success factors for adopting cloud computing, the total number of technological factors by all interviewees were 9. In addition, the list contained 7 organisational, and 7 environmental factors. The analysis of the interviews emphasised Australian SMEs were interested in technological and organisational factors, but were less interested in environmental factors, as shown in table 7.2. These factors will be analysed in detail in the following sections.

Table 7.2: Summarised Thematical Analysis of Cloud Computing Drivers for SMEs

Cat	Factor	QR	n	Considered By	Rank	Category Rank
Technology	Performance	1	7	I_1, I_2, I_9, I_{11}, I_{16}, I_{17}, I_{20}	6	3
	Convenience of use	2	6	I_2, I_9, I_{13}, I_{14}, I_{17}, I_{19}	*	*
	Security	3	5	I_1, I_9, I_{16}, I_{17}, I_{20}	2	1
	Accessibility	4	4	I_3, I_9, I_{16}, I_{19}	5	2
	Better maintenance	4	4	I_1, I_8, I_{10}, I_{15}	10	5
	Availability	6	2	I_3, I_{19}	8	4
	Scalability	7	0	N/A	11	6
	Setup time	7	0	N/A	12	7
	Complexity	7	0	N/A	16	8
Organisation	Operational time saving	1	6	I_1, I_8, I_{10}, I_{11}, I_{15}, I_{19}	1	1
	Business process	1	6	I_1, I_{12}, I_{14}, I_{15}, I_{16}, I_{19}	7	4
	Cost	3	5	I_1, I_9, I_{10}, I_{11}, I_{20}	4	3
	Improving business outcomes	4	2	I_{11}, I_{15}	3	2
	Supporting business strategies	5	1	I_9	9	5
	Up skills motivation	5	1	I_{12}	*	*
	Agility	7	0	N/A	14	6
Environment	Improving the relations with customers	1	4	I_2, I_3, I_9, I_{20}	13	1
	Trusted vendor	2	2	I_8, I_{18}	15	2
	Backup location	3	1	I_9	17	3
	Hosting location	3	1	I_9	18	4
	Vendor services	3	1	I_8	19	5
	Controlling IP	6	0	N/A	20	6
	Government regulation	6	0	N/A	21	7

Where:

- QR → Qualitative analysis rank in each category of the TOE model based on the number of organisations that consider the factor as a driver to utilising cloud computing.
- n → Number of companies who consider the factor as a driver to utilising cloud computing (out of 20 interviews)
- * → Explored from interviews.
- Rank → Quantitative overall rank of the factor by 470 Australian SMEs among all explored factors.
  Category Rank → Quantitative rank of the factor by 470 Australian SMEs within a category of the TOE model.

7.4.2 Technical Drivers

The data from the interviews showed the following most important technology factors: SMEs utilising cloud were seeking *better performance* (7 organisations), *convenience of use* (6 organisations), *increased security* (5 organisations), *accessibility* (4 organisations) and *better maintenance* (4 organisations). These factors were followed by seeking *better availability* (2 organisations). On the other hand, none of the 20 interviewees considered *scalability*, *setup time* and *complexity* as drivers for adopting cloud technologies.

7.4.3 Organisational Drivers

The data analysis from the interviews for organisational views of cloud computing use showed *saving operational time* and *supporting business process* were the most targeted organisational goals considered by 6 SMEs, followed closely by *saving budgets* considered by 5 organisations. Improving *business outcomes* (2 organisations) and supporting *business strategies* (1 organisation) were less important. One of the interviewees highlighted another organisational driver for adopting cloud computing - namely encouraging personnel to *improve their skills*. However, the *agility of cloud computing* was not considered as an organisational driver**.**

7.4.4 Environmental Drivers

The data showed that consideration of environmental factors by Australian SMEs was minimal. However, *improving relations with customers* (4 organisations) topped the list as an environmental driver in adopting cloud computing. *Dealing with a trusted vendor* (2 organisations) came second. *Backup and hosting locations* (1 organisation) as well as *services provided* (1 organisation) by the cloud provider came next. interestingly, Australian SMEs did not consider *controlling the IP* by cloud service providers or *government regulations* as drivers for adopting cloud technologies.

7.4.5 Challenges of Adopting Cloud Computing by SMEs

The challenges were previously identified in the quantitative phase. The data analysis of the interviews showed that the most common challenges facing SMEs in adopting and utilising cloud computing were technical. the data from the interviews confirmed 6 issues as sources of technical challenges among 13 investigated factors. Table 7.3 shows that organisational issues were the least challenging, appearing in 6 factors. Environmental factors were not perceived as challenges by non-adopters SMEs of cloud services, but were still significant among 6 out of 7 factors.

Table 7.3: Summarised Thematic Analysis of Cloud Computing Challenges to SMEs[26]

Cat	Factor	QR	n	Faced By	Rank	Category Rank
Technology	Lack of professional staff	1	8	I_1, I_4, I_8, I_{10}, I_{13}, I_{16}, I_{17}, I_{18}	24	13
	Implementation issues	2	7	I_1, I_2, I_4, I_8, I_{10}, I_{15}, I_{18}	22	11
	Security	3	5	I_2, I_9, I_{12}, I_{13}, I_{19}	3	1
	Privacy issues	3	5	I_1, I_{13}, I_{14}, I_{17}, I_{18}	10	7
	Lack of understanding cloud computing	5	4	I_{10}, I_{16}, I_{18}, I_{20}	17	9
	Operational issues	6	2	I_{16}, I_{19}	23	12
	Availability	7	0	N/A	4	2
	Accessibility	7	0	N/A	5	3
	Performance	7	0	N/A	6	4
	Setup time	7	0	N/A	8	5
	Complexity	7	0	N/A	9	6
	Scalability	7	0	N/A	13	8
	Lack of technical resources	7	0	N/A	18	10
Organisation	In-house data control	1	3	I_1, I_7, I_{16}	14	5
	Lack of executive support	1	3	I_3, I_{13}, I_{20}	19	6
	Losing IT jobs	3	2	I_9, I_{12}	*	*
	Setup and operational Cost	4	1	I_8	2	2
	Business process	4	1	I_{14}	7	3
	Personnel acceptance level to change	4	1	I_{10}	*	*
	The business does not need any of the cloud services	7	0	N/A	1	1
	Agility	7	0	N/A	11	4
	Lack of management support	7	0	N/A	20	7

[26] Although this chapter is analysing the qualitative data, table 7.3 also included the quantitative results from chapter 6, to give the reader the opportunity to compare the quantitative and qualitative results easily.

Environment	Communication & internet issues	1	8	I_1, I_2, I_3, I_5, I_8, I_{12}, I_{15}, I_{20}	21	4
	Hosting location	2	5	I_2, I_3, I_9, I_{12}, I_{20}	16	3
	Backup location	3	2	I_2, I_{20}	12	1
	Lack of provided services	3	2	I_9, I_{16}	25	5
	The international regulations	3	2	I_9, I_{12}	26	6
	Lack of government regulation	6	1	I_1	27	7
	Lack of overall trust	7	0	N/A	15	2

Where:

- QR → Qualitative analysis rank in each category of the TOE model is based on the number of organisations that consider the factor as a driver to utilise cloud computing.
- n → Number of companies who consider the factor as a driver to utilising cloud computing - out of 20 interviews.
- * → Explored from interviews.
- Rank → Quantitative overall rank of the factor by 241 non-adopter SMEs among all explored factors.
- Category Rank → Quantitative rank of the factor by 241 non-adopter SMEs within a category of the TOE model.

7.4.6 Technical challenges

The data analysis shows that all technical challenges came from only 6 factors out of 13. *Lack of skilled personnel* (8 organisations) appeared first. *Implementation issues* (7 organisations) were second. *Security and privacy* (5 organisations) came third, followed by a *lack of understanding* (4 organisations) of concepts of cloud computing as well as *operational issues* (2 organisations).

7.4.7 Organisational challenges

Organisational challenges comprised *in-house data control* (3 organisations) and *lack of executive support* (3 organisations). These were followed by a challenge highlighted from the interviews, namely *fear of losing IT jobs* (2 organisations). *Setup and operational costs* (1 organisation) and *business processes* (1 organisation) were also noted. Another parameter arising from in-depth interviews was *acceptance of personnel to change*. None of the firms investigated seemed concerned over *business agility* or *management support* in adopting cloud computing.

7.4.8 Environmental challenges

The environmental challenges showed 8 SMEs faced *communication and internet speed* issues, followed by hosting location (4 organisations), *backup locations* (2 organisations), *lack of services* provided (2 organisations), and *international regulation* (2 organisations), followed by *government regulation* (1 organisation). None of the SMEs experienced problems regarding *overall trust* in cloud computing for their businesses.

7.5 ANALYSING TECHNICAL FACTORS

The interviews were analysed in more depth by analysing each factor from two aspects to highlight potential success factors and challenges to cloud adoption. The factors are analysed in three categories according to the TOE model. The factors are arranged according to the order resulting from the qualitative analysis, first the success factors followed by the challenges. For each factor, the analysis highlights the significance from the interviewee's perspective, followed by a comparison with the quantitative results from chapter 6 to provide a comprehensive analysis of the data.

7.5.1 Performance

Interviewees considered seeking better performance as the first factor among the technical goals in adopting the cloud; which supports previous quantitative results, where seeking better performance is one of the common drivers noted by SMEs surveyed, who ranked performance as the third most important factor. This harmonized result between the qualitative and quantitative phases means that seeking better performance from the cloud is one of the top influences that attract SMEs to adopt it.

The demand for better performance from utilising cloud computing increases when the firm has limited on-premises resources to handle assigned tasks. For example, working collaboratively on shared documents and spreadsheets requires extra resources to maintain system performance, which is supported by cloud computing. Another example is when the organisation needs to work with high-performance resources for development, graphics, audio and video processing, as interviewee (11) stated:

We have used quite a lot of service providers to run time sheets, billing software, adjust help desk software for our client projects; most of that's outsourced to cloud providers. Generally, it’s worked quite well.

And:

We do a lot of outsourcing for our developed work. We need specialist services for audio work. Lot of creative graphic work

Another view of the significance of cloud computing performance in an indirect way is ensuring the firm obtains the latest updates from the cloud provider as part of the provided service. Interviewees believe that being up to date would increase the likelihood of best performance at the level of resources in the market without costing more. Interviewee (1) discussed the issue of having outdated solutions before moving to the cloud:

From the email perspective, we were using an outdated version of email platform and it was becoming very expensive to maintain or update. This hindered our business from performing tasks with better performance.

After utilising cloud computing, interviewees (2) and (9) are examples supporting the view of having the latest applications in the market as being possible from using the cloud:

The minor base to use our ability to use the best of the offered software so that rather than developing a newer solution which, you know, involves a lot of resources to setup. We’re able to look at what survival in the market, make a choice that suits our needs.

And:

It’s good from a marketing perspective to be on the cloud. People generally accepted that’s the way forward. A lot of staff want to be working on the latest technology, not outdated technology. So, it’s good from that perspective because it makes people feel that, you know, they’re on the cutting edge, the clients.

The data shows that the performance factor is connected to several other factors, such as business process requirements as well as cost savings.

The performance factor was ranked fourth in the quantitative stage of this study as a technical challenge preventing non-adopters from using cloud services. However, the adopter SMEs interviewed using cloud computing, didn’t note any direct technical performance issues. They highlighted some external – environmental – factors that could affect the performance[27].

7.5.2 Convenience of Use and Complexity

The data analysis showed an opposing relationship between convenience of use and complexity. Viewing cloud computing as a complex solution hindering non-adopters from using cloud services ranked sixth among the thirteen technical factors in the survey. As a driver, interviewees expressed the simplicity and convenience when utilising cloud computing as a driving factor. Convenience was the second most important driver and one of several critical success factors in adopting cloud computing, as interviewees (9) and (14) said respectively:

> *Its recognition in the marketplace, its rate of use. So, we need to provision for new servers and create new databases and things like that. So, it's pretty important that we can do that easily. And it needs to be cost competitive, but that’s probably not as critical as the other things. So, sort of awareness, security, and ease of use, they’re probably the critical things from our perspective.*

And:

> *The critical success factors: convenient and easy to use.*

Investigating the possible complexity of adopting cloud computing from the adopter SMEs’ perspective in the interviews showed none of the investigated SMEs had problems related to cloud complexity.

Compared with the quantitative results, *facilitating business tasks and processes* and *expecting non-complex solutions* by using cloud based solutions, was supported by SMEs in the survey, where they didn’t see any additional complexity arising from using cloud-based solutions.

7.5.3 Security and Privacy

SMEs need to consider regulatory requirements such as the *Privacy Act* (1988) and if applicable competition and resources (Privacy Act, 1988a). The results highlighted security in

[27] For further details, please check section 7.7

the cloud was a critical as well as a controversial factor. As a driver, interviewees believed that the cloud was a secure solution, especially if the service was provided by a well-known provider, as noted by interviewee (17):

> *… it [the cloud] would enhance the system security. Even if we have secure systems, but obviously, our systems are not as secure as the large companies, such as Microsoft and Amazon … I think it's very secure because I only have a part of access to the information. So, I think it's quite secure.*

Investigating cloud security[28] was a challenge that prevented some SMEs from adopting cloud services as noted by five SMEs who saw this challenge was a concern of outsourcing, and emphasised a belief in finding better security when systems are in the cloud, as noted by interviewees (1), and (13):

> *I think the cloud solution provided good comfort in availability and security. People often are concerned about security in the cloud but the major cloud service providers do better than us in security and data centres.*

And:

> *… while the fear from cloud security and collecting private information without permission is always in the mind as a cloud consumer … just concern.*

Although SME adopters of cloud computing addressed data privacy by moving to the cloud, there were still concerns regarding privacy as a possibility of data breach. A related challenge with governments' regulation appeared here, as some governments have the authority to access any data within their borders, as mentioned by interviewee (1):

> *There is still of course the other underlying issues about data privacy as we still have challenges with government in a lot locations that want all the data centres stored within the country. How we do that presents*

[28] In order to gain further insights into the challenges of security and privacy, these two factors were separated in the interviews while studying them as challenges.

> *some challenges so that sometimes it means we need to work with the service providers that can offer facilities in other countries.*

As a solution to this issue, an interviewee suggested using services from providers who offer data storage within Australian borders, discussed by interviewee (2):

> *We in Australia, we understand what rules and regulations apply to privacy and security and to, you know, those sorts of things, so that's why we specify that the vendor must be Australian based not only in terms of the company but the actual data centre, you know, is located in Australia.*

These findings support the quantitative results of the survey emphasises this controversy when discussing security and privacy in the cloud, where seeking better security ranked as the top technical driver to adopting cloud services and the top challenge encouraging non-adopters to step back from a cloud environment.

7.5.4 Accessibility

The qualitative analysis showed that accessibility was the fourth ranked factor when Australian SMEs adopted cloud computing, considered by four out of the twenty interviewees. Gaining *better accessibility* to the organisation's systems was one of the most important drivers encouraging them to use cloud services. Accessibility was more important to organisations who had more than one location. Some of these locations could be overseas and required access to the same centralised systems as well as access to distributed systems easier than before, as interviewee (9) stated:

> *I guess the other thing is we sell overseas. So, the ability to have access and data stored and backup in different locations is very important… We can support the application here, rather than having to go to the clients. So, it makes it much easier to support and sit here to, you know …., we support applications out of Singapore and New Zealand.*

Recall the survey in the last chapter emphasised the significance of gaining better accessibility was ranked as the second most important technical factor among the 229 firms who utilised cloud computing. Both qualitative and quantitative phases emphasis accessibility as a significant influence to adopt cloud computing.

Interviewees did not encounter any accessibility problems while using the cloud. This would minimise the concern of the non-adopters who ranked accessibility in the survey as the third technical issue acting as a barrier to adopting cloud computing.

7.5.5 System Maintainability

The interviewees believed that seeking *better maintenance* was one of the goals for adopting cloud computing. Similar to seeking better accessibility, four interviewees considered it a significant driver to adopting cloud based solutions ranking it as the fourth most important technical factor. The quantitative data aligns with this result, where looking for better maintenance was ranked the fifth technical driver.

The nature of some SMEs working in limited environments saw outsourcing their workload as a means for reducing overheads of having dedicated resources, including highly skilled IT staff and focusing on their core business instead. Interviewees (1) and (8) supported this view respectively:

> *We are going through a significant change because we've taken a lot of work away from them and given them to cloud providers.*

And:

> *Less overhead (less IT staff's hours to be used to maintain the infrastructure such as backing up, upgrading the application or operating system, etc.). This gave us more opportunities to focus on our business.*

7.5.6 Availability

The availability of uptime was noted as one of the success factors in adopting cloud computing by Australian SMEs. The interviews showed two organisations considered availability a driver in adopting cloud computing to facilitate business tasks and processes as interviewee (3) mentioned:

> *We are able to provide a much high level of reliability and much higher level of uptime… It's quite amazing how readily people talk, you know, to really being contactable almost 24 hours a day and using it not just for work-related purposes.*

The qualitative phase ranked availability as the sixth technical driver to adopt cloud computing. This slightly aligned with the quantitative phase that ranked availability as the fourth technical driver.

System availability was not seen as a threat by the interviewed adopter SMEs. However, the quantitative phase showed that the non-adopters had a significant concern regarding system availability in the cloud, and ranked it as the second most significant challenge. The only issue highlighted in the interviews is summarised in these words:

> *If I lost the internet connection, the entire business could die.*

7.5.7 Scalability and Setup Time

Scalability and *setup time* factors were not considered significant by the interviewed adopter SMEs. Neither of these factors were considered as drivers for adoption of cloud computing nor a source of threat in using the cloud. In the survey these parameters were seen to be last as technical success factors, ranked sixth and seventh respectively. As a source of challenge, *setup time* was ranked by cloud non-adopters as the fifth highest potential technical source of challenge with *scalability* in eighth place.

The following factors were considered technical challenges as Australian SMEs adoption cloud computing. The following factors were ranked lower as challenges by non-adopters in the survey. However, the interviewees noted some of these factors were highly significant, discussed in the next section.

7.5.8 Lack of Professional Staff

Although lack of professional staff was ranked number 13 (the least significant technical challenge and 24th among 27 investigated challenges by non-adopters in the survey), interviewees highlighted the opposite view, considering lack of skilled personnel as the top challenge their SMEs faced if and when adopting the cloud. This observation was noted by eight interviewees. They agreed adopting advanced systems require some configuration, or at least migrating on-premises systems to the cloud; including dealing with middleware and requiring knowledgeable staff to deal with this. Some issues may be easy to solve or to configure, but those issues would require a person who has sufficient knowledge and skills in cloud computing. In addition, some technologies or solutions may require specific training.

These obstacles could cost the organisation a significant portion of their budget as interviewees (1), (8), and (13) stated:

> *When you move to cloud based system and you need middleware it's a different set of integration, even things like identity management, how to manage login to the computer and we need to do upskilling, was a fact that into the cost of project are people upskilling.*

And:

> *There are no skilled personnel, we need to hire third parties to help at the start, especially during migration. We have to send the staff for training…*

And:

> *Some cloud technologies need skilled people, which are not always available in the IT market, or you find expensive people.*

7.5.9 Implementation Issues

Implementing cloud based solutions was not considered as a driver by interviewees. However, some interviewees admitted ease of migration to the cloud was one of the unexpected features of cloud computing as interviewees (2) and (10) said:

> *The unexpected outcome was how easy and straightforward is moving systems to the cloud*

And:

> *Ease of file migration is kind of unexpected…*

Similar to the lack of professional staff, the quantitative results showed Australian SMEs ranked migration as the 11th technical factor. Additionally, the non-adopters had not considered possible implementation issues as significant challenges when adopting cloud computing.

However, seven interviewees who experienced adoption of cloud services, highlighted issues around implementation, placing this factor as the second most significant challenge in adopting cloud services by SMEs in Australia. Although some third parties provide customisation services, customisation is the most common challenge in implementing SMEs systems which can cost the organisation extra time and budget. This factor is connected to the lack of the professional staff, because of certain technical concepts and knowledge. SMEs may have to comply with what cloud service providers offer in their provided service, especially when utilising a SaaS model, leading to a potential loss of certain features of on-premise systems, replacing these with features provided in cloud-based solutions, known as business process re-engineering (Guha et al., 1993). As discussed by interviewees (1), (2), (8), and (15) respectively:

> *When the service provider decides to push a feature that you don't like you got no choice, you have to take it, well it's the same with cloud solutions… we used to customise heavily. We can't customise as much anymore.*

And:

> *When you're buying software as a service, you don't have the same ability to customise it as you might have used it with an internal application.*

And:

> *The customisations that company wants take some time to get it done. Again, a third-party vendor that can help with more complex customisations was engaged to help for the higher level customisation.*

And:

> *Yes, we spend many long times to do this. Yes, that was the other problem*

In addition, depending on the size and nature of the migrated system, on-premise systems might require middleware for migration as interviewee (1) mentioned:

> *Integrating salesforce data with ERP systems requires some middleware. So, we had to reengineer that but at the same time we are getting better.*

7.5.10 Lack of Understanding of Cloud Computing

Although the quantitative results showed the majority of the non-adopter Australian SMEs had not considered their knowledge and understanding of cloud computing as a challenge that could hinder cloud adoption, nonetheless four interviewees stated limited understanding of cloud computing provided challenges for adopting cloud services. The level of these challenges depended on the complexity of the adopted solutions, where simple systems might not need extra skills or might need just minimal technical knowledge, but acquiring advanced, detailed and complex solutions would require more knowledge to do so. This issue could get more complicated when acquiring PaaS or IaaS, and is one of the reasons leading SMEs hire skilled personnel, as interviewee (10) mentioned when adopting PaaS and IaaS:

> *I have to say this provider is very, very technical because first of all, you need to understand the terminologies… All these terms were very difficult to understand at the beginning. So, you need to look into the descriptions of the terms as well as the services they're offering to those terms. So, I guess, to use this kind of service you need to be technical as well. So, if you don't have any technical background for a small business I think it will be pretty hard to adopt.*

In addition, misunderstanding some cloud computing concepts could lead to misleading costs in using cloud services. As advised by an interviewee where SMEs should hire experts to calculate accurate costs, interviewee (16) said:

> *Yes, especially if the concept is important to run your business or to calculate the cost. For this I said that we need the right person to fill this gap.*

7.5.11 Operational Issues

Exploring possible operational issues showed the majority of interviewees had none or limited concerns about these issues, being mentioned twice only. One of those two SMEs interviewees mentioned that they didn't encounter any issues, but they prepared a contingency plan by contracting a skilled person casually to solve issues if they appeared. The only issue came from the other SME due to their service level agreement (SLA), which is the need to contact the service enabler every time they want to add new accounts for new staff.

Interview results along with the quantitative result from the previous chapter ranked operational issues as the 12th most significant technical challenge.

7.5.12 Lack of Technical Resources

The required technical resources factor was insignificant. Non-adopter interviewees ranked it as the 10th technical source of challenge, and the interviewees who utilise cloud-based solutions, did not identify technical resources as a challenge. Analysing technical resources comprises the last section covered under technical factors. The following section will analyse the organisational factors.

7.6 ANALYSING ORGANISATIONAL FACTORS

7.6.1 Operational Time Saving

The interviewees nominated reducing operational time as one of the top drivers that would encourage SMEs to use cloud computing. Six interviewees elected operational time saving as one of the top two organisational factors. They stated utilising cloud computing helped in time-saving in daily operational activities. Advanced technologies in cloud computing make it easier as well as saving time, for the organisation in maintaining and replicating servers with minimal issues as interviewees (10) and (19) noted:

> *Another important factor is that it's very easy to replicate the server. So, if a client decides to upgrade the plan it's very easy for us to do so…*

And:

> *Cloud computing helped us to save operational time in doing our daily activities.*

Additionally, utilising cloud computing by some SMEs with remote locations, can potentially save communication time in collaborating with others as well as in utilising video conference solutions, also saved considerable operational time in running remote meetings instead of being physically present. From interviewee (15):

> *Since we have most of our people working offshore in Europe, it was really good because it speeded up the communication and we can share all the information between us and between them without sending an email and the attachments. We talk cloud base and we see all the information at the same time. We can all work at the same time on the same things because we are not here at the same time. We're not in the same office.*

The previous chapter showed that the quantitative results ranked saving time as the first goal for adopting cloud computing among all the factors investigated in the explanatory framework.

7.6.2 Business Process and Needs

Analysing the need of SMEs to utilise cloud computing showed contradictory views. The qualitative viewpoint showed that the interviewees nominated the expected benefits in improving business process as one of the top two organisational factors. Having multiple branches requires centralised data to improve daily activities, accuracy and business decision-making. Six organisations interviewed stated cloud computing improved business processes to provide collaborative work within and with other businesses, this feature seemed more efficient for SMEs having remote sites that could be also overseas. Interviewee (15) in the previous section (7.6.1) and interviewee (1) provided examples of collaboration in the cloud:

> *We did some video conference investment, but the major investment was a cloud based collaboration called Jive which is like a web version of SharePoint and so we brought that up to give users the ability to build their own departmental project based websites like them all together you can follow each other. It's a bit like Facebook and LinkedIn combined on intranet platform and so is really fast and better collaboration between everywhere in the organisation.*

In addition, using cloud solutions helped improve business processes by avoiding unnecessary activities such as email based communications, replacing them with more productive solutions such as cloud-based ERP systems, as interviewees (1) and (12) discussed:

> *…. you know breaking down the barriers of ERP systems and hundreds of mail services everywhere and getting it back to single data centre.*

And:

> *We are using Software for architecture engineers to work on the design together.*

An interviewee (16) highlighted some organisations might require certain IT based solutions. However, the limited space on-premise counted against making use of such resources, while cloud computing helped in utilising the required services without the need to hire additional physical space to accommodate the required IT:

> *It [cloud] gives us huge amount of storage that avoids the headache of saving and protecting data on-premise as we couldn't bring our system before due to the limited space in our firm. Also, cloud computing is very cheap to adopt and gives massive opportunity to collaborate even with other businesses online.*

Appearing as a challenge to the firm, cloud computing would affect the business in producing an over-dependency on using computers to implement business processes, as one interviewee (14) articulated:

> *It might make people over depend on computers.*

Recalling the quantitative results (chapter 6), businesses stating they do not need cloud services as the top reason of non-adopter SMEs for not adopting cloud computing. Also, they believed that the situation of current business process hinders the adoption of cloud computing ranking it as the third organisational challenge. On the other hand, the survey showed that the cloud-adopter SMEs ranked improving business processes as the fourth most important organisational factor.

7.6.3 Setup and Operational Cost

The related costs to adopting and utilising cloud computing is one of the contested factors considered a major success factor by some interviewees and considered a significant threat by other interviewees in the same study. The analysed data – as in table 7.2 – showed SMEs who were in favour of the positive effect of cost in adopting cloud services, ranked it as the third most important driver (considered by 5 out of 20 interviewed SMEs). On the other hand, one firm considered it a clear challenge (4th place), with two other factors, discussed in the following sections. Controversy appeared with regard to cost, as several companies raised some significant issues related to costs. By looking back to the result of the survey in chapter 6, the cost factor was still a contested topic, where it was ranked as the third most important organisational driver to encourage SMEs to adopt cloud computing, but the second main organisational challenge that prevented non-adopters from utilising cloud services. Therefore, every interviewee was asked to discuss the relationship between the estimated and actual cost of adopting and utilising cloud computing by SMEs.

The interviewees who were happy with the cost of cloud services, admitted the adoption of cloud services was affordable and one of the main cost related benefits of cloud computing, as interviewees (11) and (20) mentioned:

> *The success factors I'd say as being, cost is very important.*

And:

> *The benefits got to be for us that it's cheaper.*

Using cloud computing is a considerable operational cost saving that provides most of the required solutions to the business compared to the on-premise solution or compared to not using cloud based hosting options when it came to utilising a large amount of resources, as interviewees (9) and (10) stated respectively:

> *Cloud Computing is very inexpensive. So, compared to traditional hardware models. The nice thing for us is we use the scalability of the cloud so we only need to pay for the hardware that we need. And that means we don't need to buy big machines in anticipation of future business. And if someone wants some results using enlarged clusters or something like that, we can spin it out for a couple of days and run it, and spin it down again.*

And:

> *Firstly, obviously, is the price. So, we did use a few other hosting companies in the past which I believe were not cloud based. So, they will have a standalone server sitting somewhere. But, you know, the minute we came across our current cloud provider, we felt the price was cheaper.*

Several other interviewees agreed that saving the operational costs was one of the benefits from cloud computing, even if they didn't consider it as a driver when they decided to adopt cloud based solutions for their firms, as interviewees (14) and (18) mentioned when they were asked about tangible/intangible benefits of cloud computing:

> *Tangible benefit: save money*

And:

> *See in that sense it saves hours and basically it saves printing. We don't have to print much. So, it's very cost-efficient.*

Migrating to cloud computing helps SMEs save additional costs in removing many on-premise hardware resources that were not necessary. This also saved costs indirectly by avoiding extra physical space to accommodate on-premises resources, as interviewee (1) said:

> *In terms of tangible benefits, we were able to reduce down to two servers from tens … we have better leverage with isolation, significant real estate savings, power, people and genuine cost savings.*

Thinking about the benefits from the adoption of cloud computing to SMEs without pre-considering them at the early stages as drivers to adopt came with three features. First SMEs could save operational costs by avoiding hardware and software license costs and reducing resource maintenance to a minimum through outsourcing maintenance as part of provided services, or via the internet from affordable IT professionals around the globe as interviewee (8), (9) and (18) mentioned respectively:

> *The amount of cost savings for hardware and software licenses.*

And:

> *We don’t need to have IT people right there to support or back you out. You can have them [service] if you need them via the internet from the place that provides good, cheap IT support.*

And:

> *See in that sense it saves hours and basically it saves printing we don't have to print much. So, it is very cost-efficient.*

The second feature is the expectation to facilitate tasks and collaboration, and to provide better customer service to SME customers at lower cost, as interviewees (3), (7) and (16) discussed:

> *We can provide and deliver a service that we would otherwise not be able to do because we're very under-resourced. We have a very, very small team and we don’t have a lot of budget. And yet, people want to do all sorts of wonderful things.*

And:

> *A tangible benefit is cost. It simplifies things because I don't have to deal with it in the office … Tangible benefit is cost. It simplifies things because I don't have to deal with it in the office.*

And:

> *Cloud computing is very cheap to adopt and gives massive opportunity to collaborate even with other businesses online.*

The third feature are significant cost savings that some cloud service providers used to offer to educational, philanthropic and non-profit organisations. They can utilise some costly services free of charge as part of the service provider’s policies supporting those types of organisations, as interviewees (3) and (20) mentioned:

> *We use completely Microsoft, Windows you know and Microsoft services, because being a public museum, we’re a public education entity so we enjoy the sort of licensing arrangements as universities. So, we get enterprise educational agreement with an incredible range of services and products to consume at really a very affordable price.*

And:

> *Being a charity, we get those sorts of things very cheaply anyway. But we can get Office365 at zero cost if we want to, provided, we do everything in the cloud. If you want stuff on computers as well, we have to pay a small fee per month.*

Some cloud service providers included the total cost calculation in the provided service as part of the service level agreement (SLAs), as interviewees (2) and (11) said:

> *I think for us, the services we use are all subscription-based and in most cases included a setup cost and subscription cost to use the service at the time and so the costs were upfront, we’re well aware of them.*

And:

> *The cost has been pretty transparent in most of the services that we have used. They are relatively like cost services where you are typically paying a monthly fee, a lot of our development products have now turned into a cloud service.*

However, the other side of cloud computing costs were the possible threats of increasing adoption and utilisation costs as a result of miscalculating certain hidden costs, such as the cost of providing sufficient training to SME staff to work on the new systems, as interviewee (8) mentioned:

> *The initial training for staff to use the new cloud system can be costly.*

This particular issue was mentioned by interviewees (2) and (14) as their SMEs were aware of this in order to get actual costs close to what was estimated:

> *The training cost was one of the things we budgeted for, we anticipated what they've been, I had a training budget and in most cases, the training was simpler and easier than anticipated.*

And:

> *The actual cost is ok if you calculate the hidden costs.*

Calculating the hidden costs also plays a significant role in calculating the return on investment (ROI), which should include all possible tasks and requirements. Some possible costs arising could come from inside the SME where the provider might not be able to cover, such as salaries of skilled personnel, as interviewees (2), (4), and (11) highlighted:

> *I am aware that once you get into a platform as a service or infrastructure as a service, the calculations become much more complicated. We've been lucky because of using software is a service. Certainly, the applications that we're using have been straightforward.*

And:

> *Yes, so every cloud provider is calculating the usage … we are not exposed to that kind of calculation so it was challenging.*

And:

> *There is a lot of calculation that goes on. Our main costs are obviously wages and the costs of the various services and software products that we use are mid-skilled, compared to the wages my staff get paid. So, those costs are relatively insignificant compared to our overall sort of salary cost.*

Hence the lack of factoring in adoption requirements could end up with unexpected extra budget that is potentially a serious challenge, also problematic if the organisation realises they need additional services after assigning and confirming the budget, as interviewee (8) mentioned:

> *The estimated cost is usually lower than the actual costs, because sometimes companies realise along the way they need to add extra features or add extra clients to access cloud services.*

There are other external factors that could affect the budget assigned while utilising cloud services, which should be considered when preparing the budget, e.g. reviewing the service price by the cloud service provider. The service price can affect the budget, either to help SMEs in saving or even consuming more of their budgets. Also, some cloud applications may charge per downloaded data, which can lead SMEs to controlling their data traffic to avoid running over their dedicated budget. In addition, adopting cloud services and paying in a foreign currency is likely to be affected by the fluctuation of the exchange rate which would be better to consider in the SLA, as interviewees (4), (6), and (9) said:

> *We had estimated an extra cost than the actual … the cloud providers always have a habit of releasing the cost mark, and then decreasing this, it's good for us.*

And:

> *The downloading process could be charging for any material which is hard to estimate.*

And:

> *In our contracts, we have the right to review the price according to the currency exchange and customers accept that because they know that we're relying on third party to provide the service … So, we're happy to go with the currency fluctuations and swings and roundabouts …. Some of our customers are paying in US dollars or New Zealand dollars and stuff like that. So, we get a bit of an offset here as well. So, it's totally obvious that we want to be everything based in Aussie dollars.*

7.6.4 Improving Business Outcomes

Enhancing the production and business outcomes is one of the expected drivers from adopting cloud computing. The interviewees ranked it as the fourth organisational success factor which considered by two interviewees. Furthermore, none of the 20 interviewees stated cloud computing could reduce their outcomes. Linking this result to the quantitative survey there were noted to be better outcomes from utilising cloud services which was the second most important organisational factor ranked by some 229 of the Australian SMEs.

The interviewees stated that utilising cloud solutions helped their organisations perform tasks quicker, and to innovate new tasks to facilitate business processes, e.g. online collaboration, communication, and sharing real time and updated information among different sites instead of sending or waiting information via a classic channel, such as emails. These points can be seen mentioned by interviewees (11) and (15):

> *Convenience, being able to get something happening very quickly*

And:

> *Since we have most of our people working offshore in Europe, it was really good because it speeded up the communication and we can share all the information between us and between them without sending an email and the attachments. We talk cloud base and we see all the information at the same time. We can all work at the same time on the same things because we are not here at the same time. We're not in the same office.*

7.6.5 Supporting Business Strategies

Adopting a solution to the business that is able to reduce the business consumption and improving the organisation’s outcomes would lead to a support for business strategies. Interviewee (9) stated one of their business strategies is minimising dependency on their clients while providing the required service to them by utilising cloud based solutions:

> *We’re not relying on the customer to buy machines. We're not relying on a customer to create an environment in which our application can run. All they need to do is be able to log on.*

This concept placed the ability of cloud computing for support business strategies as one of two drivers as the fifth organisational success factor. This view was supported before in the survey where it ranked as the fifth organisational factor, and the ninth among all studied drivers in the survey.

7.6.6 Up Skilling Motivation and Job Security

The pressure to adopt new solutions or technologies in the firm could lead some staff to improve their skills and knowledge in order to secure their positions. This factor was explored during analysis of the interviews and was not noted during the survey itself, but was revealed by interviewee (12) who placed it as the fifth organisational driver that would help the organisation in encouraging its workers to upskill:

> *The positive side is pushing people to get extra skills to be competitive.*

The opposite view of motivating personnel to upskill was not discussed in the quantitative study, but mentioned here in the interviews by two SMEs who ranked it as the third source of challenge in adopting cloud computing; this view focused mainly on job security. Skilled resources are at a premium and the other side of this is that if the SME has upskilled workers, those workers may leave and go to other competitors. Also, staff might have a concern of losing their jobs if they don't have the required skills to deal with new solutions. Even if they have those skills, the threat still exists if the business shifts to hiring cheaper professionals from overseas to save budgets or local professionals might face a dilemma to choose between either accepting lower salaries or being forced to leave their jobs, as interviewees (9) and (12) highlighted:

> *IT people working for companies make their daily living by writing stuff about security and building databases and managing stacks and stuff like that. So, the last thing they want to hear, is that a lot of their job is going to be taken away.*

And:

> *The drawback is removing thousands of jobs in the IT industry by relying on the big players. This also impacts the salary for local workers by outsourcing work overseas to cheaper workers.*

7.6.7 Business Agility

This study found SMEs seemed relatively disinterested in business agility. Interviewees did not consider business agility as a driver nor as a challenge in adopting cloud computing. This finding is supported by the quantitative survey findings where participant ranked this factor last.

The following factors appeared as sources of organisational challenges to SMEs who adopted cloud computing, after analysing the interviews.

7.6.8 In-house Data Control

The desire to have full control of data by hosting data on-premises, was considered by three SMEs as one of the top two organisational challenges that could stop organisations from taking a step forward to utilising cloud services,[29] this would limit certain on-premise flexibilities. For example, an organisation could access old data of inactive accounts easily when needed, such as accessing emails of previous employees. If a cloud service is adopted, employees may have to ask the service provider to reactivate accounts or retrieve required data. It may hinder an organisation's responsiveness by delaying access to information to provide a solution to a customer. The organisation may lose some data if they decided to unsubscribe from the provided service and missed backing-up the required data, as interviewees (1), (7) and (16) noted:

> *If someone had to leave the company, it was easy to administer his mail internally. And we lost the control when we moved to the cloud. You can reset the mailbox to somebody else but you can't drop in and out of the mailbox like you do. From a business perspective, they don't like that, so if a manager loses access for somebody who's left, but from the IT perspective they do not like having that access to a mail file as a level of comfort and privacy.*

And:

> *I guess the negative thing is also a loss of control to some extent because if something happens I don't have, you know, I don't have the IT guy*

[29] As discussed before, the organisational challenges were very limited. This appears here, where the top organisational challenges were considered by only three firms, and it was ranked in the survey as the 14th challenge among all of the examined challenges.

here who can do that for me, right? So, I guess the loss of control is a factor and if something goes down ….

And:

The other issue is when you stop your subscription; you might lose your work and data.

7.6.9 Lack of Executive Support

Interviewees elected lack of executive support as the other top challenge facing firms adopting the cloud, although this challenge was considered by only three interviewees. This factor was ranked in the quantitative survey as only 19th among all 27 challenges. An SME may be interested in moving toward the cloud, but find that they face resistance from executive management for varying reasons, including having general or specific concerns, lack of sufficient knowledge in understanding cloud computing and having insufficient awareness regarding possible opportunities of adopting cloud computing. Government agencies and departments may face additional obstacles, falling into a long process to obtain required approval to adopt the necessary cloud based solutions, as interviewees (3), (13), and (20) claimed:

In government agency, I mean, we've got many levels of approval, business cases, procurement plans, procurement policies. We've to go through all of that process.

And:

The support was very difficult from the senior executive management.

And:

When I first raise this issue here, the CEO, he was sitting, no way, afraid, doesn't understand and doesn't really know much about the cloud but we have been ganging up on him so that he is slowly, he is coming around at the point where he can set out seeing that it's advantageous.

7.6.10 Personnel Acceptance Level to Change

Employee acceptance to move toward the cloud appears to be a challenge in some SMEs. This issue was considered by one interviewee and ranked as the last possible organisational challenge during the interviews (but not noted in the list of challenges in the quantitative study - chapter 6). Interviewee (10) stated they faced some challenges until staff became familiar with the new system, which is as the interviewee believed a common reaction from workers at the beginning. Do you have a quote from the interview to illustrate this point? The next section analyses environmental factors.

7.7 ANALYSING ENVIRONMENTAL FACTORS

The third analysed category with regard to the TOE model is related to environmental factors, which come from outside the firm and could affect the business. The following analysis in this section shows the environmental category is contested, especially when it comes to the possible challenges. This is because the majority of non-adopters (arising out of the quantitative results in chapter 6), did not consider environmental challenges as significant - ranking the top environmental challenge as 12^{th} among all the challenges. However, the interviewees revealed the high chance of facing several environmental obstacles that could compromise expected results in utilising cloud computing. The environmental drivers and challenges were analysed as the following:

7.7.1 Customer Relationship Improvement

Cloud computing plays a significant role in improving relationships with customers. Four interviewees considered relationship improvement a success factor in adopting cloud technologies placing it at the top of the environmental factors' list. None of the interviewees considered cloud computing a challenge that could affect their relationships with customers. The significance of this factor was also noted before (chapter 6), where 229 SMEs mentioned the power of cloud computing in improving relationships with customers, as the top environmental factor when migrating to the cloud.

The interviewees highlighted utilising cloud computing led to positive feedback from customers, more than what the firm expected, depending on the type of business and the nature services offered by it. Cloud computing may also increase customer trust in the SME that utilised cloud based services, as customers might prefer businesses who run using the latest technologies in the market. Utilising cloud computing would preferentially place the organisation against equivalent businesses not adopting the cloud. Here interviewees (2), (3), and (9) discuss some of these issues:

> *The feedback from them has been positive as well. So, I'd have to say that that was an unexpected outcome.*

And:

> *The equivalent sectors in the state public service have come to us to ask for advice to ask for help with the adoption or their strategies or how they should go. So, that certainly I'm sure are called intangible benefits for the directors and the assistant directors and people like that, because we're otherwise a fairly small agency.*

And:

> *It is good from a marketing perspective to be saying we are on the cloud. People generally accepted that's the way forward … It's good from that perspective because it makes people feel that, you know, they're on the cutting edges, the clients of course.*

7.7.2 Trust

Having sufficient trust in cloud computing and cloud vendors is one of the noteworthy factors that would work as driver or a challenge. Two interviewees believed that the trust of the service provider as the second important environmental driver and essential to utilising cloud services. Interviewees argued SMEs must not pick a provider or a service randomly. Instead, they should do some research to select appropriate solutions. In addition, the trust factor itself is a broad category, and would be affected by several factors, which include securing against insider threats such as local machines and the capabilities of staff in accessing and using the data. Other issues related to securing against outsider threats such as encrypting the internet connection used, as interviewees (8) and (18) discussed:

> *Choosing the right product and services, including the right provider … Research about how the company (cloud provider) has invested.*

And:

Cloud computing is good but it needs a few things. First of all good internet, second good computers, third the capabilities of individual persons who are working in the industry.

Recalling the quantitative results (chapter 6), non-adopter SMEs ranked their lack of trust in the cloud environment as the second environmental challenge stopping them from its adoption.

7.7.3 Service Location & Political Regulations

With regard to the storage of SME data for hosting or backup, they were considered drivers by one SME among the 20 interviews even if these two factors were not at the top of the drivers or challenges lists in the quantitative study (chapter 6). The interviewee data showed five SMEs considered hosting location as a possible source of a challenge ranking it as the second environmental issue. Also, backup location was considered by two SMEs during the interviews placing it one of the third possible environmental challenges that SMEs would encounter in adopting the cloud.

Viewing the location as a driver would depend on the nature of the SME's business. If the organisation provides overseas services, hosting and backing up data in different sites would speed up and facilitate offshore tasks and transactions, as per interviewee (9):

We sell overseas. So, the ability to have access and data stored and backed-up in different locations is very important to speed up transactions.

Hosting and backup location would bring some challenges to the organisation if they were not selected properly, as a result of other factors that could make the location a challenge. Technically, the location could affect data traffic speed, especially when the SME was running major tasks or downloading/uploading large amounts of data, as interviewee (12) mentioned.

The location could be a challenge in association with other challenging factors, such as the related factors to government regulations and the privacy act. Hosting and backing up data overseas would necessitate SMEs comply with both local and international regulations, which would generate extra obstacles to the firm, as interviewee (12) highlighted.

In some government jurisdictions, the government has the right to access all the stored data within its' country's borders. In Australia, this issue can be resolved if the SME selects a cloud provider, which has a data centre in Australia - discussed by interviewee (20):

> *Well, that is an issue because by storing data in some countries, like U.S.A, you give permission to the U.S. government to access any data without permission, as part of their national security, but as long as it's located within this country, that wouldn't be a problem.*

In some industry sector, organisations must host and backup their data within Australia's border; this would limit available options in the market and lead the organisation to choose a provider that has a data centre in Australia, as interviewee (2) stated:

> *We are in Australia, we understand what rules and regulations apply to privacy and security and that's why we specify the vendor must be Australian based, not only in terms of the company but the actual data centre.*

In addition, some other countries insist all business-related data in their countries must be managed and stored within their borders. An interviewee noted that one of the reasons for this, is to let cloud providers establish local data centres to create jobs for local people. If a SME provides services to one of these countries, they may face this type of issue, as per interviewee (9):

> *Some countries insist that data does not leave their borders, and that means you need to have the data stored there. So, more data centre locations would be a trend. … You can understand if you're in Thailand for example. Thai politicians want to build a data centre in Thailand. It creates jobs inside your own country.*

7.7.4 Vendor Services

Seeking specific services from cloud computing that were not provided by SMEs is one of the drivers that encouraged SMEs to utilise cloud services. For example, interviewee (8) considered providing up and running solutions for 24 hours/7 days as one of the success factors leading firms to adopt cloud technologies.

However, provided services could appear as challenges to adopter organisations of cloud services. For instance, as part of the SLA, adopter SMEs have to comply and accept standards, possible limitations and available services from the provider, as the SME is renting not owning the solutions provided. Additionally, some SME might need to run heavy computational tasks due to the nature of their business. It is claimed that SME can suffer from an occasional drop in system performance from a specific vendor, as mentioned here by interviewees (9) and (16):

> *Sometimes, you can get little drop in performance. Like I said, we're a high-performance computing platform. So, we're quite computationally intensive and there can be two or three second sort of timeouts. It might happen a couple of times a week, two or three times a week.*

And:

> *One of the main thing is we must accept the cloud provider's standards, because you are not owning the software, but renting it.*

The interviews included exploring another factor as a driver which was outsourcing control of the SME's IP. However, it appeared SMEs were not interested in this issue as none of the interviewees considered it as a driver to adopting cloud computing.

7.7.5 Telecommunication and Internet Issues

Analysing the interviews, telecommunications and internet related issues were one of the main two challenges SME's could face among all three categories in the TOE model, considered by 8 out of 20 interviewed SMEs.

In relation to service location some interviewees had a concern if any technical issues could happen to the main international internet cables, especially in Australia surrounded by water with all international lines undersea[30]. Additionally, some SMEs suffered from limited bandwidth of the internet in Australia, which was mentioned by several interviewees. This issue also affects SMEs who have overseas locations and are using cloud services to collaborate and share information with remote sites or if the organisation has international customers. SMEs considered the introduction of fibre optic internet services in Australia (known as NBN[31]) as a big shift from government to solve these sorts of challenges – mentioned here by interviewees (3), (5), and (20):

> *When you think about people all around the world going to our websites or various parts of Australia, residing on underlying hardware that was in Sydney or Melbourne, is affected by Australian's connections to the*

[30] For more information, please visit: http://www.submarinecablemap.com, date accessed: 15-07-2016
[31] NBN is the national broadband network in Australia that provides internet services to the public with traffic speed up to 100Mbps. For more details, please visit: http://www nbnco.com.au, date accessed: 09-05-2016

rest of the world via the internet aren’t that wonderful. I think we're probably better off hosting services in the middle, such as in Singapore and Hong Kong, but we have a big hope after introducing the NBN services.

And:

The only drawbacks are that if you add on the website and you're doing remote connection, it can be slow at times, downloading on the cloud, but the Australian government took a good action in introducing NBN.

And:

Yes, well, at the moment we are restricted. We have got ADSL 2+, so that restricts us somewhat. I know that if we want to move files to the cloud that will have to be upgraded to the new NBN services. There is no way you can survive without upgrading because it will just be too slow.

Surprisingly, issues relating to telecommunications and the internet was not expected much by non-adopters as a challenge in the survey (chapter 6).

7.8 CONCLUSION

This chapter analysed the qualitative data were collected via semi-structured interviews among 20 SMEs who consented in the survey to be part of the qualitative study. This chapter relied on the developed research framework of RBT theory and the TOE model to examine several factors as drivers or challenges in adopting cloud computing.

The examined factors were classified in technical, organisational, and environmental categories. All the factors studied were developed as a result of the survey conducted, ending up with 8 technical, 6 organisational, and 7 environmental drivers. The analysis of the qualitative interviews to explore the drivers found an additional technical factor which was the convenience of using systems in the cloud as well as an additional organisational driver which was related to motivating SME personnel to upskill themselves to secure their positions in the firm.

The list also included 12 technical, 7 organisational, and 7 environmental challenges. Additionally, the data analysed resulted in two additional possible organisational sources of challenge, which were staff fear of losing IT jobs and personnel acceptance level to change in the current environment from on-premise to cloud computing. The next chapter will discuss the results of chapters 6 and 7.

Chapter Eight: Discussion

8.1 INTRODUCTION

The previous two chapters (6 and 7) analysed the data of this study. Chapter 6 presented quantitative results focusing on exploring approximate adoption rates of cloud computing by Australian SMEs as well as possible drivers of cloud computing adoption from the business viewpoint and challenges that hindered non-adopter SMEs from using cloud services. Chapter 7 provided qualitative results exploring drivers of cloud adoption as well as investigating challenges.

This chapter provides in-depth insights by analysing and synthesising the previous analysis. We start by reviewing the aim of this research and re-posit three issues required to be answered. Then we analyse the adoption rate of cloud computing by Australian SMEs from different viewpoints. This section will be followed by an in-depth analysis of the explored drivers and challenges of cloud computing, starting with the quantitative and followed by the qualitative analysis.

The contribution section begins by developing a cloud utilisation framework that consists of the possible drivers and challenges of adopting cloud computing by SMEs. The contribution section then presents guidelines that will help researchers, SMEs, and service providers in effectively utilising cloud computing by better understanding the factors and challenges.

8.2 THEORETICAL BACKGROUND

Resource Based Theory (RBT), also called the Resource Based View (RBV) of the firm, highlights the successful utilisation of resources required that improve business capability, productivity and outcomes leading to competitive advantage and support for business strategy (Grant, 1991, Taher, 2012, Wernerfelt, 1984, Yigitbasioglu, 2015). SMEs can benefit from RBT through developing a roadmap to achieve competitive advantage to perform in a similar way to large enterprises (Barney, 1991, Terziovski, 2010). Therefore we could expect using the RBT view that cloud adoption by SMEs is a critical success factor (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012) for increasing output and business productivity (Fakieh et al., 2016). The representation of using RBT to examine cloud utility was covered in the literature analysis (chapters 2 and 3) to illustrate that:

> *Successful utilisation of cloud services → increases SME output → improves productivity → achieves competitive advantage.*

This research aimed in the early phases to explore possible drivers as success factors and challenges of cloud adoption by Australian SMEs. However, reviewing previous research highlighted an absence of studies in the literature, making it difficult to predict adoption rates of cloud adoption by Australian SMEs. Of the industry studies investigated, MYOB (2012) suggested an adoption rate of 20%, that was updated in 2015 - claiming 40% of SMEs operators (but not SMEs in general), were using cloud services.

Conducting academic studies exploring cloud computing benefits and challenges, required an understanding of the status of cloud services utility by SMEs from an academic research perspective. Therefore, the main aim of this research was to explore three aspects relating to cloud utilisation by Australian SMEs. The first phase of this study focused on exploring the approximate adoption rate to answer the following question:

1. *What has been the adoption rate of cloud computing for Australian SMEs during the period 2015-2016?*

Two aspects focused on exploring possible drivers and challenges in adopting cloud computing by Australian SMEs, by posing the following questions:

2. *What are the potential benefits of cloud computing utilisation to improve business capabilities and achieve competitive advantage?*
3. *What are the potential challenges of cloud computing utilisation that the Australian SME sector faces?*

The literature highlighted factors that act as drivers or challenges to any firm in adopting cloud computing (Marston et al., 2010, HBR, 2014, Sadiku et al., 2014, Astri, 2015, Dubey and Wagle, 2007, Busch et al., 2014, Garrison et al., 2012). To emphasise the second and third questions, a theory or framework to classify SME resources within specific categories was selected after analysis of suitable theories (chapter 4). The framework selected was the *Technology*, *Organisation*, *Environment* (TOE) framework, which states successful implementation of technology is influenced by different factors in three main categories - *technology*, *organisation* and *environment* (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013). This framework was used widely by researchers to examine the adoption of new technologies including cloud computing by businesses (Yigitbasioglu, 2015, Lian et al., 2014, Alshamaila et al., 2013). Therefore, the conceptual framework used in this study consists of the TOE and RBT as shown in figure 8.1. The three categories in the TOE model were used to classify the drivers and challenges identified in the literature.

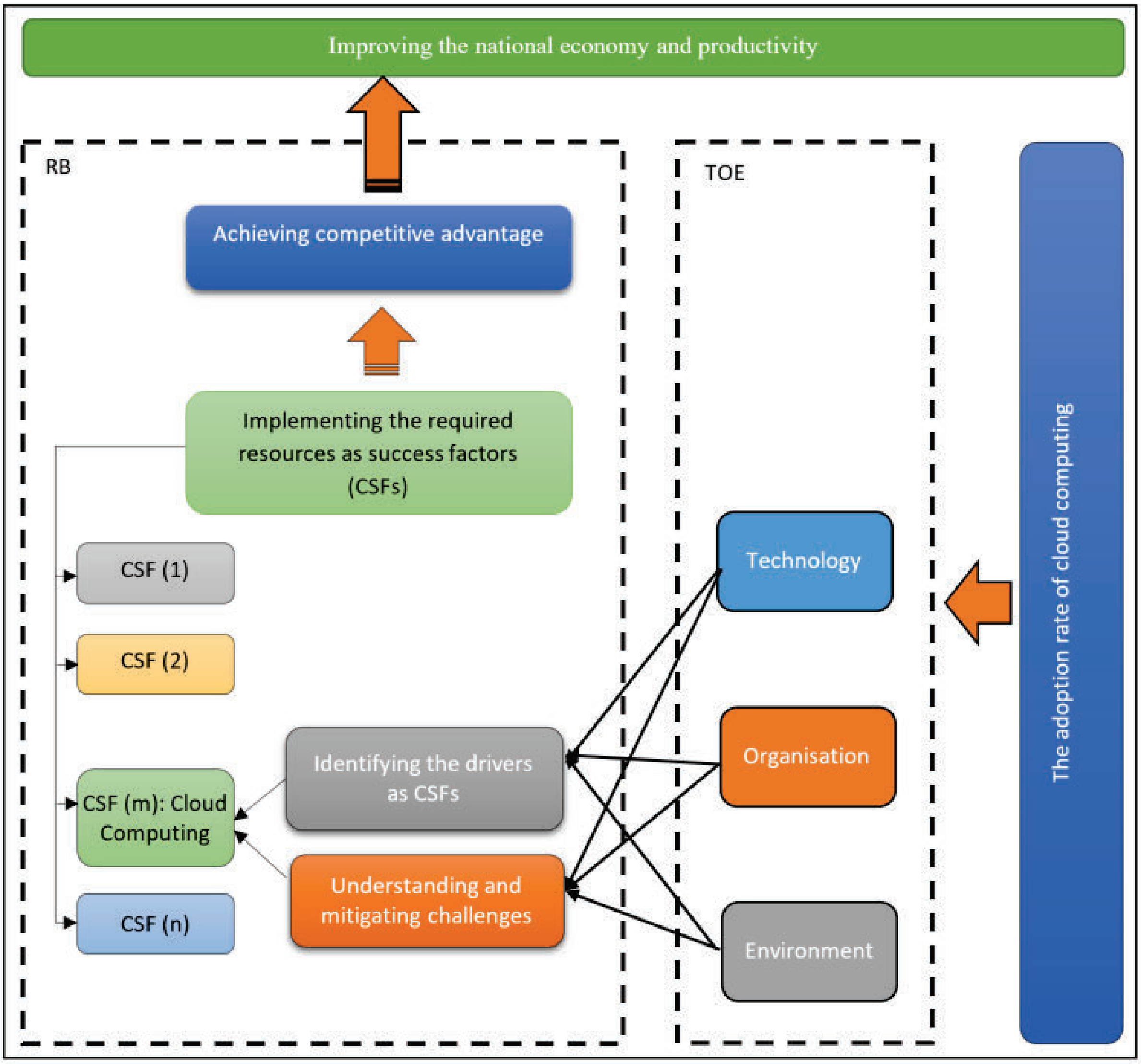

Figure 8.1: Research Conceptual Framework[32]

The framework shows that the first phase focuses on exploring the adoption rate of cloud computing by Australian SMEs. The second phase explored the possible drivers and challenges in cloud computing using the three categories in the TOE model. Each category could potentially act as driver and/or challenge, and that is why each category is linked to a group of

[32] Note: The reason for not placing all factors here in figure 8.1 is to develop the final framework later in this chapter, where the purpose of figure 8.1 is just to guide the reader regarding the structure of this study.

drivers and challenges in the conceptual framework. The drivers and challenges are related to successful implementation of cloud computing as one of the possible resources acting as a success factor in the business to achieve competitive advantage (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012).

Each of the three questions is discussed in the next sections, starting with exploring the adoption rate of cloud computing by Australian SMEs during 2015-2016.

8.3 CLOUD COMPUTING ADOPTION RATE BY AUSTRALIAN SMEs

This research has addressed the gap in the academic research by exploring the approximate adoption rate of cloud computing by Australian SMEs through asking 470 Australian SMEs their perspectives on cloud adoption, including their cloud adoption state of affairs.

Chapter 5 (methodology) showed that collecting the required data from SMEs was one of the most difficult phases in this research because of very low response rates after contacting SMEs online, which led to some delay in completing this study. Solving this major issue led to another approach, namely visiting SMEs onsite to obtain the data using paper copies of the survey instrument. This option consumed extra time, effort and budget, especially when collecting data from six cities requiring commuting by car, train and airplane. However, this approach was very useful. For instance, the new approach helped sample a significant number of SMEs resulting in 470 valid surveys mainly from six cities - Sydney, Newcastle, Wollongong, Canberra, Brisbane and Melbourne including a small number of online surveys. The interpretation of this substantial difference between contacting SMEs online and visiting occurred partially because SME staff do not check emails frequently while they are at work preferring to focus on their business. A second explanation is that staff might see the survey invitation but decide to undertake the survey later. Then, either forget or get caught up with other business priorities.

Visiting SMEs onsite helped highlight the significance of this study and encourage participation by completing the survey at the time of the visit.

Another benefit of visiting SMEs appeared during data collection. Participants had the opportunity to ask questions, which many did, prior to completing the survey. The benefit of being on hand to answer queries about the meaning of the questions was a more accurate and reliable response to the survey questions.

Some SMEs admitted they did not use some cloud services even if they were utilising other services such as enterprise versions of consumer products/services, email services or perhaps cloud based storage services like OneDrive, Dropbox or GoogleDrive. An explanation is that there may be poor understanding from the participants of cloud computing. Quantitative analysis in chapter 6 covered various formerly hidden aspects to gain a richer understanding of cloud utility by SMEs in Australia.

8.3.1 Utilising Cloud Enterprise Services

The first aspect explored if the firm used any cloud enterprise services, such as *Microsoft Azure, Amazon Web Services (AWS), Salesforce*, and *MYOB*. The survey results showed 48.7% of 470 SMEs utilised cloud services - equal to 229 firms. Compare this result to the 2012 industry study from MYOB – around 1 in 5 or 20% (MYOB, 2012), which shows a clearly increasing trend of cloud utilisation by SMEs. A more recent MYOB industry report highlighted that 40% of SMEs operators utilise Cloud. Therefore between 2012 and 2015 there was a big change (MYOB, 2015).

The more recent MYOB report (MYOB, 2015), is closer to the findings of this study, at 48.7%. Another point that might be highlighted here is the limited interest of micro businesses in using cloud computing perhaps due to the nature of their business where only 32.6% of the micro firms were using cloud services among some 135 businesses investigated. However small – but not micro – and medium sized enterprises showed approximately similar rate at 56.3% and 54% respectively.

8.3.2 Utilising Cloud Consumer Products

The second aspect focused on utilising enterprise versions of consumer products/services via any of the public internet service providers (ISPs) such as *Hotmail*, *Facebook*, *Twitter* and *LinkedIn*. During visits to SMEs to requesting participation in the study, it was surprising many staff did not recognise these services as cloud based, but the concept of providing these services to consumers fit under deployment of *Software as a Service* (SaaS), which is one of the main three deployments of cloud computing, providing off the shelf online products to customers (Jamsa, 2012, Leymann et al., 2014, Knorr and Gruman, 2008, Marinos and Briscoe, 2009, Ashrafa, 2014), along with *Infrastructure as a Service* (IaaS) providing virtualised hardware resources over the internet (Garrison et al., 2012, Sadiku et al., 2014, Dillon et al., 2010) and *Platform as a Service* (PaaS) giving customers the required platforms to develop their own solutions, such as providing operating systems and development platforms in a virtual environment (Jamsa, 2012, Stammer and Wilson, 2013, Sadiku et al., 2014, Ashrafa, 2014).

The result exploring these aspects showed insufficient awareness in understanding cloud computing concepts by cloud consumers, including SMEs, because they didn't know some of the applications that they used were in fact Cloud. While investigating cloud enterprise services above showed 48.7% used cloud services, 67.7% of the same studied sample used enterprise versions of consumer products for business purposes. Even micro businesses were very interested in using these kinds of services – compared to the enterprise services – where the result showed 64.4% were using enterprise versions of consumer products.

8.3.3 Utilising Cloud Storage Services

The third aspect focused on exploring using cloud based storage services such as OneDrive, Dropbox or GoogleDrive. Results here supported the need to be more specific when it came to studying cloud adoption, where different understanding of cloud computing led to different results. Continuing the outcomes of the first two aspects that showed different adoption rates, cloud adoption from online storage services showed 54% of the same sample were using such services.

The inconsistent results in these three different aspects studying approximate adoption rates would enable future research to be more specific to study each aspect separately, as each aspect provides different insights.

8.3.4 Utilising On-Premise Data Centres

Micro firms utilise cloud services in a more limited way. Therefore, a question was added to the survey to explore the utilisation rate of data centres by SMEs. If micro firms believed that their businesses did not need cloud services, they would be also not be interested in owning on-premises data centres that would cost them more for installing and operating services (Jamsa, 2012, Sadiku et al., 2014). The results supported this view, where only 9.63% of micro businesses had on-premises data centres. It seemed the demand to own a data centre increased with increasing size of the firm, where 32.18% of small – but not micro –and 63.35% of medium businesses owned such data centres.

8.3.5 Utilising Service Delivery Models

The reader might ask why investigating ownership of data centres is part of this research? The answer is because this is an important aspect of cloud use, based on the delivery model. If SMEs had data centres, they might need to utilise advanced options from the cloud, represented by IaaS or PaaS. However, if SMEs did not own data centres, they may prefer to use SaaS if they found other solutions to their business activities. The data showed that of 229 SMEs, 95% were utilising SaaS, 17% utilised PaaS, and only 10% utilised IaaS. The high adoption rate of SaaS shows that SMEs are likely to use cloud for adapting to competition, as SMEs appeared to require a quick solution for their business. Further investigation exploring SME use of utilised services, found 96% used cloud for production while only 20% and 17% respectively used cloud for development and testing purposes.

8.3.6 Utilising Cloud by Business Industry

Analysing quantitative data from different views highlighted another puzzle which was investigating the relationship between adopting cloud computing and the nature of business activity. The clear variety of cloud adoption by business in chapter six needed further investigation, where some industries were very interested in using cloud computing such as recruitment services (81.8%), IT & Engineering (78%), and wholesalers (71.4%). While only 33.3% of health and beauty, 30.3% of medical services, 30% of retailers, and 20% of import and export services used cloud services. The data in chapter 6 showed limited data from some industries, such as philanthropy (two firms only), and mining and transport (one business in each sector) due to the locations of the survey undertaken. For instance, most mining firms would reside close to mining fields rather than major cities and therefore difficult to access. These sectors might require specific studies to gain further understanding regarding cloud adoption.

The status of cloud computing by Australian SMEs was explored using a quantitative approach, which seemed sufficient to gain required results in answering the first question of this study. However, answering the other two questions needed to be explored using a quantitative approach which was part of the survey followed by an in-depth qualitative study to emphasise or criticise the quantitative results along the lines of other studies (Zhou et al., 2010, Morin et al., 2012, Suo, 2013, Subashini and Kavitha, 2011, Smith and Jamieson, 2006, Bhuasiri et al., 2012, Nicho and Mourad, 2012, Verburg et al., 2013, Shaul and Tauber, 2013, Petter et al., 2013, Zhang et al., 2003, Somers and Nelson, 2001, Agboh, 2015, Dillon et al., 2010).

Therefore, the next section will analyse drivers and challenges for Australian SMEs utilising cloud computing based on the quantitative and qualitative analysis (chapters 6 and 7).

8.4 DRIVERS AND CHALLENGES

Both quantitative and qualitative approaches were used to explore drivers and challenges in adopting cloud computing by Australian SMEs. The significance of using a mixed method in exploring drivers and challenges took place through asking adopter SMEs of cloud computing to rank drivers or nominate new drivers. The survey numerical results were represented by descriptive statistical methods. However, the results did not show reasons for electing some drivers as more important than others and considered some factors as weak drivers. Providing a comprehensive research study requires answering the "why" questions after answering the "what" questions to provide richer detail regarding each factor as a driver when using cloud computing.

The 241 non-adopter SMEs were asked to rank reasons for staying away from cloud computing. These reasons (as challenges) were collected from the literature. The number of firms investigated gave sufficient understanding of their thoughts when considering possible challenges preventing them from moving toward utilising cloud computing. After analysing this quantitative data, it was interesting to take these challenges to the adopters to explore their views using a qualitative approach. If non-adopters had specific concerns, these could just be perceptions, but not exist or be limited when it came to the real reasons for adopting or not-adopting the cloud. If we took non-adopters' challenges and asked adopters to rank them again, the results would be different, but such results would not convince non-adopters if there were any contradictions. Therefore, using a qualitative approach here would help non-adopters if they needed to answer ambiguous issues or correct specific perceptions about cloud computing before deciding to utilise the cloud in their firms by listening to SMEs that already adopted the cloud.

8.4.1 The Quantitative View

It was expected before conducting the survey that factors as drivers and challenges by Australian SMEs through a quantitative approach would match the factors in the literature and may not require further study. However, the quantitative results showed some contradiction requiring further investigation. This led to the qualitative phase using qualitative semi-structured interviews becoming the main underpinning of the research here. The numeric results will now be discussed through the three categories of the TOE model, which are technical, organisational, and environmental.

8.4.1.1 The Technical View

The results (chapter 6) showed several factors aligned with the literature. However, the technical view of influences and challenges showed contradictions among the literature, and adopter, and non-adopter viewpoints required further qualitative study. This contradiction arises in several areas.

One example of technical factors in the literature showed systems and data security is one of the common technical concerns relating to a SME's decision to adopt cloud computing (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010). Chapter 6 showed the data from non-adopters supported this view, where they believed security in the cloud was the top technical challenge hindering them adopting. However, a surprising view from adopters noted security in the cloud was the top driver encouraging them to utilise cloud services. This contradiction required further investigation, as it now answered the "what" question but we needed to understand the "why" to solve this puzzle. Conducting qualitative interviews asking non-adopters for reasons in electing security as the top challenge found this related to their concerns and trust, as the literature also highlighted (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010). However, viewing security as a driver required asking SMEs which practiced adoption to gain in-depth understanding of security potential in the cloud.

Another example supporting the need to focus more on the qualitative phase was the cloud system's accessibility. As supported by the literature (Jadeja and Modi, 2012, Jamsa, 2012), adopter SMEs ranked accessibility as the second important technical driver to utilise services from cloud computing. However, a contradiction arose from non-adopters as they faced difficulties accessing these systems, where those systems depended mainly on using the internet. This fear led them to rank system accessibility as the third significant technical challenge in avoiding cloud services. To interpret this and solve the dilemma, adopters were asked their experience in dealing with system accessibility in detail. The significance here was to support non-adopter SMEs' views or to assist them in correcting their existing awareness in utilising cloud computing.

System performance is a third example requiring in-depth qualitative investigation. The literature viewed performance in the cloud as a feature that would encourage businesses to utilise cloud services in its automatic and rapid elasticity to scale up and down the resources based on the load on the system (Chiang and Wainwright, 2005, Herbst et al., 2013, Victories, 2015), and as a challenge that would create some concerns from adopting cloud computing (Jamsa, 2012). Both aspects were presented in the quantitative data, where adopter SMEs ranked system performance in the cloud as the third technical driver, while non-adopters ranked it as the fourth technical challenge. As before, a contradiction appeared here and required further study to ask cloud practitioners (adopter SMEs) regarding their practical experiences with cloud performance to gain greater insight over reasons for being a driver and challenge at the same time.

8.4.1.2 The Organisational View

In general, several issues could be related to having sufficient organisational awareness and understanding of the potential of cloud computing to the business from all three ‘lens’ of the TOE framework, which would affect a firm’s decision to utilise the cloud. The literature discussed this from different aspects, including the potential of Pay-as-you-go concepts to save budget (Fox et al., 2009, Mell and Grance, 2011), providing more flexibility in performing business activities and improving business process (Connolly et al., 2012, Isom and Holley, 2012), the opportunity to utilise powerful hardware resources (Jamsa, 2012, Sadiku et al., 2014), and the ease to avoid having unnecessary resources (Plummer et al., 2009, Herbst et al., 2013). Adopter SMEs believed in the expected potential of the cloud, ranking several drivers among the three categories of the TOE model, and by adopting required services for their organisations. The literature discussed that limited knowledge and awareness of cloud computing could act against taking advantage of certain features of the cloud (Garrison et al., 2012, Ross and Blumenstein, 2015). The literature considered focusing on improving consumer awareness of cloud computing is as important as focusing on developing cloud solutions to them (Ross and Blumenstein, 2015).

Exploring challenges in the quantitative phase among non-adopter SMEs showed clear support for the need to improve the cloud computing knowledge, where the belief the firm does not require service from the cloud was chosen as the top challenge by non-adopters among all explored challenges in the three categories of the TOE framework. The qualitative phase could ask adopters if they needed cloud services. However, the majority were expected to admit that as they utilised the services, this would not necessarily convince non-adopters to do likewise.

Therefore, to the study explored tangible and intangible benefits gained from cloud computing. These benefits would add to non-adopters' knowledge and might correct some perceptions regarding the need to use cloud computing for their businesses.

The quantitative analysis of the organisational factors presented similar results to the technical analysis above, where some of these factors supported the literature, and others did not. For example, one of the main features of cloud computing is related to the expected savings in setup and operational budgets (Avram, 2014, Khurana and Verma, 2013, Sadiku et al., 2014) that usually offer simple and clear calculation methods (Mell and Grance, 2011, Dillon et al., 2010, Cearley and Reeves, 2011). The quantitative results supported this view, where adopter SMEs believed the third important organisational driver of cloud computing was to save setup and operational costs. However, the concern of non-adopters arose again when they ranked the cost of cloud services as the second significant organisational challenge in avoiding cloud solutions. Similar to the other factors, this issue was included in the qualitative phase to explore adopters' experiences with regard to adopting cloud computing based on cost benefit.

8.4.1.3 The Environmental View

Exploring drivers and challenges of cloud computing from the environmental view also required further explanation. For example, utilising cloud computing would help organisations outsource several operational tasks and focus on their core business activities (Mell and Grance, 2011). This may potentially allow SMEs to improve customer service, and relationships with customers and other stakeholders. The results from the environmental drivers in the quantitative study ranked the potential of cloud computing to improve relationships with customers as the top environmental driver leading adopters to take up the cloud. However, insufficient awareness seemed an obvious factor amongst non-adopters, where none of the participants considered the possible effects of cloud computing on improving customer service.

Trusting cloud computing in general plays a significant role in deciding to move toward the cloud. The literature highlighted trust in the cloud as a challenge that would avoid the desire to adopt it (Pearson and Benameur, 2010). Non-adopters expressed their concerns by ranking lack of overall trust in cloud computing as the second environmental challenge preventing them from utilising cloud services. In addition, the first and third environmental challenges by non-adopters in the quantitative phase were the backup location and hosting location respectively. Those two factors (also considered as challenges in the literature) would help prevent up take of the cloud (Sultan, 2011, Sahandi et al., 2012). By analysing these top three environmental challenges, it seemed all of them were related to lack of overall trust in the cloud environment, where trust would improve if concerns of non-adopters regarding backup and hosting locations were avoided or mitigated. Interestingly, adopter SMEs elected trusted vendor, backup location, and hosting location as the second, third and fourth most significant environmental drivers in using cloud computing respectively. This view was not expected and required further investigation to understand how adopter SMEs converted those challenges to drivers in the qualitative phase. This may also improve non-adopters' trust that might lead to an increasing trend in adopting the cloud by Australian SMEs.

The qualitative phase that explored drivers and challenges of cloud computing in-depth is presented in the next section.

8.4.2 The Qualitative View

The significance of the quantitative phase in exploring possible drivers and challenges was to understand the general view of adopter and non-adopter SMEs of cloud computing. It was expected the quantitative results would show a clear understanding of each factor as a driver or challenge. However, the results showed different and unexpected views. Some of the findings aligned with the literature, but some were opposite to what the literature indicated.

Therefore, the qualitative phase focused mainly on adopters to achieve two goals. The first goal was to gain more detail regarding possible drivers and benefits of adopting cloud computing. The second goal aimed to discuss challenges by non-adopters to explore if adopter SMEs encountered them and how to avoid or mitigate possible challenges. Achieving these two goals would help in performing a successful implementation of cloud computing. In addition, it would assist non-adopters by offering them the best practice from similar industries in turn to gain competitive advantage.

NVivo[33] software was used to organise and analyse the qualitative data. It helped to highlight the most interested factors in general, and to categorise them within one of the three TOE framework's categories.

Exploring the most interested factors in general is presented in figure 8.2. It shows that the most interest was focusing on the data itself. The explored factors in this study could have direct or indirect effect on SMEs' data. It can be seen from the same figure the relationship between utilising cloud computing and considering several other factors, such as people,

[33] http://www.qsrinternational.com/what-is-nvivo

business needs, the associated cost, and the provided services. After that, the word cloud figure showed up the time factor, security in the cloud, understanding cloud computing, accessibility and the support.

To clarify the relationship between these factors and the utilisation of cloud computing, tables 8.1a, 8.1b, and 8.1c summarise the qualitative study in highlighting and exploring each factor (driver, challenge, or both) from adopter SME perspectives.

Figure 8.2: The most interested factors by the 20 interviewees

Table 8.1a: Technical Drivers and Challenges of Cloud Adoption by Australian SMEs

Factor	Results by SMEs	
	Why Driver?	Why Challenge?
Performance (Victories, 2015, Alliance, 2011, Harding, 2011, Sadiku et al., 2014)	- To overcome limited capabilities of on-premise resources. - Having up to date solutions.	- Just concern from the non-adopters, but cloud computing users didn't face that. There is an environmental impact on performance as will be shown in the environmental factors.
Convenience of use and Complexity (Jadeja and Modi, 2012)	- More convenience and easier than current solutions.	- Just concern from the non-adopters, but cloud computing users didn't face that.
Security (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and	- Service providers provide better security than on-premises, especially from a well-known provider.	- Just concern from non-adopters regarding security, but cloud computing users didn't face that.

Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010)	- If the company has a concern, they could keep sensitive data on-premises.	- In regard to privacy, even some of current utilisers of cloud computing still have concerns. - Privacy issue - Some governments have authority to access data within borders without permission. Suggested solution is utilising service which resides in data centres within borders of Australia.
Accessibility (Jadeja and Modi, 2012, Marston et al., 2010)	- Enhance ability to access and work on local systems remotely. - Support centralised work from different remote sites. Could be in different countries. - Helps in providing better maintenance without need to visit branches onsite.	N/A
System maintainability (Fox et al., 2009, Khurana and Verma, 2013, Dillon et al., 2010, Dikaiakos et al., 2009)	- Solve issue of limited resources, skilled personnel, and spaces. - Focusing more on core business.	N/A
Availability (Harding, 2011, Alliance, 2011, Dillon et al., 2010)	- Having reliable system running 24/7.	- Going offline for any reason will terminate service and could harm business.
Scalability (Khurana and Verma, 2013, Herbst et al., 2013, Cearley and Reeves, 2011)	- Not in interest of Australian SMEs as a driver.	N/A
Setup Time (Khurana and Verma, 2013, Dillon et al., 2010)	- Not in interest of Australian SMEs as a driver.	N/A
Lack of Professional Staff (Sosna et al., 2010)	N/A	- One of the two top challenges among all studied challenges in the TOE model. - Difficulty in understanding advanced concepts. - Migrating current systems to cloud requires professionals, including handling middleware. - Configuring advanced systems. - SMEs might need to upskill their workers in-house or via a third-party training. - All issues could prove expensive to SMEs.
Implementation issues (Jadeja and Modi, 2012, Dikaiakos et al., 2009, Lin and Chen, 2012, Tarmidi et al., 2014, Ross and Blumenstein, 2015)	- Easy to migrate.	- Systems' customisation. Require skilled personnel. Also, when utilising Software as a Service (SaaS), SMEs might have to comply with provider's service. - Some systems might require middleware to facilitate migration and implementation.

Lack of understanding Cloud Computing (ENISA, 2009, Tarmidi et al., 2014, Garrison et al., 2012, Ross and Blumenstein, 2015)	N/A	- Some technical concepts need knowledgeable people. - Issue could arise when utilising PaaS or IaaS. - Could also lead to misleading cloud utilisation cost calculation. SMEs might require third party to calculate correct costs.
Operational issues (Ross and Blumenstein, 2015)	N/A	- Frequent contact with service provider to change/add permissions, but rarely noted as an issue.
Lack of Technical resources (Fox et al., 2009)	N/A	N/A

Table 8.1b: Organisational Drivers and Challenges of Cloud Adoption by Australian SMEs

Factor	Results by SMEs	
	Why Driver?	Why Challenge?
Operational Time Savings (Marston et al., 2010, HBR, 2014)	- Saving business daily activities time. - Saving maintenance time, such as servers' replication. - Much time savings to collaborate with remote branches.	N/A
Business process and needs (Isom and Holley, 2012, Stammer and Wilson, 2013)	- Supporting collaborative work within and with other businesses; especially among remote locations. - Providing centralised data. - Replacing legacy activities with more efficient software and work processes - such as replacing in-house emails with centralised cloud-based ERP systems. - Solving issue of having limited spaces on-premises to adopt IT based solutions.	- Non-adopters believe that their firms do not need cloud-based solutions. Is there a need for more awareness? - Over-dependency on computers to perform business process.
Setup and operational cost (Rafaels, 2015, Marston et al., 2010, Singh et al., 2015, Carroll et al., 2011, Victories, 2015, Girola et al., 2011)	- Affordable service adoption. - Considerable operational cost savings compared to on-premises or compared to non-cloud based hosting options when utilising large amount of resources, as SMEs are required to pay for resources used only. - Providing opportunity for massive reduction of on-premise hardware. - Maintenance and resource licensing cost saving. - Better customer service with lower cost, such as collaboration. - Clear cost if hidden costs are included - Extra savings for education, philanthropy and non-profit organisations.	- Hidden costs could increase cost significantly, such as cost of training, and salary of skilled personnel. - Calculating hidden costs could become more difficult after implementing system as many issues and dependencies could appear. - Even if service provider calculates costs, it might not be able to calculate costs from within company. - The SME may recognise a need to extra features from cloud after assigning budget. - Could be affected by other factors, such as cloud service provider re-pricing, download fees, and exchange rate.
Improving business outcomes (Marston et al.,	- Speedup business processes. - Innovating new tasks, such as real time information sharing and	N/A

2010, HBR, 2014, Avram, 2014)	collaboration, as well as communication	
Up-Skilling Motivation and Job Security (Marston et al., 2010)	- Professionals feel need to update skills through new technology to secure their positions. - Would help organisation to have up to date skilled personnel.	- Fear of IT jobs loss. - Relying on cheaper option of outsourcing tasks to overseas workers. - Might push local workers to accept working with lower salary.
Business Agility (Kim, 2009)	N/A	N/A
In-house data control (Armbrust et al., 2010, Marinos and Briscoe, 2009)	N/A	- Limiting flexibility of system control. - More difficult to access old data. - Cannot take full action if sudden issues affect system. - Likelihood of data loss after un-subscribing.
Lack of executive support (Sosna et al., 2010)	N/A	- Some executives resist cloud utilisation. - Resistance reasons include fear of cloud services, lack of cloud understanding, invisible opportunities for the business from the cloud. - SMEs in governmental sectors might suffer from long approval process.
Personnel Acceptance Level to Change (Sosna et al., 2010)	N/A	- Workers might dislike new system or environment until used to it.

Table 8.1c: Environmental Drivers and Challenges of Cloud Adoption by Australian SMEs

Factor	Results by SMEs	
	Why Driver?	Why Challenge?
Improving relations with customers (Marinos and Briscoe, 2009, Benkler, 2004)	- Receiving better feedback from customers. - Gaining trust from customers because of latest technologies. - Could open doors to further relations with equivalent businesses who may ask adopter-SMEs their experiences and recommendations.	N/A
Trust (Garrison et al., 2012)	- Essential to adopt services. - SMEs should do research to select appropriate solution. - Several factors contribute to increase trust by considering insider and outsider sources of threat, including using internet safety, securing local machines, and the proper identification of authorisations and authentications.	N/A
Service location and Government Regulation (Ashrafa, 2014, Kshetri, 2013, DoC, 2014, Gershater, 2012)	- If SMEs provide overseas services, storing data in different locations would help facilitate and speedup overseas transactions.	- Would affect data traffic speed. - SMEs have to comply with local and international regulations. - Some governments have right to access data stored in their countries without permission. - Some SMEs must comply with government regulation in storing data

		within border of Australia, which would limit available options in the market.
Vendor services (Ashrafa, 2014, Kshetri, 2013)	- Cloud computing could provide some services easily to firm, with greater difficulty than before, such as 24/7 uptime.	- SME has to follow provider's standards, services, and limitations, because SME is not owning, but renting provided solutions. - Occasionally case of dropping system performance with few vendors, when running heavy computational tasks.
Telecommunication and internet (Fox et al., 2009)	- Introducing fibre optic internet (i.e. NBN) services to public helped speed up traffic rate.	- One two top challenges among all studied challenges. - Speed before introducing NBN services - limited. - SMEs could suffer while connecting to overseas branches or having overseas customers.

Discussion

The clear significance of the qualitative phase appears in tables 8.1a, 8.1b, and 8.1c by interpreting, emphasising, or defending the quantitative results encouraging exploration of aspects of cloud adoption by Australian SMEs. The results of the quantitative and qualitative phases of this research highlighted a significant issue relating to having adequate knowledge regarding cloud computing – which included the potential, opportunities and possible risks that may be encountered by adopter businesses. Several SMEs resisted cloud adoption because of different belief systems that might not actually exist in practice.

A sufficient awareness of what the cloud brings to a business is necessary to gain clearer understanding of possible benefits and challenges in adopting cloud services. Several SMEs did not adopt cloud services because of their expectation of certain factors such as challenges, e.g. difficulty of use. However, SMEs using cloud services found the opposite, namely convenience of use. Also, non-adopters had not considered certain factors, but cloud users found them to be issues of note relating to communication and internet issues in general. Exploring tables 8.1a, 8.1b, and 8.1c and 7.3 – from the last chapter – support this view that will be discussed in each category of the TOE framework.

8.4.2.1 The Technical View

Starting from the technical perspective, insufficient awareness of cloud computing led non-adopters in the quantitative phase into believing lack of professional staff is not an issue preventing or hindering adoption - placing this factor at the end of the technical list (number 13) and 24th out of all 27 factors examined in the quantitative phase. However, an unexpected result appeared in the qualitative phase, revealing adopter SMEs of cloud computing found lack of skilled personnel was one of the top two dilemmas SMEs could encounter when using services among all explored factors in the three categories of the TOE framework. Insufficient awareness appeared again when examining implementation issues as a technical factor. Again, non-adopter SMEs believed they might not face significant implementation issues and ranked this factor 22nd among all 27 factors, and the 11th possible technical challenge. However, interviews showed technical issues related to implementing cloud services placed this factor as the second technical issue, opposite to what non-adopters believed.

The non-adopters view held some factors as the main technical challenge when they attempted cloud adoption, but the adopters' view based on their practical cloud utilisation experience showed the opposite. For instance, non-adopter SMEs believed system availability, accessibility, performance, setup time, and complexity were significant technical challenges, ranking them from second to sixth respectively. However, adopters in the qualitative study did not consider these factors as challenge when adopting cloud computing.

Continuing the discussion in the quantitative sections earlier in this chapter, some factors were presented in the literature as drivers or challenges, but the results from this study showed the opposite effect that required further study to understand the "why?" The first example was related to security in the cloud which was noted in the literature as a challenge affecting SMEs' decisions when adopting the cloud (Garrison et al., 2012, Pearson and Benameur, 2010, Ross and Blumenstein, 2015, Tari et al., 2015, Chen et al., 2010). Table 8.1a showed the concern of hackers breaching systems or data disclosure as an expected challenge. Adopters also expressed a concern related to data privacy, which is affected by environmental factors. This issue arises from unlimited authority of certain governments to access any data residing within their geographical borders without permission. As a suggested solution from some adopter SMEs to avoid this challenge, businesses should select the hosting and backup location as Australia or another country that ensures the required privacy. This would be an interesting answer to the privacy challenge and to take advantage of security factors for being a driver stating that adopter SMEs believed that cloud providers have more capability and knowledge to provide better systems and data security compared to on-premise solutions, due to limited security knowledge of most SMEs compared to specialist cloud providers.

Accessibility in the cloud environment was highlighted in the quantitative section as a significant driver influencing several SMEs to utilise cloud services, which is also supported clearly in the literature (Jadeja and Modi, 2012, Jamsa, 2012). Interviewing 20 adopter SMEs showed none of the interviewees encountered any related issues. This result may provide non-adopters with more confidence and minimise their fear in expecting satisfactory accessibility solutions via the cloud.

Cloud computing system performance is known as one of the features encouraging SMEs overcome limitations in on-premise physical resources (Chiang and Wainwright, 2005, Herbst et al., 2013, Victories, 2015). Adopter SMEs supported this view adding that utilising cloud services gave the firm the latest updated solutions as part of the *Service Level Agreement* (SLA) to ensure maximum performance in the market. However, adopters clarified non-adopters' concerns regarding performance, when adopters expressed they did not encounter any significant drop in performance by the cloud provider, but other environmental factors could potentially affect performance, such as hosting and backup location as well as unexpected telecommunication issues. For example, the speed limitation of using ADSL services, that could potentially be mitigated after introducing the *National Broadband Network* [34] (NBN).

8.4.2.2 The Organisational View

Generally, non-adopter SMEs believed their businesses did not require service from cloud computing, rating it as the top inhibiter. However, none of the adopter SMEs in the qualitative phase believed business did not require services from cloud computing. Having greater awareness may lead to better utilisation by realising real possible limitations as well as the expected potential of adoption. Table 8.1b supports this view by discussing non-adopter challenges from the adopters' viewpoint. Discussing the same examples used in the quantitative discussion earlier in this chapter provides further clarification.

Starting with the potential of cloud computing to save costs - one of the main organisational factors for adopting the cloud (Avram, 2014, Khurana and Verma, 2013, Sadiku et al., 2014), non-adopter SMEs ranked setup and operational costs as the second top organisational challenge preventing them from using cloud computing, as they believed cloud computing would be prohibitively expensive.

Most adopters agreed - cloud computing would reduce costs, as several services were offered at affordable prices, and did not require significant operational budgets when compared to on-premise solutions. However, the cost saving goal might not be achievable when all utilisation costs were included when calculating the final costs for adoption. The adopters justified the cost by using providers' cost calculation approach, however this calculation of costs for the service covers the entire service cost from the standpoint of the service provider. However,

[34] Fibre-optic internet. For further details, please visit: http://www nbnco.com.au

businesses who utilise cloud should consider other costs arising for the adopter firm, such as costs of training and up-skilling SME staff, as well as salary of skilled personnel, if needed. One interviewee highlighted that any miscalculating of the possible included costs of utilising cloud services would lead to indirect challenges in unexpected additional costs appeared to the firm as hidden costs. These unexpected additional costs are in fact an example of one of the main goals of this research, namely to highlight such factors.

Using cloud services can assist SMEs in improving business processes and activities (Connolly et al., 2012, Isom and Holley, 2012). The adopters agreed with this view because replacing legacy resources with cloud solutions gave them the opportunity to use the latest solutions in the market providing extra features to improve business processes and outcomes. The additional features I support SMEs to provide better services to their customers and improve their relationship with customers.

Recalling some of the non-adopters' considerations of the effect of cloud computing in complicating business process, it was important to discover possible negative aspects of the cloud on business processes from the adopters' perspective. Similar to the previous concept, several adopter SMEs suggested viewing cloud as a challenge when it came to business processes might be related to limited awareness by non-adopters regarding the potential of cloud computing, which was also noted in the literature (Garrison et al., 2012, Ross and Blumenstein, 2015). Although, SMEs still highlighted possible challenges represented in an over-dependency on computers and internet, which might disadvantage micro-enterprises in particular. Therefore, better understanding SMEs needs, including exploring their expectations from the cloud, would increase the trend in using the cloud and improve business productivity and outcomes to achieve competitive advantage.

The desire to control data on-premises is another example of the organisational challenges that may prevent cloud adoption (Armbrust et al., 2010, Marinos and Briscoe, 2009). Although adopter SMEs did not insist on keeping all data under their full control on-premises, they expressed possible reasons that led non-adopters to consider this as a challenge. This challenge could be related to possible loss of some functionality and control when moving to the cloud. Non-adopters expressed a concern of this loss might slow down taking a quick action if a sudden business problem required an immediate response. In addition, non-adopters might have a concern of losing data during or after terminating the service. Again, having adequate awareness regarding the acquired service represented here by awareness of SLA dimensions and conditions, may mitigate such fears. Also, this issue could be linked to trust in the cloud, which requires greater efforts to improve conditions between SMEs and cloud providers.

The organisational list contained several interrelated factors that might act as drivers or challenges. For instance, the literature highlighted personal acceptance level to change as one of the possible challenges when adopting cloud services (Sosna et al., 2010). In general, adopters discussed their experiences noting some workers might dislike changing to new systems until they become familiar with them. Analysing other factors would link the personal acceptance level of change to them. For example, job security is one of the challenges highlighted in the literature (Marston et al., 2010) that would be related to personal acceptance level to change. Interestingly, adopter SMEs highlighted two opposite effects of this instance - as expected, these factors appeared as a challenge due to the fear of professionals losing their IT jobs or accepting a lower salary to stay in their positions, otherwise the firm may replace them with other workers potentially even from overseas. The possible unexpected challenge here represented through hiring remote workers from overseas, might lead to an increase in the unemployment rate. However, adopter SMEs did not ignore the limitation when it came to job security. They highlighted the fear of losing jobs may motivate staff to learn new skills and upgrade their knowledge to secure their positions. Ultimately, this may lead to an upskilling of workers to be able to work with the latest technologies.

The personal acceptance level to change may also be linked to the possibility of lack of executive support (Sosna et al., 2010), noted by some adopters. The findings showed that some executives resist anything related to cloud computing without justification. Another group of executives resisted cloud computing as a result of their lack of trusting cloud computing or possessing limited knowledge regarding possible opportunities from the cloud. While some executives stated their SMEs was considered as a government sector, which hindered them from taking independent action to migrate to cloud computing without passing through a long approval process.

8.4.2.3 The Environmental View

Adopter SMEs agreed with the literature in considering the effect of cloud computing enabling organisations to focus on core business activities (Mell and Grance, 2011) that in turn would lead to improvements in customer service offered (Marinos and Briscoe, 2009, Benkler, 2004). Adopters stated utilising the latest technologies from the cloud helped them gain more trust from their customers regarding the services provided. Also, this utilisation aided firms in better feedback from SME’s customers. Additionally, this noticeable improvement led some non-adopter SMEs to contact adopters to learn from their experience, which created unexpected relationship opportunities between businesses in the same fields. This relationship may support improving SMEs' awareness regarding adopting cloud computing. Exploring these yet non-considered benefits was one of the main aims of this research.

Trust in cloud computing is a broad and hot topic that could act as a challenge (Pearson and Benameur, 2010, Garrison et al., 2012), but also as a driver as discussed in the organisational view. The reason for highlighting trust again here is because this factor could be affected by other environmental factors, such as that related to other stakeholders. Cloud adopters expressed sufficient trust in the cloud environment must exist for successful utilisation. Also, they highlighted some factors that would help enhance trust levels. Adopter SMEs should assess possible insider and outsider threats. Viewing environmental threats comes from outside the firm, adopters suggested to non-adopted SMEs, to conduct sufficient research to select well-known and trusted service providers. Selecting such providers would be more expensive compared to some other cheaper – but unknown – providers, which would be less trusted. However, it is better to spend a little more to gain trusted service. Otherwise, risk levels in security, privacy, performance offered as well as other services may be higher.

Although the service hosting and backup locations were considered as challenges in adopting cloud computing (Sultan, 2011, Sahandi et al., 2012), this was less expected as an environmental challenge by non-adopters, which could be also be related to limited knowledge of cloud computing. Adopter SMEs showed two opposite effects of service location. One it could act as a driver if the SME had overseas branches and needed systems or part of systems to be hosted near to remote locations for easier and faster transactions. However, secondly adopters totally agreed with the literature on several points. Having cloud solutions overseas would slow down local accessibility and transactions, especially tasks performed included heavy upload or download. Therefore, SMEs should be aware of their requirements for the best outcome in geographical location of services provided. In addition, hosting systems overseas would force SMEs to comply with both local and overseas government regulations. This includes as example overseas governments accessing SME's data without permission if the overseas government regulations permit. To mitigate this issue, several well-known cloud providers currently offer local cloud services such as Microsoft[35] and Amazon[36], to be hosted within Australia's borders.

The environmental view of these possible challenges emphasised insufficient awareness of cloud computing. Non-adopters of cloud computing believed telecommunication and internet performance was not a source of challenge when adopting cloud services, ranking it as 21st among 27 challenges in the three categories of the TOE framework. However, eight interviewees placed it as one of the top two challenges among all factors studied. This challenge may be mitigated to some extent with the NBN. Clearly there is a need to improve SMEs' awareness of the potential of cloud computing including the drivers and challenges.

As seen in tables 8.1a, 8.1b, and 8.1c, some factors in each category appeared as drivers or challenges, but not both. This does not imply an absence of oppositional effect of these factors. The views of adopters and non-adopters could provide a sense that if those factors have further dedicated studies, the opposite effect parameter could be explored.

8.5 RESEARCH CONTRIBUTION

8.5.1 Developing Cloud Utilisation Framework

Exploring tables 8.1a, 8.1b, and 8.1c from another viewpoint shows several factors could act as drivers and challenges. One of the most contradictory factors relates to security in the cloud, ranking as the second driver and third challenge among all factors in the quantitative phase. Results in the qualitative phase did not ignore the security factor, ranking it as the third technical driver providing SME's with greater security compared to on-premise solutions. Qualitatively, security was viewed as a challenge showing the existing fear of SME's migrating systems to the cloud as well as concerns of giving third parties the ability in accessing SMEs' systems.

The successful utilisation of cloud computing required factors be accessible to both sides - as drivers as well as challenges, to increase productivity and gain competitive advantage to SMEs – as noted by RBT (Grant, 1991, Taher, 2012, Wernerfelt, 1984, Yigitbasioglu, 2015). Therefore, one of the main contributions of this research is represented through a cloud computing framework. This framework contains all factors explored in the three categories of the TOE model to improve productivity and achieve competitive advantage. The simplified

[35] Microsoft cloud computing data centres. For further details, please visit: https://azure.microsoft.com/en-us/regions
[36] Amazon cloud computing data centres. For further details, please visit: https://aws.amazon.com/about-aws/global-infrastructure

status of each factor being a driver, challenge, or both providing the reader a cursory idea regarding the possible effects of each factor is shown in Figure 8.3.

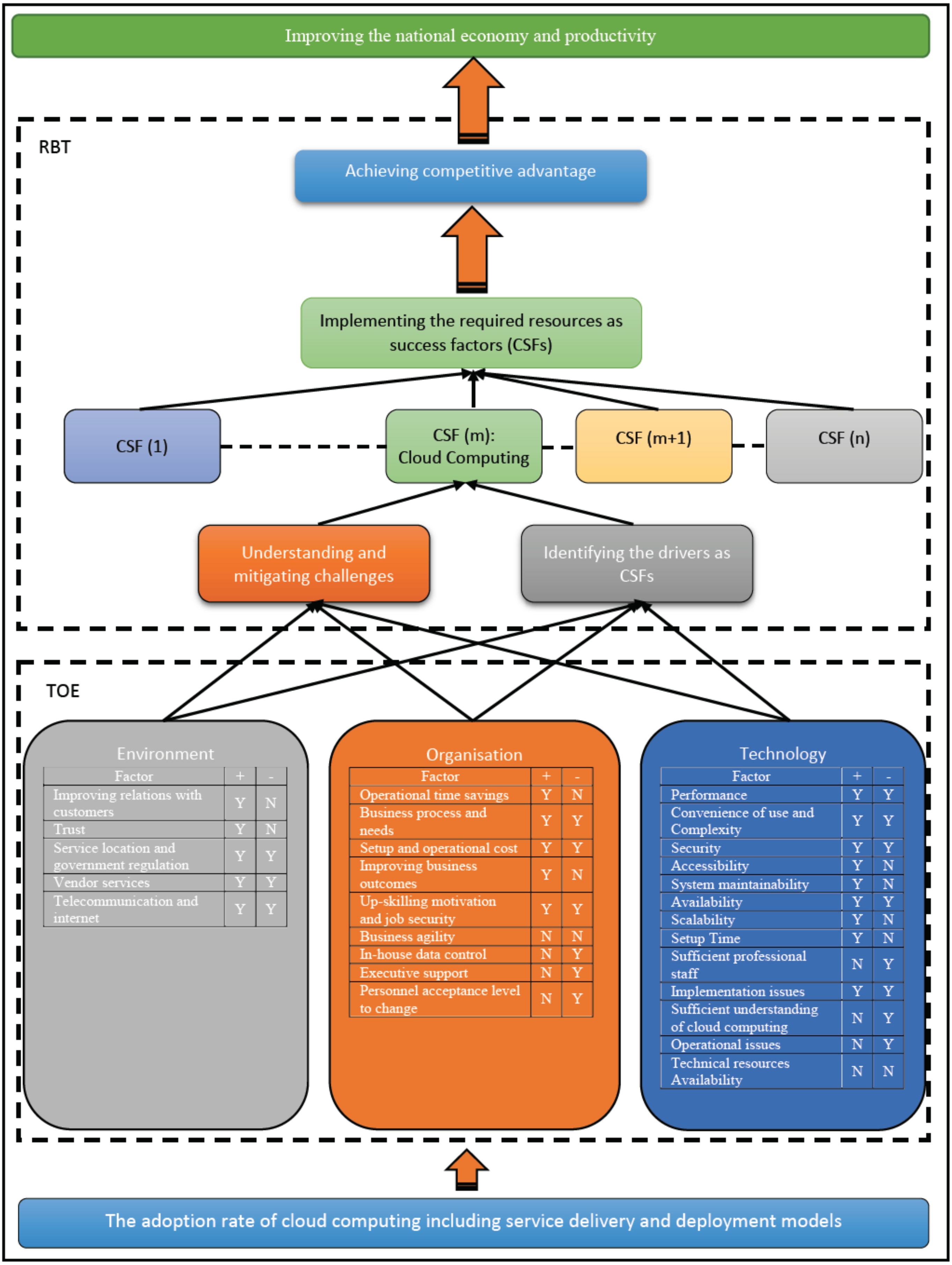

Figure 8.3: Cloud Computing Utilisation Framework for SMEs

Where:

- + means the factor was identified as a driver.
- - means the factor was identified as a challenge.
- Y and N refer to yes and no respectively.

The analysis in chapters 6 and 7 showed the majority of factors explored had the opposite effect, and could act as drivers or challenges depending on the situation, as discussed in tables 8.1a, 8.1b, and 8.1c and figure 8.3.

8.5.1.1 The Technical Factors

The technical list included accessibility, system maintainability, scalability, and approximate setup time which cloud computing adopter SMEs found as drivers only. Alternatively, adopters found availability of sufficient professional staff, having sufficient understanding of cloud computing and unexpected operational issues, acted as sources of challenge only. Australian SMEs did not consider technical resource availability either as a driver nor challenge when utilising cloud services.

8.5.1.2 The Organisational Factors

Only three factors acted as drivers and challenges, which were business processes and needs, setup and operational costs, up-skilling motivation and job security. SMEs stated operational time savings and improving business outcomes were drivers when adopting cloud computing, while they considered desire for in-house data control, receiving executive support, and personnel acceptance level to change as challenges when adopting services. Additionally, SMEs seemed not entirely disinterested in business agility and did not consider it either as a driver nor challenge.

8.5.1.3 The Environment Factors

The Environment consisted of five factors. Three of the factors acted as drivers and challenges, which were service location and government regulation, vendor services, and telecommunication and the internet. The other two factors were considered drivers when SMEs adopted cloud services. These factors were improving relations with customers and overall trust in utilising cloud computing.

8.5.2 SMEs Guidance

Australian SMEs would benefit from understanding the adoption rate in several ways. Viewing the benefits in answering questions from the industry perspective, SMEs could take advantage of understanding currents trend of cloud adoption. This would help both adopters and non-adopters SMEs see the most required services for specific industries, sizes, or even cities and towns to increase the efficacy of most appropriate service to the firm.

Non-adopters would benefit by gaining more understanding and awareness of competitors, this may encourage them to rethink adoption of cloud rather that finding themselves behind the trend, which might lead to loss of competitiveness as RBT infers. Additionally, results shown here may provide non-adopters with more confidence to start looking for appropriate cloud based solutions, and start searching for best practices in the marketplace, again to increase productivity and stay competitive with other SMEs. Moreover, results shown here may contribute to knowledge regarding preferred services by specific sector, such as SaaS adoption by small firms.

The framework presented here may potentially help SMEs in different situations. Starting with the perspective of non-adopters who are considering adopting cloud services, this framework may guide them in understanding the factors that could affect their decision if and when they adopt the cloud. These factors may also aid non-adopter awareness to avoid possible challenges.

In addition, adopter SMEs might benefit from this framework in several ways. The framework shows unexpected factors have the potential of being drivers to maximise benefits of cloud adoption or act as challenges to the business. Even if the firm does not encounter a issue, the framework here may help create contingency plans and provide solutions for possible risks. The results in tables 8.1a, 8.1b, and 8.1c would guide SMEs to understand possible tendencies of each factor as driver or challenge in greater detail.

8.5.3 Service Providers’ Guidance

This research may benefit cloud service providers in different ways. The approximate adoption rate and preferred services may permit cloud providers the ability to gain greater understanding of the current status of cloud computing in the Australian market and more precisely the SMEs market. This in turn may assist cloud providers better understand SME needs and provide desired services, such as focusing on SaaS for the SME sector, which was the most preferred option by Australian SMEs. Also, the adoption rate per industry sector may allow cloud providers improved understanding of sectors most interested in cloud adoption. Acquiring such knowledge may help cloud providers better understand the needs of the most important customer industries; such as recruitment agencies; as well as the reasons from less interested industries, such as medical services.

Combining the SMEs' trend of utilising SaaS plus understanding their requirements may help in providing specific cloud based solutions that could support the expected drivers for adoption. For example, studying less interested industries in-depth (such as retailers and import/export services). This includes understanding their requirements and their expected potential of utilising cloud. It could lead to develop SaaS solutions that would cover most of their needs, including localisation, and alignment with the government regulations This would seem to be a ready solution to improve business outcomes without the SMEs' need to consume time in the development lifecycle with gathering requirements, specifications, development and so on, where an 'turn-key' solution would suffice. Additionally, understanding the nature of tasks performed in these businesses would help mitigate certain current issues - such as developing adaptable systems to work with different internet speeds to avoid any possible drop in service if communication issues appeared whilst performing business tasks.

8.6 CONCLUSION

The purpose of this chapter was to synthesis, recapitulate and discuss results after analysing the quantitative and qualitative data in chapters 6 and 7 respectively, as well as to highlight the contribution of this research to different industries. The chapter began discussing the adoption rate among the 470 selected SMEs, which suggested conducting similar studies should cover a particular adoption rate, such as adopting enterprise cloud products, consumer cloud solutions, and cloud storage services. The results supported this view by highlighting different rates among cloud enterprise services utilised, cloud consumer products and cloud storage services. This chapter also highlighted the clear trend of SMEs in Australia to adopt SaaS. In addition, the chapter discussed the diversity of interest in cloud computing by business industry. The chapter then analysed factors from both chapters 6 and 7 according to the TOE model and discussed the occurrence of each factor as a driver or challenge leading to a unique framework for SME cloud utilisation. The analysis and summary contributed to a framework through 13 technical, 9 organisational and 5 environmental factors. Some factors have the potential to act as drivers and challenges, where others could be drivers or challenges - but not both. Few factors were not in the interest of SMEs and thus had no effect. The next chapter will conclude this thesis and discuss the research contributions, recommendations and future work.

Chapter Nine: Conclusion and Future Work

9.1 CONCLUSION

9.1.1 Research Significance

The motivation for undertaking this research was to examine SMEs adoption of Cloud. This area was under researched because researchers found it problematic to obtain the data to examine to what extent SMEs adopt Cloud as well as the potential challenges and barriers. Cloud computing and the industry of *Information and Communication Technology* (ICT) in general play a significant role to improve business outcomes and to achieve competitive advantage. Understanding this phenomenon may enhance the national economy because SMEs are 99% of the economy. The potential for the SME sector to play a key role in the national economy (Mohlameane and Ruxwana, 2013, Mamman et al., 2015), led several researchers and industries to focus on this sector to better understand how ICT can contribute to achieving competitive advantage (Neumark et al., 2008, Mamman et al., 2015). From a research perspective, several fields – including computing and information systems – note the importance of SMEs and consider this sector in several studies (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012).

This research adds to both the SME and IS literature in better understanding how SMEs use ICT to gain competitive advantage. The significance of *ICT* for achieving business outcomes has been examined by researchers (Melville et al., 2004, Drnevich and Croson, 2013, Piotrowicz and Cuthbertson, 2014). More specifically, cloud computing is a current trend that has the potential to improve business productivity and support SMEs to achieve competitive advantage (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012).

Therefore, this research examined cloud computing adoption by SMEs in the Australian context. The aim of this research was to explore three main aspects. The first aspect was to establish the status of cloud adoption by SMEs in Australia covering 2015-2016. The second aspect was to explore influences that led SMEs to adopt cloud computing. The third aspect examined challenges that organisation’s encounter when utilising the cloud.

9.1.2 Economic Analysis

This study showed positive effects of cloud adoption by SMEs relating to increased productivity. Ultimately their increased productivity would add to the national economy (Fakieh et al., 2016). The status of the national economy is identified by several methods. One of them is by measuring the market value of all national products and services in a specific timeframe, known as *Gross Domestic Product* (GDP), which is commonly measured annually (Mankiw, 2014, Gans et al., 2011). Having a positive GDP in a specific year means the economy is improving that year. Australia has slightly economic growth, scoring positive GDP in the last few years (Mankiw, 2014, Gans et al., 2011). However, this growth seems limited and not competitive, when compared with the highest global GDPs. For instance, Turkmenistan scored the highest global GDP in 2014, which was 10.3% (WB, 2015), while the Australian economy was ranked as 140th the same year at scored 2.4% (RBA, 2015). Such figures, encouraged the research here to explore possible parameters that would help improve the national GDP. The analysis showed three main factors play a significant role in the national economy, which are trade, production, and the status of the fund supply (Stevenson, 2010). National production would be enhanced by national productivity (Gruen, 2012). Focusing on possible factors that would lead to improvements in the national productivity was under consideration of this study. National productivity is affected by four main factors - effective use of technology, capital and cost efficiency, human resources and resource endowment (Gordon et al., 2015). As information system's research, we adopted a technology perspective, exploring the effective use of technology. The literature showed the possible effect of information technology (Chen et al., 2015, Bhatt et al., 2010, Wang et al., 2013b, Melville et al., 2004), including cloud computing in improving business productivity that ultimately would lead to enhanced national productivity (Sultan and van de Bunt-Kokhuis, 2012, Ross and Blumenstein, 2013, Ross and Blumenstein, 2012). While SMEs are a significant player in the national economy, this study focused on SMEs to explore cloud utilisation by Australian SMEs.

9.2 CONTRIBUTION TO KNOWLEDGE

This thesis set out to explore the status of cloud computing with regards to the Australian SMEs. This research started by developing a conceptual framework by combining the *Resource Based Theory (*RBT) with the *Technology*, *Organisation, Environment* (TOE) framework. This thesis provides three contributions to the IS and SME literature. The first contribution is that this research provides insights into state of SME adoption of Cloud in the Australian context in 2015-2016. The second contribution is to provide in-depth insight into the possible drivers or influences that motivate SMEs to adopt cloud computing. The third contribution also provides in-depth insights into the challenges and limitations of Cloud adoption by SMEs.

The first contribution was implemented via a quantitative survey. The quantitative survey was used also to explore the factors as drivers and challenges. Those factors were explored in-depth in the second phase of this study in forms of semi-structured interviews.

9.2.1 Research Theories

This research examined three questions exploring the current status of the cloud adoption rate by Australian SMEs; the drivers of adopting cloud computing; and possible challenges encountered by SMEs utilising cloud computing. We started by developing a conceptual framework as the basis of this study. This framework was adapted by combining two theories. RBT was the first theory. It said successful implementation of resources – such as cloud computing – could improve capability and productivity leading to competitive advantage of the firm (Carcary et al., 2014, Garrison et al., 2012, Yigitbasioglu, 2015, Caldeira and Ward, 2003). The second theory was the (TOE) framework that categorise business factors as Technical, Organisational, and Environmental factors (Oliveira and Martins, 2010, Baker, 2012, Tornatzky and Fleischer, 1990, Paul Jones et al., 2013), which explores possible drivers and challenges in the three categories of the TOE framework. The research was principally a qualitative study through semi-structured interviews. However, the first phase involved the conduct of a quantitative survey, discussed in detail in the following section. In addition, the results uncovered here, help to develop a suggested cloud adoption framework for SMEs in Australia. This framework aims to assist SMEs in understanding possible drivers and challenges if and when they attempt to utilise cloud services.

9.2.2 Research First Phase (Quantitative Survey)

The main goal of conducting the quantitative phase was to explore the approximate adoption rate of cloud computing. Gaining more participants would lead to more accurate results. If the adoption rate was explored as part of the qualitative phase, the sample obtained might not be sufficient and results might not be accurate due to the limited number of interviewees compared to survey participants. The second goal of the quantitative stage was to gain an initial understanding of the possible factors as drivers and challenges in adopting cloud computing by

Australian SMEs. These factors were classified into three categories according to the TOE framework, which were technological, organisational and environmental factors.

The survey was distributed among six Australian cities - Sydney, Melbourne, Canberra, Brisbane, Newcastle and Wollongong. This distribution came up with 470 valid participants or participating organisations.

Exploring the adoption rate of cloud computing from different perspectives highlighted different adoption rates. The study here showed 48.7% of Australian SMEs used enterprise cloud services, such as *Salesforce.com* or *MS. Azure*. Exploring the adoption of online consumer services such as *Hotmail.com* showed 67.7% of our sampled Australian SMEs used them. A third investigation to explore online cloud storage service use, showed 54% of the sample used such services. The study highlighted some industries such as recruitment (81.8%), IT and engineering (78%) were more interested in cloud computing compared to other industries, such as medical services (30.3%) and retailers (30%).

One possible research question to still be addressed when exploring the adoption of cloud computing, is related to the preferred service delivery and deployment model. Exploring service delivery models showed 95% of our sample used SaaS as their most preferred option, yet only 17% used PaaS and 10% used IaaS. Most of SMEs preferred private cloud deployment (70%), while SMEs were generally less interested in other deployment models - (31%) hybrid, (8%) public, and (5%) community.

Exploring drivers and challenges in this phase focused on asking participants to rank 21 factors, collected from the literature as drivers and another 27 factors as challenges. Exploring these factors helped prepare semi-structured interviews to conduct the in-depth qualitative phase.

9.2.3 Research Second Phase (Qualitative interview)

The qualitative phase aimed for in-depth understanding of ranked factors from the quantitative stage. This phase involved 20 interviews. Cloud adopter SMEs were asked to discuss possible drivers and challenges when their firm utilised cloud computing. Results showed most factors could act as drivers as well as challenges, while a few factors could act only as drivers or challenges.

Technical factors explored as drivers *and* challenges were performance, convenience of use and complexity, security, availability, and implementation issues. Technical factors explored as drivers *only* included accessibility, system maintainability, and scalability. Factors as challenges *only* were lack of professional staff, lack of understanding cloud computing, and certain operational issues.

The organisational perspective highlighted business processes and needs, setup and operational costs as well as up-skilling motivation and job security as bi-directional organisational factors that could act as drivers or challenges. Operational time savings and improving business outcomes were the only two factors in the organisational list acting as drivers only. While in-house data control, executive support, and personal acceptance level to change were three explored factors appearing as challenges only.

The environmental list did not include any factors as a challenge only. Only three factors in the list were considered as drivers and challenges by adopter SMEs – being service location and government regulation, vendor services, as well as telecommunication and internet. While two factors appeared as environmental drivers only, which were improving the relationship with customers, and trust. Even several non-adopter SMEs ranked trust as one of their top challenges. However, adopter SMEs did not find any challenge related to trust, while they believed trust was a significant influence encouraging the firm to adopt the cloud.

Analysis of phases 1 & 2 helped develop a suggested SME cloud adoption framework.

9.2.4 RESEARCH CHALLENGES

This short section recalls challenges faced in collecting the required data from SMEs. This phase started by contacting SMEs mainly by email to invite them to participate in the study. However, the nature of SMEs as relatively small businesses, with limited staff numbers, busy environments, or just having no interest in participating in such studies makes SME-related academic research so much more difficult. Therefore, from the start of this research, most SMEs' data came from industry such as the MYOB study (MYOB, 2012, MYOB, 2015). The issue of receiving very limited participation via online invitations was overcome by switching from an online approach to onsite visits resulting in 470 valid samples. This phase was a very long process and consumed a significant amount of time, cost, and effort to collect data from six cities requiring travel by car, train and plane.

Ultimately, successfully overcoming of this challenge allowed the data collected to one of the main strengths of this research through an industry contribution from 470 SMEs reflecting the current status of cloud adoption.

9.3 RESEARCH LIMITATIONS

The major difficulty of this study was in collecting the required data from SMEs, that led to convenience sampling, summarised as picking the *first to hand* samples (Bryman, 2012, Denscombe, 2014, Hartas, 2015) that significantly assisted in collecting the required data. However, the limitation of using convenience sampling means there is a difficulty in generalising results to all sectors (Hartas, 2015), where data collected from some sectors was much higher than others. For example, the sample included 69 finance and 50 IT & Engineering SMEs, while there is only one SME in each of the mining and transport industries.

Additionally, the SMEs adoption framework is one of the contributions of this study which investigated possible factors as drivers and challenges. Most of these factors noted 'status' during the adoption or after adoption during the operational time frame. In order to enhance this framework, it is better to focus on possible factors prior to adoption as an initial phase of in future research.

The framework developed to assist SMEs adopting cloud computing was based on results in the Australian context, however these could potentially be applicable to any SME globally. Few factors are likely to be applicable to Australia SMEs only. Moreover, this framework is based on results of data collected in 2015-2016 - after a while factors noted in the framework developed may change. While some new factors might appear, other existing factors could disappear.

9.4 FUTURE WORK

This research answered questions relating to the approximate adoption rate of cloud computing by Australian SMEs in 2015-2016, as well as drivers and challenges, to fill a gap in the literature. The framework developed provides researchers with the opportunity to gain further insight into possible drivers and challenges in cloud adoption by Australian SMEs. The framework can help to interpret or answer specific issues in further research with regard to cloud adoption by SMEs, such as 'why SMEs tend to use cloud computing to improve productivity?'

This research unlocked several research ideas as potential future directions. It is possible to enhance the conceptual framework through exploring the significant preparation factors when SMEs attempt to use the cloud. Isom and Holley (2012) highlighted the importance to build a cloud adoption strategy. This strategy contains a check list of ten important factors in cloud computing adoption that should be identified and considered prior to adoption, being cloud vision, use case, drive business innovation, expected outcomes, determining cloud opportunity, cloud ecosystem, stakeholders, metrics, governance, and roadmap (Isom and Holley, 2012). These ten managerial factors will be explored in future research to gain further insight regarding adopter SMEs considerations of these factors.

9.5 RECOMMENDATIONS

The potential of cloud computing and the critical significance of SMEs globally, and especially in Australia as discussed in the literature encouraged investigation of the approximate rate of cloud adoption and possible drivers and challenges when an organistion utilises desired services from the cloud. This research has raised several other questions and recommendations for different industries relating to Cloud. The following sections provide some suggestions and recommendations to researchers, SMEs and practitioners, service providers, and to Australian policy makers.

9.5.1 For Researchers

The academic significance of this research lies in providing rich industry data, that is to say 'ecologically valid' data, based on academic study that can help future researchers answer other research questions. For example, exploring the relationship between organisation size or industry category and type of cloud adoption including service delivery and deployment models.

Starting with the academic field, one suggestion is to explore adoption rates in different timeframes to identify the trend of cloud use by Australian SMEs. Researchers may also focus on specific SME industries to investigate reasons that hinder or minimise some specific industries from using cloud computing, outlined in chapter 6. It may be because limited numbers of investigated SMEs in those sectors such as transport and philanthropy, or perhaps some SMEs did not find good solutions. For example, 33 SMEs from the medical services sector were included in the study, but only 30.3% (10 firms) used cloud services. Additionally, an important issue is why micro firms are not interested in adopting cloud computing compared to small – but not micro – and medium enterprises.

Researchers may use the framework developed here from different aspects. The framework could be used to investigate drivers and challenges of cloud adoption by Australian SMEs in different timeframes. This would explore new factors or finding that some existing factors disappearing or arising. The framework could also be used to investigate drivers and challenges of adopting cloud computing by specific industry such as the medical services. Additionally, the framework could be used to investigate drivers and challenges in other countries with a view to their local factors.

Researchers could also use the framework here to investigate effects on their firm in more detail, such as business agility.

Lastly, the potential of cloud computing for improving business customer services is another important point. This potential should be highlighted with regard to other possible opportunities as well as possible challenge on customer service and relationships – if they exist – requires further investigation.

9.5.2 For Practitioners and SMEs

Practitioners and SMEs may be interested in the adoption rate of cloud computing by Australian SMEs to gain insights regarding their competitive position. Practitioners might use the conceptual framework as a form of guidance when attempting to adopt cloud services. Additionally, the framework could help adopter SMEs in Australia and globally to assess their cloud use for benefits and to mitigate or avoid possible challenges. Both cloud computing adopters and SMEs who adopt cloud services might use this framework whilst conducting a *Strength, Weakness, Opportunity,* and *Threat* (SWOT) analysis (Böhm, 2009, Pahl and Richter, 2007) to increase the likelihood of cloud adoption success.

9.5.3 For Service Providers

Some sectors may not be interested in utilising cloud computing because of lack of proper solutions for their needs or because of limited awareness of cloud potential to their firms. In this case, it may be better if service providers work to improve SME awareness by distributing simple understandable flyers or running dedicated workshops for SMEs or specific SME industries. In addition, gaining improved understanding of SME needs would lead to specific cloud based solutions for each sector, such as *Salesforce* for customer relationship management or *MYOB* for accounting, as noted in the literature.

9.5.4 For Policy Makers

The significance of SMEs in Australia and possible opportunities for cloud computing means policy makers gain some support from research in this area. Research here noted a negative effect of the cloud, where local businesses hire overseas workers to work remotely, potentially leading to increased unemployment. It would be better if policy makers legislate linking the cloud to employment rates to maintain or improve employment of local professionals in high-demand jobs.

As the literature says, there is a clear effect of SMEs in driving the national economy. Also, there is a potential of utilising cloud computing in enhancing the national economy. A further consideration of the relation between SMEs and cloud computing would ultimately result in enhancing the national productivity and economy, which should be in the consideration of researchers, practitioners, SMEs, service providers, and policy makers.

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Appendix 1: Publications

A Study of Government Cloud Adoption: The Australian Context

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Abstract

The literature is scant around the take up rates of cloud computing by organisations. Cloud computing is nonetheless expected to be a major computing paradigm in the future. The benefits of the cloud vis-à-vis outsourcing many current in-house IT services and applications – both hardware and software based, are numerous. However, governments and many enterprises are still relatively unclear on the motives for adopting cloud technologies and the consequent benefits gained in a real-world operational environment. This paper examines the results from a survey conducted at a forum of senior government IT managers and their views towards cloud computing adoption. The paper provides insights both from technological and non-technological perspectives in the overall context of cloud adoption in Australian government enterprises.

Keywords

Cloud computing, Adoption, Digital Economy, Australian organisations, New South Wales State Government.

INTRODUCTION

The phenomena of cloud computing can be a valued addition to business environments to facilitate online business and improve digital productivity (Gill, Bunker and Seltsikas, 2011). There is significant opportunity for organisations of all sizes to gain tangible benefits, such as scalability, flexibility, affordability, maintainability, and online operating service availability (Zhang *et al.*, 2010). In particular, cloud computing provides opportunities for Australian government enterprises to increase their productivity and therefore boost the national economy (Gill *et al.*, 2014). Cloud computing claims to provide several benefits, however there is an absence in academic studies about cloud computing adoption from Australian government enterprise perspectives. In order to address this, a survey was recently undertaken identifying Australian government professionals' perspectives about cloud computing adoption in the public sector. This paper analyses the survey results conducted in February 2014 with 150+ CIOs, IT and business managers across the New South Wales public sector, examining their attitudes toward cloud computing adoption in Australian government agencies and enterprises. The next section in this paper will discuss the background to cloud computing and some of its features.

WHAT IS CLOUD COMPUTING?

There are many definitions that continue to emerge around the concept of cloud computing. A recent example is delivering everything as a service (XaaS) (Mladenow *et al.*, 2012), where X means "everything". XaaS refers to the availability of the IT infrastructure, platforms, software, databases, and the other IT resources on the internet that can be accessed remotely (Winkler, 2011). Another definition of cloud computing states that "it is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location" (Marston *et al.*, 2010) as illustrated in figure 1 below.

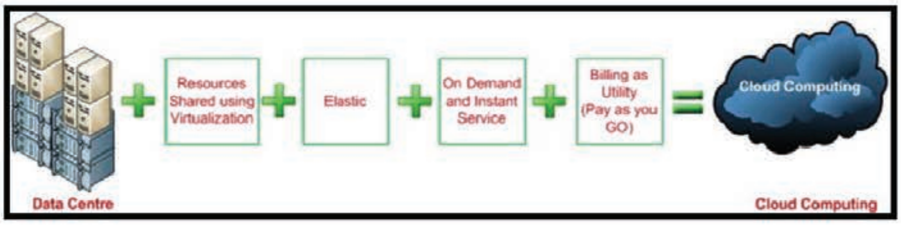

Figure 1: What is Cloud Computing? (source: Khorshed, Ali and Wasimi, 2012)

The National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011). There is another way to view cloud computing which is from the business point of view, which defines such computing as a model of delivering, enabling and consuming the IT services with the flexibility of economical scaling up and down as well as adding, changing or removing the IT based business processes (Isom and Holley, 2012). However there does seem to be some consensus that the basic model of cloud computing consists of users, organisations, and/or applications that share different IT resources; such as applications, data, servers, and storage through the internet (Harding, 2011) as illustrated in figure 2. The previous view may define cloud computing as an innovation of facilitating business processes by utilising flexible and scalable online on-demand IT hardware and software resources, to achieve the flexibility of adding, removing, and reengineering business processes with minimum cost.

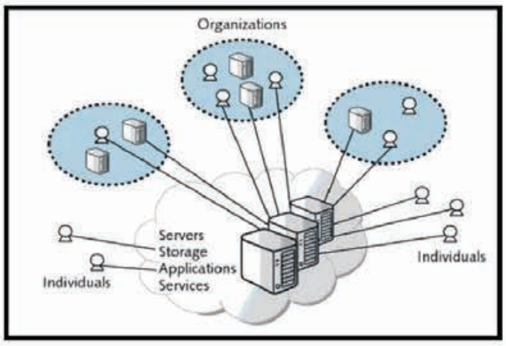

Figure 2: The basic model of Cloud Computing (source: (Harding 2011)

In short here are three main service delivery models of cloud computing, which are *Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)* (Mell and Grance 2011). IaaS provides hardware resources for customers, such as storage and processing. IaaS supplies a virtual data centre in the cloud. In this model developers are responsible for installing the required software assets, such as operating systems, backup systems, developing platforms, and databases. The main feature of this model is the ability to configure and customise most of the hardware and software resources. PaaS acts as a superset of IaaS by providing IaaS plus the necessary operating systems and development environments.

This includes providing network support, dedicated or virtual servers, operating systems, development environments, databases, and data storage. The hardware and software resources are managed by the cloud service provider, which is a feature of PaaS to allow developers to focus on development, rather than consuming time in other administrative tasks. SaaS lies further on top of this stack by providing the required applications to customers via the cloud. The main advantages of SaaS are scalability (adding or removing resources), cost (data centres are in the cloud), and simple integration, where users mostly need web browsers only to interact with systems. However, there are some drawbacks of using SaaS, such as security and customization. Salesforce.com is one of the well-known examples of SaaS (Jamsa, 2012). From the business perspective, there is an additional service delivery model called *Business Process as a Service (BPaaS)*, which is used to deliver any vertical or horizontal business processes via the cloud, such as e-procurement, and business travel services (Isom and Holley, 2012).

What is clear is that cloud computing technologies are used to save, manage, and control data remotely and are stored in unknown and distant places from the enterprise's geographical location. However, some business organisations *do* choose the geographical location of their data, such as companies that require management of their customers' information in a specific location (Sultan, 2011). *YouTube* and *Twitter* are two such examples that target both businesses and individuals (Lin and Chen, 2012). While *Google Apps* and the Customer Relationship Management (CRM) system from Salesforce.com are two well-known examples of leveraging from SaaS in business environments (Jamsa, 2012). The deployment of cloud services relies on one of four deployment models. The first model is the *public cloud*, which is deployed by the provider and open for all internet customers. It is usually used by small and medium organisations as a cost effective method to deploy their IT services. Opposite to the public model, the *private* model comes as the second deployment model, in order to provide cloud services to a specific customer. The third model called *hybrid*, is a mix of the public and private model: it allows cloud customers to utilise some of cloud services privately for their local systems, and generally for their clients. The fourth or *community* model allows only a group of companies to utilise provided services (Marston *et al.*, 2010).

BACKGROUND TO CLOUD COMPUTING

The term *Cloud Computing* was first mentioned in 1999 for business purposes when www.salesforce.com introduced its business applications. Major online retailer www.amazon.com followed in 2002 when it provided its cloud based storage services, followed by Amazon Elastic Cloud Computing (EC2) in 2006 for small businesses. During this time several cloud applications and services from various companies, such as Microsoft and Google as well as Force.com and Amazon were developed (Withee and Reed, 2012). Some features of cloud computing existed prior to the internet, one of the main features of which was centralised processing, for example service providers used their substantial resources to process all clients' transactions. This method was originally used during the 1960s and '70s (Lageschulte *et al.*, 2011), when a computing expert called McCarthy predicted that if computing services could be facilitated like a public utility, it would become an important new industry (Gillam, 2010). Medium sized computers then came to change this concept slightly by distributing processing via computers, but *within* the enterprise. In the 1990s, Microsoft Windows changed this concept by assigning the processing to clients' desktops as well as to enterprises in general, which then in turn changed some of their processes to work on client desktops. Since then cloud computing has turned the processing trend back on to the centralised concept of data processing, and can thus be considered the modern version of the mainframe (Lageschulte *et al.*, 2011).

Cloud computing is predicted to be an evolving trend that will provide organisations with the flexibility they need to compete effectively in a rapidly changing business environment. This is particularly important in the Australian public sector (Australian Government, 2011). Thus the overarching question explored here is: *what are the take up rates and critical success factors for Australian public organisation's adoption of cloud computing to achieve competitive advantage and increase national productivity?* The next section explores the evolution of cloud computing.

CHARACTARISTICS OF CLOUD COMPUTING

Cloud computing technologies are considered to possess several characteristics. The National Institute of Standards and Technology highlighted five main features of cloud computing, which were:

1- *On demand self service* allows customers to select the appropriate service, whether it is software, platform and/or infrastructure services, and pay as they need to use only.

2- *Measured service*. The systems of cloud computing have the ability to measure, monitor, report and control the resources used automatically and provide accurate costing and invoices to customers.

3- *Rapid elasticity*. Cloud computing service consumers are able to add or remove any of the IT resources at any time as required without any major investments in their own IT resources. There are three distinct benefits:
   - *linear scaling*: performance remains the same among users.
   - *on-demand utilisation*: clients allocate resources as they need to use them.
   - *pay-as-you-go*: paying only for the resources that are used.

4- *Resource pooling*. Is able to provide a high level of *Quality of Service* (QoS) at a competitive cost by sharing the tasks of IT management and administration, with a high commitment to service efficiency.

5- *Broad network access*. Is the ability and availability to access services among different platforms and devices. Broad network access via telcos can increase the users of the cloud services which would in turn improve their business (Alliance, 2011; Harding, 2011).

Cloud computing services can bring several advantages to business organisations. First of all, utilising the cloud can provide the ability to empower innovation trends in organisations from the IT side, by providing several solutions with a distinct reduction of IT obstacles (Marston *et al.*, 2010). Secondly, it provides direct access to hardware infrastructure remotely via the internet, with each client separated from others (Marston *et al.*, 2010). Moreover, cloud computing facilitates the scalability of IT resources, where enterprises are able to scale resources up and down depending on their requirements (Dubey and Wagle, 2007), which is one of the main features of cloud computing, such as pay-as-you-go, allowing users to pay only for resources utilised (Leavitt, 2009). Reducing IT investment and operational costs is another advantage in adopting cloud computing. For investments, companies can rent the required IT resources from the cloud provider instead of building dedicated IT centres. On the other hand, organisations can cut operational costs of servers, licenses, energy, staff, and other IT resources by authorising a third party - the cloud provider, to do such tasks (Choo, 2010; Marston *et al.*, 2010). This financial saving can help SMEs for example, to manage their limited budgets through saving IT service costs and scaling up their capital to empower their business (Miller, 2008).

CURRENT IS RESEARCH AREAS IN CLOUD COMPUTING

There are several fields of research in cloud computing that can be applied within a specific region or country. For example at the Australian level, Dr. Renato Iannella: principal scientist of National ICT Australia; proposed research to build Australian cloud services to put all local data under Australian control and protection in order to mitigate the fear of migrating data overseas that could be affected by foreign rules and policies (Choo, 2010). Organisations in Australia have to comply with the Australian Government's *Privacy Act*, an Australian law that sets the rules with regard to the handling of individual information including the disclosure, storage, use and collection of personal information (Privacy_Act 2013). In the *economic* space, there is a need to show how cloud enablers can add economic value as well as what the most suitable pricing strategies are. Different pricing strategies are used in cloud computing, such as flat rate, payment per use or a combination of payment strategies (Marston *et al.*, 2010). Decisions on the most appropriate pricing strategy require an analysis of each method to ensure the relationship between quality and investment, as well as determine the best practice in this field. *Regulation* could be part of all other research areas, from the government level such as the Australian government privacy act; down to issues inside the organisation, such as budgeting. Regulation also includes pricing, Service Level Agreements (SLAs), security, international standards, risk assessments, adoption, and partnerships. With regard to research on the *adoption* of cloud computing there are many issues that need to be addressed. Implementing cloud computing requires an understanding of best practice and development of risk assessment methodologies, such as security in hardware and software and policy in general (ENISA, 2009). Research relating to *strategy* could target clients to determine the most important factors in order to meet their business goals, whilst targeting IT organisations that attempt to provide cloud services, this also includes matching business goals, issues of change management as well as staff training. *Policy* research may vary from managing the migration from on-premises to a third party in the cloud, setting a road map for migrating standards to cloud providers, and setting the rules of monitoring and auditing the cloud services locally and internationally. Having discussed some of the key research issues surrounding cloud computing generally, let us turn our attention to the Australian context more specifically.

CLOUD COMPUTING WITH REGARD TO AUSTRALIA

There exists an opportunity for Australian organisations to adopt cloud services to develop flexible IT platforms at a relatively low cost. These three broad services: IaaS, PaaS and SaaS provide the IT resources for organisations to take advantage of online services, such as e-commerce; without a massive investment in IT resources (Galer, 2013). Not surprisingly there has been a significant growth in the cloud computing market over the last few years. Gartner Group (2013) reported that the global cloud services' market was valued at $110.3 billion in 2012, and was predicted to grow 18.6% to $131 billion in 2013. The IaaS market was $6.1 billion in 2012 and this number was forecast to be $9 billion in 2013. The Gartner report also mentioned the major sectors of cloud computing market. Advertising in the cloud was classified as a top investment sector in the cloud by 48% of the total market in 2012. Moreover, the cloud investment was estimated to rise to $677 billion from 2013 to 2016, where around $310 billion is dedicated for advertising. The second largest industry in the cloud is the Business Process as a Service (BPaaS) market by 28%. SaaS comes in third at 14.7%, followed by IaaS by 5.5%, and cloud security and management at 2.8%, while the last sector was PaaS at only 1% (Anderson *et al.*, 2013).

A survey undertaken in 2010 (CIO and IDG, 2011) conducted in 636 companies in five countries (USA, UK, China, Japan, and Australia) showed that 88% of IT decision-makers agreed that cloud computing would be a priority in their organisations. Cloud computing was identified as important for achieving eight key objectives, which were e-industry regulatory change, disaster recovery, improving capability and availability, minimizing IT investment in infrastructure, enhancing IT control, business agility, mitigating IT maintenance and management as well as improving IT productivity. Business agility was identified by 75% of interviewees as the most important contribution of cloud computing. The second most important contribution at 56% was reducing IT infrastructure investment. The third most important at 53% was decreasing IT maintenance and management resources. Other cloud contributions included improving capability and availability (50%), improving IT productivity (46%), disaster recovery (40%), enhancing IT control (32%) and industry regulation (17%).

Cloud computing is thus considered as one of the business success factors that could lead to improvements in business outcomes and the national economy as a whole (Mladenow *et al.*, 2012). Cloud computing is described as a group of innovative IT utilities that provide on-demand on-line services (Surendro and Fardani, 2012), which provide several benefits to SMEs with limited budgets which cannot support a specific investment in their IT resources. It can help SMEs by providing most of the needed utilities online by renting the required resources which varies from hardware infrastructure to operating systems, software, file storage, databases and more. This utilisation is supposed to mitigate the IT resource issues for those companies, improving their income and adding value to the Australian economy. Cloud computing can also act one of the most important success factors for business survival in improving and managing business processes as well as innovating new business ideas, for example using mobile computing, dealing with Big Data issues, and for social media (Isom and Holley, 2012).

In order to be effective, cloud computing requires access to fast and reliable internet infrastructure to guarantee the quality of service and to ensure online availability for 24/7 operations. The Australian government has moved an important technological step forward by introducing the *National Broadband Network (NBN)* which is planned to reach 93% of Australian buildings in order to provide peak speeds of up to 25Mbps (Department_of_Broadband 2013c), with several options of speed and three different technologies, being fixed wireless, optical fibre and internet by satellite technology, where the last one is proposed to work by 2015

(Department_of_Broadband 2013a). This shift can support the Australian government's trend in its regulation of cloud computing through three main strategies. The first strategy is increasing the business value of cloud computing in the government digital environment (Gill *et al.*, 2014). Secondly, promoting the utilisation of cloud services for SMEs and non-profitable organisations as noted in Fakieh, Blount and Busch (2014). The third strategy is focused on supporting the cloud services sector (Department_of_Broadband 2013b). Globally, Japan is one of the leading countries in internet and computing technologies in providing internet services, a critical factor to gaining global competitive advantage. Japan leads the world's internet speed through the introduction of the fastest internet in the world, reaching speeds of up to 2Gbps (Alabaster, 2013); this shows for Australia to be competitive it needs to have fast ubiquitous broadband.

CURRENT CHALLENGES FACING CLOUD COMPUTING ADOPTION

As with any technology, there are several threats that could affect the evolution of cloud computing. In general, the challenges of adopting cloud computing can be categorised into four main groups, which are: *technical*, *organisational and policy*, *legal*, and *miscellaneous* risks that do not fall in to the previous three categories (Khajeh-Hosseini *et al.*, 2012).

Cloud computing *regulation* is a critical political and legal issue from the business perspective. Regulation is required in order to regulate dealing with cloud computing on local, national and international levels to ensure availability, accessibility, and privacy under any possible conditions (e.g. natural, financial or political), to avoid any unexpected consequences, such as the failure of data privacy, which could lead to administrative, local, national, or even international problems. Therefore cloud stakeholders are required to set clear SLAs highlighting all possible issues (Alliance, 2011).

Data availability is one of the main technical and organisational issues in cloud computing. Organisations need to gain the highest availability of their businesses online, and they might not accept faults that could hinder their work. Such availability issues are connected to *regulation* in order to set rules to avoid unexpected issues (Choo, 2010).

Data privacy and security is another data-related dilemma than hinders the expansion of cloud computing. Clients wonder if cloud service providers can provide better or even the same level of data privacy and data security compared with an in-house model. Moreover, clients typically have several questions about who can access their data, and how to insure the privacy from the staff side of the cloud service provider (Zhang *et al.*, 2010).

Lack of cloud standards is another technical threat that inhibits cloud growth. There are no clear interfaces between platforms from different service providers (Armbrust *et al.*, 2010). As a consequence, cloud clients may face several problems when they decide to move to another cloud provider. However, some of the main industrial cloud players; such as Microsoft and Google; have commenced attempting to solve this issue through developing different solutions to move data to and from their systems (Marston *et al.*, 2010).

Multi-tenancy and cyber-attacks are one of the major technical issues in cloud computing. While data from different clients are stored in a single multi-tenant server, the server needs to run at the maximum protection level to ensure security. If one of the virtual environments faces attack, the server must provide complete protection to the other virtual tenants (Choo, 2010) as well as protect physical resources, because hackers are always trying to reach all of the cloud's clients in the victim's server (Alliance, 2011).

Lack of data control could be considered as a major legal and organisational deal in adopting cloud services to the business. Organisations may refuse to take advantage of cloud services, because they feel their valuable data is owned and controlled by a third party, namely the cloud service provider (Armbrust *et al.*, 2010). Furthermore, the sense of data being controlled by others leads companies to think they lack flexibility; compared with an in-house option to edit or change their own applications (Leavitt, 2009; Miller, 2008).

GOVERNMENT CLOUD

Traditionally Government agencies collected, created, maintained and managed their operational data individually, essentially if they owned the data collected. Recent technology innovations allows agencies to contemplate the adoption of 'cloud' sourced services and software for the three broad categories (IaaS, PaaS and Saas) of cloud computing. This represents a significant shift in the way agencies manage and deliver services, and also raises legislative challenges around ownership and control of information. The driver for this move was the need for greater efficiency (cloud is a cost-effective solution), infrastructure and also a need for legislative reform. In July 2013 the NSW government CIO and Finance Minister (Bender, 2013) issued a statement announcing that the state government would be shifting their agencies towards the cloud. In the previous month they released the "NSW Government Cloud Services Policy and Guidelines" (NSW Government, 2013) to match cloud delivery models to agency business requirements. This *directed* NSW Government agencies to consider adopting cloud technology on a cost benefit framework. Nonetheless, there exists a lack of academic study with regard to Australian government cloud adoption.

RESEARCH APPROACH

In general, there are several social research methods, however there are three main epistemologies, which are *positivist, interpretive,* and the *critical social research method* (Myers and Avison, 2002). Positivism assumes reality is a given and it can be measured by its features and is mostly applied as observations, precision and the independence of values and theory (Neuman, 2010). Interpretive research starts with assumptions that might lead to reality. It is usually used to understand an phenomena, such as the influences of information systems (Walsham, 1993), with its purpose being to learn how the world works by understanding people and knowledge (Neuman, 2010). Critical Social Research assumes there are some realities that need to be criticized in order to transform them to other forms (Neuman, 2010). The role of this paper is to present the results of a cloud computing survey conducted with IT managers in NSW Government. The complementary paper (Fakieh, Blount and Busch, 2014) in this ACIS track, discusses the literature, research approach and theory in further detail. In this study over the next couple of years, the epistemology will be interpretive initially for several reasons. It is useful to collect the opinions of public sector employees' on cloud computing adoption through an administrative survey. After collecting data, the reality then begins to form. From this point, a positivist epistemology will prove beneficial in order to analyse the collected data. The initial survey results are hence further discussed in next section.

SURVEY QUESTIONS

From the discussion above the major issues may be summarised in two main points: (1) there is no clear academic study on Australian Government cloud adoption, thus (2) there exists a need to study Australian public sector employees' perspectives on cloud computing adoption. Enhancing our understanding from employees' perspectives will potentially provide insights into how Australian public organisations should proceed with cloud computing adoption to increase competitive advantage and improve national productivity. In order to understand the state government agencies' perspectives on cloud computing, a workshop involving public sector employees was held on the 18th February 2014 in Sydney at the MLC Tower in the offices of NSW Trade and Investment. This workshop was attended by 151 CIO's, IT and Business Managers across several NSW government agencies. The survey was conducted within a forum using electronic 'clickers' to record the participant's responses. The discussion, forum and survey were moderated by the Director of Intel Asia-Pacific Region. A total of twelve questions were asked through a close-ended administrative survey questionnaire,[1] of which only the more relevant ones (table 1) are addressed here.

Table 1. Cloud workshop questions and answers

Questions	Answers
Q2. [2] Do you now feel you understand about using the cloud?	Not really, Somewhat, Moderately, I have a pretty good idea, I am a subject matter expert
Q3. Following today's debate, are you more likely or less likely to use cloud services at your agency?	Much less likely, Less likely, About the same, More likely, Much more likely
Q4. Which team had the most compelling argument?	The 'extreme' cloud team were much more compelling, The 'extreme' cloud team were a little more compelling, I think both arguments were equally compelling, The 'considered approach' team were a little more compelling, The 'considered approach' team was much more compelling
Q5. Cloud services will do me out of a job within 5 years	For sure, Probably, Don't know, Unlikely, No it won't
Q6. Cloud computing is a fad like outsourcing. It will swing back again to in-sourcing when people get tired of poor service	This won't happen, Maybe it will happen to some extent, I don't know, It could happen, It will definitely happen
Q7. Would you prefer to use a government cloud or a public cloud?	I would only use a government cloud, I would prefer to use government cloud, I have no particular preference, I prefer to use public cloud, I would only use a public cloud
Q8. It is time to stop trying to manage things that can be provided better and cheaper out of a cloud. Do you	Totally agree, Partially agree, Don't know, Partially disagree, Totally disagree
Q9. Are you planning to change jobs in the next 12 months	Yes, trying to change now, Yes, like to change this year; I don't know; Like to change in 2-5 years; I am not looking
Q10. The one thing I would like to change about my job is	For my boss to appreciate me more, To work closer to home, To get promoted, To work less, To have more of a say in what happens at work
Q11. The biggest issue that keeps me up at night is	Staff capability; The work budget; Too much work; System problems; Organisational changes

[1] Refer to appendix 1, which provides a more structured presentation of results.

[2] Q1 simply asked respondents what type of cloud they like: cumulus, cirrus, stratus etc.; Q12 asked what the respondents liked about working in the NSW public sector.

DISCUSSION

The survey results provide some useful insights about government cloud computing for both academics and professionals. Cloud computing is a relatively new and emerging concept in the Australia public sector. Surprisingly, the analysis of Q2 suggests that most of the survey participants (43%) have a good grasp of the cloud. Only 7% of the participants indicated non-familiarity with the cloud. More surprisingly, only 10% indicated that they are subject matter experts in the cloud; this seems to suggest that professionals from the public sector are only beginning to become fully cognizant of cloud computing. Awareness of emerging cloud computing is one thing, it is important however to know whether public sector professionals are aware of how the cloud can be incorporated into ICT strategies in their respective agencies. The responses to Q3 highlighted that in total 90% (60+21+9) of the participants are interested to use the cloud services in their agencies. This high number may well be due to the government cloud strategy (Australian Government, 2011). However, it is more likely driven by the threat of IT budget freezes or reductions while maintaining the same customer service levels.

Cloud awareness and willingness to adopt it, show positive perceptions. It is important here to understand the Australian public employees' concerns about job losses due to cloud computing. A large response of 72% (Q5: 37% + 35%) indicates that they will not be out of job in next 5 year if their agencies decided to embrace cloud computing. This seems to suggest that most of the public sector employees do not see cloud adoption as a threat to their jobs. Although, cloud computing may not directly impact their job, there may be indirect impacts. Question 9 and Q10 further expand on job aspects in the overall context of cloud computing in the Australia public sector. The analysis of Q9 indicates about 46% respondents intend to change their job in next 12 months. Question 10 further highlights some non-technology aspects that may cause employees to change their job (see Appendix 1). Question 6 indicates 55% (19+36) of the respondents believe cloud computing will not fade away like outsourcing, 42% (25+17) of the respondents believe otherwise, whereas only 4% remain silent or neutral in response to this question. This seems to us a mixed response, and we believe that organisations go through natural back and forth strategies in response to the changing business and technology landscape.

There are a number of cloud service deployment models such as private government cloud or public cloud etc. (Gill *et al.,* 2014). Question 7 assumes that governments will adopt a cloud service model and seeks to understand whether agencies would prefer a private government or public cloud. Most of the respondents (62%) favoured the use of government cloud; only 12% preferred to use public cloud, whereas 25% respondents have no particular preference. This seems to suggest that public cloud is not an option in most agencies, mainly due to a number of potential risks attached to it (e.g. Perepa, 2013) or the cost/time to build infrastructure. This issue has been highlighted by Government enterprises across developed countries such as the UK, Canada, and the USA (e.g. Gov UK, 2013; Kundra, 2011). Following on from the strategies of these countries, the Australian government (2011) has a similar strategy that suggests "agencies may choose cloud-based services where they demonstrate value for money and adequate security." Australia has a value and risk driven strategy to cloud adoption; Q8 relates to this and is intended to determine the participants' response on this strategy. An overwhelming 78% of participants (31+47) favoured this strategy, while only 16% thought otherwise with 6% remaining neutral, indicating perhaps they did not know about this strategy. In addition to technology, Q11 and Q12 highlighted some other non-technological aspects within the context of cloud adoption. The responses to Q11 indicated that 47% (12+35) of the respondents believed that system problems and organisational changes gave them cause for concern. This factor needs to be taken into account when adopting cloud computing, as the adoption of the cloud will not only require system changes but also organisational changes (Gill *et al.,* 2014). Finally, Q12 is focused on their motivation for working in public ICT environment. Some 40% of respondents believed that helping the community was the motivating factor. The question is how can the adoption of cloud computing impact this motivation factor? - certainly a question for further research. Finally 31% of the respondents (Q12) indicated they appreciated the work/life balance. One may be interested to research the impact of cloud computing on the work/life balance.

In summary, the analysis of the survey results provided a number of insights both from technological and non-technological perspectives. The overall conclusion is that Australian enterprises are aware of the cloud opportunity and willing to take the next steps to embrace cloud, the question however is *how* should they proceed with the adoption of cloud computing? Hence it is appropriate that researchers and practitioners collaborate and develop the methods and frameworks necessary for systematic cloud adoption in Australian enterprises.

CONCLUSION

Australian government enterprises play a significant role in the digital economy and national productivity, through the hiring of a significant number of employees in Australia. Utilizing cloud services has the potential to increase individual, organisational, and national productivity. The literature shows a clear gap in our knowledge about cloud computing adoption in Australian government agencies and how cloud computing can be used for achieving competitive advantage. This research consists of two phases. In the first phase, the study attempted to highlight the Australian government agencies' views on adopting cloud computing from both technological and non-technological perspectives. The overall conclusion is that Australian agencies are aware of cloud opportunities and are willing to take steps to embrace cloud, however the question is *how* they should proceed? Researchers and practitioners can collaborate and develop methods and frameworks for systematic cloud adoption in Australian enterprises. The findings of this study will be further analysed in phase two (2) to develop and implement cloud adoption methods and frameworks for Australian government agencies. This paper presented partial results of the first phase, by using a structured survey providing insights to both researchers and practitioners on government cloud adoption in the Australian context. The first phase results will help toward establishing the second phase of this research.

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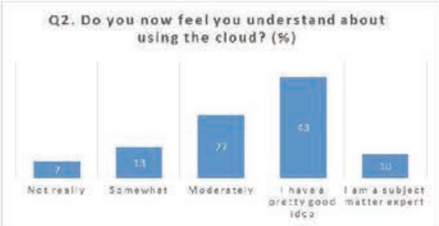
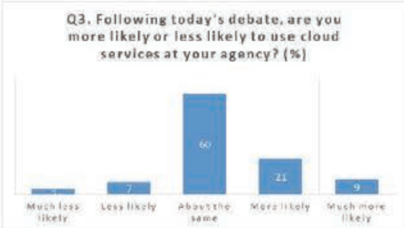
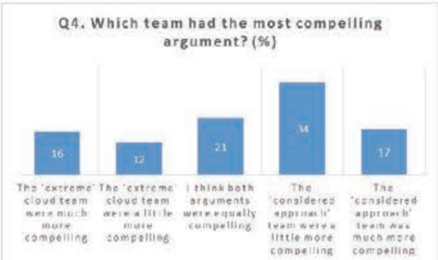
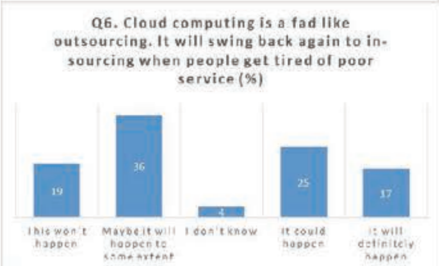
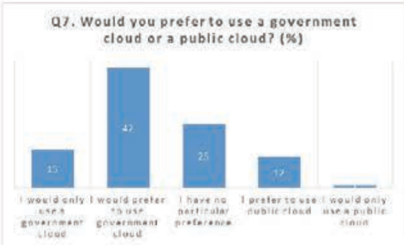
APPENDIX 1: SURVEY RESULTS

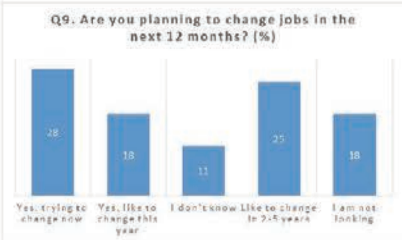


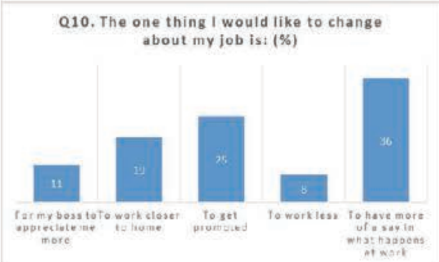


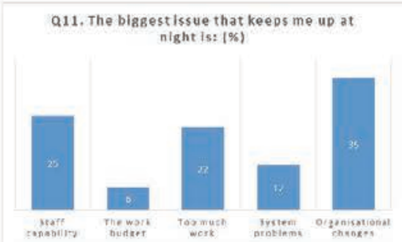












Success in the Digital Economy: Cloud Computing, SMEs and the impact to National Productivity

Research in Progress

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Abstract

The literature is scant around the take up rates of cloud computing by Small and Medium Enterprises (SMEs). This is important because Small and Medium Enterprises (SMEs) play a significant role in increasing national productivity. In Australia, SMEs employed around 70% of the total numbers of employees in 2011. This paper proposes a research program to examine how cloud computing can provide SMEs with the potential to achieve competitive advantage, increase efficiency and lift national productivity. The research will use both quantitative and qualitative measures to establish the take up rate of cloud computing and identify the critical success factors (CSF) for SMEs when adopting cloud computing technologies.

Keywords

Cloud computing, Australian Small and Medium Sized Enterprises, Digital Economy, SMEs and cloud computing, Australian SMEs, Critical Success Factors.

INTRODUCTION

The trend of cloud computing will provide distinct benefits to business environments to improve digital productivity and simplify electronic business. Cloud computing potentially provides significant opportunities for businesses of all sizes to gain discernible benefits, such as increased flexibility, online operating service availability, maintainability, affordability, and scalability (Garrison et al. 2012; Marston et al. 2010). In more detail, cloud computing opens the doors for Australian Small and Medium sized Enterprises (SMEs) to improve their outcomes that empower the national economy (MYOB 2012). There have been several industry studies exploring the take-up rate of cloud computing. However, there are no academic studies on the rate of adopting and using cloud services by Australian SMEs, nor studies exploring the critical success factors in adopting cloud computing for Australian businesses. This paper will give a brief discussion about some of the current research areas in cloud computing, and the possible challenges in adopting cloud computing. What will follow will be the significance of Australian SMEs. The proposed research will then be discussed in more detail.

CLOUD COMPUTING ADVANTAGES

Cloud computing services can bring several advantages to business organisations. It can provide the ability to empower innovation trends in organisations from the IT side, by providing several solutions with the distinct reduction of IT obstacles (Marston et al. 2010). Also, cloud computing provides direct access to hardware infrastructure remotely via the internet and treating IT as an operational expense, rather than having the need to invest in IT resources, with each client being separated from others virtually on the same physical resources, by balancing the loads of client consumption among resources (Marston et al. 2010). The scalability of IT resources is another feature of cloud computing, where the enterprises are able to scale resources up and down depending on their requirements (Dubey and Wagle 2007), which is one of the main features of cloud computing, such as Pay-as-you-go that allows users to pay only for resources used (Leavitt 2009). In addition, utilising cloud computing could help in reducing IT investment and operational costs. For investments, companies can rent the required IT resources from the cloud provider instead of building dedicated IT centres. On the other hand, organisations can cut operational costs of servers, licenses, energy, staff, and other IT resources by authorising a third party which is the cloud provider, to perform such tasks (Choo 2010; Marston et al. 2010). This financial saving can help small and medium organisations (SMEs) to manage their limited budgets by saving IT service costs and scale up their capital to empower their business (Miller 2008). Cloud computing also opens the door for developing countries that lag behind in utilising the latest information technology resources (Marston et al. 2010). Such benefits are not however without issues.

CURRENT CHALLENGES FACING CLOUD COMPUTING ADOPTION

As with any technology, there are several threats which could affect the evolution of cloud computing. Challenges to adopting cloud computing could be categorised into four main groups, which are: *technical*, *organisational and policy*, *legal*, and *miscellaneous* risks (Khajeh-Hosseini et al. 2012).

Lack of Data Control could be considered a major legal and organisational threat to adopting cloud services for the business. The sense of controlling data by others leads companies to think they lack flexibility compared with an on-premises option to edit or change their applications (Leavitt 2009; Miller 2008).

Multitenancy and Cyber-attacks are one of the major technical issues in cloud computing. While data from different clients are stored in a single multi-tenant server, the server needs to run at the maximum protection level to ensure security. Furthermore, if one of the virtual environments faces attack, the server must provide complete protection to the other virtual tenants (Choo 2010).

Data Availability is also one of the main technical and organisational issues in cloud computing. Organisations must have the highest online availability, as such they may not accept faults that could hinder their work (Choo 2010).

Data Privacy and Security is another data-related dilemma that hinders the expansion of cloud computing. Clients wonder if cloud service providers can provide better or even the same level of data privacy and data security, compared with an in-house model (Zhang et al. 2010).

Lack of cloud standards is yet another technical risk that inhibits cloud growth. There are no clear interfaces between platforms from different service providers (Armbrust et al. 2010). Consequently, cloud clients may face several problems when they decide to move to another cloud provider. However, some of the main industry cloud players such as Microsoft and Google have commenced dealing with this issue through developing different solutions to move data to and from their systems (Marston et al. 2010).

Cloud computing regulation is also a critical political and legal issue from a business perspective, but is required in order to regulate dealing with cloud computing on local, national and international levels to ensure availability, accessibility, and privacy under any possible conditions (e.g. natural, financial or political), to avoid unexpected consequences. Therefore cloud stakeholders are required to set clear Service Level Agreements (SLAs) highlighting all possible issues (Alliance 2011).

The successful utilisation from cloud computing which is considered the fifth most important utility after water, electricity, gas, and telephony (Buyya et al. 2009) could give enterprises the opportunity to concentrate on their main business processes rather than spending their resources in managing and operating IT centres that consume budget and time on other tasks in running IT centres. Garrison et al. (2012) suggested the challenges of cloud computing adoption could be classified under three main categories - technical, managerial, and relational. The literature above shows that most of the challenges could fit under one or more of these categories, as shown in figure 1 which provides an example of cloud risk classification into three categories, which will become the main perspectives in this study.

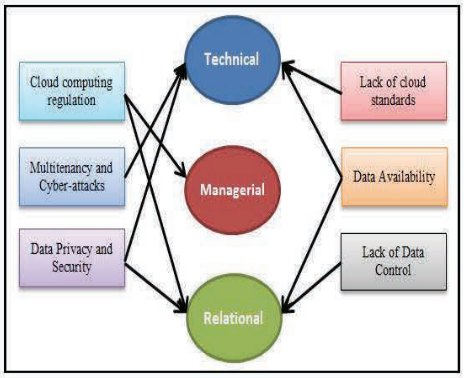

Figure 1: Cloud Challenges in 3 Categories

CURRENT IS RESEARCH AREAS IN CLOUD COMPUTING

In cloud computing, there are many areas need to be examined within a specific geographical region or country. For instance, at the Australian level Dr. Renato Iannella - principal scientist of National ICT Australia, suggested research to build Australian cloud services to put all local data under Australian control and protection, in order to mitigate the fear of migrating data overseas that could be affected by foreign rules and policies (Choo 2010). All Australian enterprises have to comply with the Australian Government's *Privacy Act1988 (Cth)* - an Australian law, that sets the rules with regard to the handling of individual information including the disclosure, storage, use and collection of personal information, and transborder regulations (Privacy_Act 1988).

From the *economic* Cloud Computing perspective several areas require further exploration, such as the need to show how cloud enablers can add economic value as well as what the most suitable pricing strategies are. For example, different pricing strategies such as flat rate, payment per use or a combination of payment strategies (Marston et al. 2010) are commonly associated with cloud computing. Decisions on the most appropriate pricing strategy require an analysis of each method to ensure the relationship between quality and investment as well as to find the best practice in this field. There are also legal perspectives, such as *regulation* involving the Australian Government privacy act, or regulation relating to pricing, SLAs, security, international standards, risk assessments, adoption, and partnerships. With regard to the *adoption* of Cloud Computing, many issues need to be addressed. Implementing cloud computing requires an understanding of best practice and development of risk assessment methodologies, such as security in hardware and software and policy in general (ENISA 2009). Moreover, such research might include economic aspects to develop a model in order to gain the highest financial benefits with minimum implementation and operational costs. Issues relating to *strategy* could target clients to determine the most important factors in order to meet their business goals, whilst targeting IT organisations that attempt to provide cloud services; this also includes matching business goals, issues of change management, as well as staff training. Issues relating to *Policy* vary from managing the migration from on-premise to a third party in the cloud, setting a road map for migrating standards to cloud providers, and setting the rules for monitoring and auditing cloud services locally and internationally. All of these areas are ripe for further research, but what of the Australian context?

THE SIGNIFICANCE OF AUSTRALIAN SMES

The Reserve Bank of Australia (2012) considers SMEs to be the backbone of the national economy of Australia. SMEs are important because they employ over 70% of the workforce and contribute more that AU$480 billion to the national economy (Department of Innovation Industry, 2011). There exists an opportunity for SMEs to adopt cloud services to develop flexible IT platforms at a relatively low cost. Cloud services provide the IT resources for SMEs to take advantage of online services such as e-commerce, without a massive investment in IT resources (Galer 2013). The Reserve Bank reported the total number of Australian businesses in 2011 was approximately 2,045,000. These figures show that 96% of businesses in Australia are classified as small businesses, and of those 1,815,000 are classified as micro businesses (1-4 employees). Medium-sized organisations represent 4% of Australian businesses with 81,000 companies. Large business were only 0.3% with 6,000 enterprises (Connolly et al. 2012).

The Australian Department of Innovation Industry reported there were around 4.8 million people working in small businesses by the end of June 2010 (Australian 2011). The Reserve Bank of Australia (2012) reported around 47% of employees were working in small businesses (including micro businesses), with 23% in medium organisations, and some 30% in large enterprises (Connolly et al. 2012). This shows that approximately 70% of employees are working in the SME sector, which plays a significant role in the Australian economy, and in turn provides an impetus for taking advantage of cloud computing to remain internationally competitive as well as improving national productivity.

As a final note, in March of 2014, the City of Sydney Council highlighted the significant importance of small sized organisations in Sydney by considering this sector as the core of Sydney's economy. The council reported that more than 80% of all businesses in the city were small businesses, which have more than 100,000 employees and contributed around 25% of Sydney's economic output, by more than AU$25 billion annually. The report also stated the strong relationship between small businesses and other sectors of medium and large enterprises by supporting their operations efficiently (City_of_Sydney_council 2014).

THE GAP IN THE CURRENT SITUATION

There has been a significant growth in the cloud computing market over the last few years. The Gartner Group (2013) reported that the global cloud services' market was valued at $110.3 billion in 2012, and is predicted to grow 18.6% to $131 billion in 2013. The Infrastructure as a Service (IaaS)[1] market was $6.1 billion in 2012 and this number was forecast to be $9 billion in 2013. The Gartner report also mentioned the major sectors of cloud computing market. Advertising in the cloud is classified as a top investment sector in the cloud by 48% of the total market in 2012. Moreover, the cloud investment is estimated to rise to $677 billion from 2013 to 2016, where around $310 billion is dedicated to advertising. The second largest industry in the cloud is the Business Process as a Service (BPaaS)[2] market by 28%. Software as a Service (SaaS)[3] comes in third at 14.7%, followed by IaaS by 5.5%, and cloud security and management at 2.8%, while the last sector was the Platform as a Service (PaaS)[4] at only one percent (Anderson et al. 2013). The importance of the cloud computing market could add

[1] i.e. proving computing hardware and associated platforms, as a service to customers: - usually used by administrators.
[2] Which as its name suggests provide business process expertise, including managing such processes to clients.
[3] Providing and hosting software applications as a service: - mostly used by end users.
[4] Providing hardware infrastructure, operating systems, and developing platforms: usually attracts developers.

value to the Australian economy through improving productivity via most business sectors, with business sizes from micro to large enterprises.

A survey undertaken in 2010 conducted in 636 companies in five countries (USA, UK, China, Japan, and Australia) showed that 88% of IT decision-makers agreed that cloud computing would be a priority in their organisations. Cloud computing was identified as important for achieving eight key objectives, which are e-industry regulatory change, disaster recovery, improving capability and availability, minimizing IT investment in infrastructure, enhancing IT control, business agility, mitigating IT maintenance and management as well as improving IT productivity. Business agility was identified by 75% of interviewees as the most important contribution of cloud computing. The second most important contribution at 56% was reducing IT infrastructure investment. The third most important at 53% was decreasing IT maintenance and management resources. Other cloud contributions included improving capability and availability (50%), improving IT productivity (46%), disaster recovery (40%), enhancing IT control (32%) and finally industry regulation (17%) (CIO and IDG 2011).

It is difficult to ascertain the adoption rate of cloud computing services for SMEs in Australia, however industry reports suggest that the take up rate is around 1 in 5 or 20% (MYOB 2012). The Organisation for Economic Co-operation and Development (OECD) supports the uptake of cloud computing by SMEs because of the importance of cloud computing in becoming the fifth important utility (after water, electricity, gas, and telephony) (Buyya et al. 2009). Compared to other OECD countries, the adoption of cloud computing by Australian SMEs appears to be significantly lower. For example, Flood (2013) predicts that 75% of American businesses and 61% of British businesses utilise cloud services. Another example, South Africa (not a member of the OECD), has 52% of SMEs (including micro businesses) consuming cloud services (Hinde and Belle 2012). Moreover a recent study on 484 American organisations[5] with 260 responses, showed that 81% of the studied organisations were utilising cloud services. The same study presented the responses of 483 senior IT leaders who revealed that cloud computing is the third most significant IT investment in U.S. organisations after business intelligence and customer relationship management (CRM) systems. The study further stated the massive increase in the priority of cloud computing investment in the U.S. which was 17th ranked in 2009 and became the 3rd ranked in 2013 (Kappelman 2013). Let us now examine some of our research techniques more specifically.

RESEARCH PURPOSE

There are three broad philosophies for conducting academic research. The first category is *exploratory*, which is used to explore new ideas from nothing or from a limited amount of knowledge. It leads to generation of new "what questions" in the future to address a specific issue. The second is *descriptive,* which is used to describe a well-known issue in more detail, creating new types or categories, and answering the "who" and "how" questions. While *explanatory* research studies the reasons for the occurrence of a well-known situation, by answering the "why" questions to connect cases with general principles (Neuman 2010).

The limited information about the take-up rate of cloud computing as well as the critical success factors for SMEs in the Australian context places this research within the exploratory camp to answer questions such as: *what is the take-up rate of cloud services for Australian SMEs?*, *what are the critical success factors for this kind of utilization?* and *what are the possible challenges in the take up of cloud computing?*

As a part of this study, certain companies have utilised some cloud computing services and may have faced challenges. Therefore, we can also focus the research light on those difficulties and answer the question of *how companies dealt with cloud utilizing hindrances?,* which may be classified as descriptive research.

RESEARCH THEORIES

This research is based on two further theories. The first theory used is *deductive*, which starts with a well-known theory followed by hypotheses (Bryman 2012) used to plan the roadmap of research. This study explores the critical success factors of cloud computing utilized by Australian SMEs as well as the challenges that organisations may encounter.

Secondly, *resource based theory* (RBT) focuses on the awareness of available resources and their capabilities to achieve competitive advantage reaching strategic goals (Grant 1991; Taher 2012). Thus RBT is used to explore the availability of resources of SMEs to achieve competitive advantage in the Australian business context such as human resources, physical assets as well as external resources such as cloud service providers.

The main hypothesis of this research is adopted from RBT (Grant 1991). It is assumed that the positive utilisation from available organisational resources (technical, managerial, relational) will improve capabilities

[5] 34th Annual Society for Information Management's (SIM) IT Trends

through adopting cloud computing for Australian SMEs, which in turn provides the organisation with competitive advantage.

RESEARCH APPROACH

The discussion above shows the major issues are summarized in three main points: 1 - there are no clear academic studies showing the take up rate of cloud services for Australian SMEs.; 2 - there is a need to study the CSFs in cloud computing adoption by such SMEs; 3 - a requirement exists to better understand the challenges of cloud computing adoption. Enhancing our understanding in these areas will potentially provide insights into how SMEs can use cloud computing to increase competitive advantage and in turn improve national productivity.

Due to the IS nature of this research it would also be prudent to also discuss appropriate research epistemologies. In general, there are several social research methods, however there are three main epistemologies, being those of *positivist, interpretive,* and the *critical social research method* (Myers and Avison 2002). In this research the initial epistemology will be interpretive, which starts with assumptions that might lead to reality. It is typically used to understand a phenomena such as the influences of information systems on the organisation (Walsham 1993). Such an epistemology has been selected for several reasons. First, the nature of this research is to understand the cloud computing phenomena, by obtaining insights into successful cloud utilisation by Australian SMEs, which reflects the interpretive method. It is important to establish the existing level of adoption of cloud computing because there has not been any rigorous academic research to establish this. In addition, what is required is to establish the status of cloud computing adoption in organisations, something that has been initially addressed by the authors in the complementary ACIS paper to this one (Busch et al. 2014). After collecting data, the reality then begins to form. At this point a positivist epistemology will prove beneficial in order to analyse the collected data.

What we propose is to investigate the CSFs in Australian SME adoption of cloud computing as illustrated in figure 2. This research indirectly aims to provide a benchmark on the status of SME adoption of cloud computing in the Australian context over the years 2014-2106. Moreover the proposed research will follow an applied research orientation in order to define a roadmap and identify needs of successful adoption of cloud computing for Australian SMEs going forward. This research will target selected practitioners in Australian organisations, such as SME managers and owners, IT staff, and key decision makers.

The research will consist of two macro-phases. The first phase will explore the take-up rate and CSFs from technical, managerial and relational perspectives (Garrison et al. 2012) as illustrated in figure 3. The *technical* perspective includes the IT resources required to provide the organisation with the functionality, flexibility and scalability required. The *managerial* perspective includes the human resources (including IT human resources) required for successful cloud computing adoption. The *relational* perspective includes the relationship with cloud service providers (Garrison et al. 2012), which by definition exist external to the organisation being researched. A quantitative survey will be used in the form of written questionnaires that will target a significant number of Australian SMEs. The findings from this first questionnaire phase will inform the second phase. For example, Isom and Holley (2012) note the importance in building a cloud adoption strategy. This strategy contains a check list of ten important steps in cloud adoption that should be identified, which are cloud vision, use case, drive business innovation, expected outcomes, cloud ecosystems, stakeholders, metrics, governance, and roadmaps (Isom and Holley 2012). These factors will be included in the survey under one of the three main perspectives mentioned above. The survey has already been coded in electronic form using *qualtrics.com*.

A pilot survey was conducted via a paper-based questionnaire with 20 IT professionals. The main purpose of this pilot study was to refine the research questions as well as survey's questions before conducting the main online survey.

In phase 2, an exploration of the business case and key challenges and limitations of cloud computing will be undertaken, using case studies and semi-structured interviews. From phase 1, participants who agreed to participate in the second phase will be contacted for interviews.

Depending on the number and variety of the contributors' industries, the targeted interviewees will be selected from different industries, such as IT, finance, and education. The interviews will likely be classified according to business location, such as metropolitan or country areas. It is then proposed to conduct around five detailed case studies.

Each case will be studied through a different 'lens', which are *technical, managerial, rational,* as well as the *general production* view. For example the technical perspective may likely inform the best practice of implementing cloud technologies, the challenges faced and how to overcome them: such as issues of compatibility, security, and training. The managerial view will likely investigate the managerial challenges, such as business process reengineering (BPR). The relational view would focus on human behavioural issues of utilising cloud computing: such as confidence, trust, and change management. Finally, the study will investigate general issues: such as business outcomes and job security.

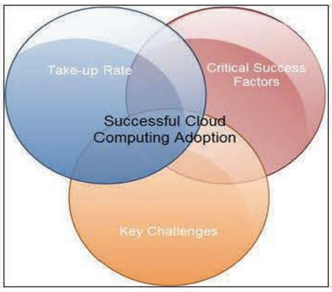

Figure 2: Research conceptual framework

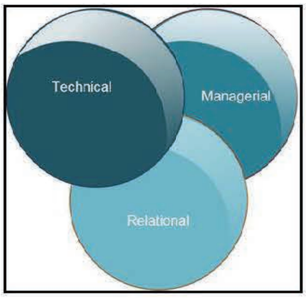

Figure 3: The Examined Perspectives

The following figure (4) illustrates the detailed framework of this research. It shows that considering the success of cloud computing utilisation for Australian SMEs should go through different steps. The current take-up rate of cloud computing should be the first step in this research to explore the current cloud computing utilisation for Australian SMEs.

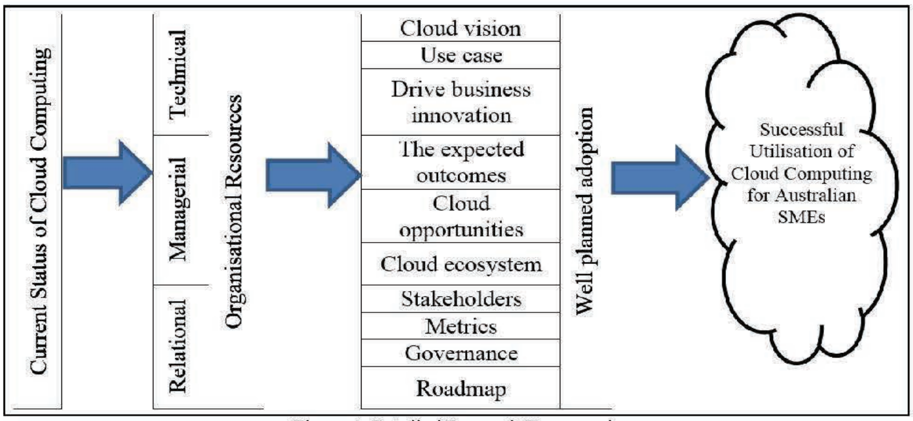

Figure 4: Detailed Research Framework

Then, the availability of the organisational resources is considered as an important success factor of adopting cloud computing (Grant 1991). These resources can be classified as technical, managerial, and relational (Garrison et al. 2012). The availability of these resources require a well plan of cloud adoption. This plan consists of ten important factors to be covered (Isom and Holley 2012), in order to overcome the possible challenges and to end up by the desired cloud utilisation. Information gathered from this stage will provide the rich data required to obtain insights into how (or not) Australian SMEs adopt cloud computing technologies to achieve competitive advantage and in turn strengthen the national economy. The research will target Australian SMEs in all sectors nationally, as there is no clear academic study for Australian SMEs as mentioned above

RESEARCH VARIABLES AND EXPECTED OUTCOMES

The dependent variable of this research is achieving competitive advantage among competitors. The independent variables are the resources which are technical, managerial and relational. This research will examine several variables via two phases. Again, the first stage (the online questionnaire) will examine the take-up rate and relevant CSFs of cloud computing. The second stage will investigate the difficulties (if existing) of utilising cloud computing and the best practice of dealing with them. The following table shows the variables and the purpose of each variable. Note, in the table the selected groups of staff numbers are based on the following:

- The first group (0-4) represents micro organisations in the Australian context.
- The second group (5-19) represents small organisations.
- The groups (20-50, 51-100, 101-150, and 151-199) show medium organisations. They have been divided into four groups to study the trend more specifically in this large subset.
- The last group (200+) represents the large organisations, which are out of the scope of this study.

Table 1: Research Variables

Category	Variable	Purpose
Organisational General Information	Number of branches	To examine the trend of cloud computing utilisation if the organisation has one office or more.
	Location	To compare the effect of metropolitan vs. rural areas to using cloud services.
	Number of staff	To see the trend of different groups of Australian SMEs depending on the number of employees (0-4, 5-19, 20-50, 51-100, 101-150, 151-199, 200+).
Technical Background	Availability of data centres	To see the effect of existing data centres on the decisions of utilising cloud computing.
	The use of the enterprise cloud services	To show the range of Australian SMEs utilising cloud enterprise services, which will lead to different questions in terms of acceptability, trust, cost, complexibility, availability and other drivers.
	The use of enterprise versions of consumer services	This will show the acceptability of utilising cloud services, even if only off-the-shelf services, such as Outlook or Gmail. This will lead to understanding the level of cloud computing in further details.
	The key factors in utilising the cloud	To investigate the drivers of cloud computing for Australian SMEs.
	The hindrances to adopting cloud services	To investigate the obstruction of utilising cloud computing for Australian SMEs.
Resources and Capabilities (Technical, Managerial,	The availability of technical support and knowledge	To examine the effect of technical resources in adopting cloud computing.
	Managerial support	To investigate managerial perspectives in utilising cloud computing through providing the required support.
	The factors of successful adoption of cloud computing	To examine the validity of ten managerial factors in adopting and utilising cloud computing.
	The relational perspective	To examine the relationship effects between organisations and cloud service providers. This part includes a study of the trust level before, during and after adopting cloud services.

SURVEY COMPONENTS

The survey covers two important factors in this study, which are the take-up rate and the critical success factors of utilising cloud computing from technical, managerial and relational perspectives, as mentioned above. To achieve these outcomes, the survey has been divided into three main components as in figure 4. The *first* component is designed to confirm that the participated organisation meets the examined criteria. For example, this part will validate that the participant is an Australian organisation and consist of one to 199 employees to be considered as Australian SME. The *second* part will investigate the first main component of this study; which is the take-up rate of cloud computing in Australian SMEs. This part contains several questions to ensure that the participant has sufficient knowledge to consider the organisation as a cloud service user or not. The *third* part of this survey will examine the critical success factors of utilising cloud services (technical, managerial and relational factors). In addition, Isom and Holley (2012) state the importance of building a cloud utilizing strategy. This strategy contains a check list of ten important steps in utilizing cloud that should be identified, which are cloud vision, use case, drive business innovation, the expected outcomes, cloud ecosystem, stakeholders, metrics, governance, and roadmap (Isom and Holley 2012). Each of these steps is classified as technical, managerial or relational factors.

SURVEY FIRST RUN

The survey in this research will explore two important factors of this study, which are the take-up rate of cloud computing for Australian SMEs and the CSFs of cloud utilisation. In order to achieve the desired design, a pilot survey had been conducted via a paper-based questionnaire with 20 IT professionals. The main purpose of this survey was to refine the research questions as well as survey's questions before conducting the online survey.

After refining the survey questions in the pilot survey stage, this survey has been sent to more than 700 organisations as a pre-test. The purpose of this stage is to ensure that the survey was visible and executable. The very limited response rate (1%) led to an investigation as to why the response rate was so trivial?

Figure 4: Survey High Level Components

The questionnaire length plays a very important role in the response rate. A marketing study (Deutskens et al. 2004) run to investigate the response rate to online surveys, showed that response rates to a short survey was 24.5% compared to 17% for a long questionnaire. Also, it is most likely for respondents to abandon long surveys before completing them (Deutskens et al. 2004). In our case we found as few as 10 participants completed only a few questions and then abandoned the survey.

The relationship the participants plays is an important role in improving the response rate. An industry study stated the clear difference of the response rate if the invitation has been sent to specific groups vs. general clients.

It showed that the response rate to a short survey that consists of up to 12 question from specific groups varied from 40% to 60%, while the rate dropped dramatically to less than 10% if the invitation targeted general customers to participate in a medium length survey, which consisted of 12 to 25 questions (PeoplePulse 2014).

There is another assumption around this issue of abandonment, which relates to the targeting of emails. It is assumed that a response rate could be very low if the invitation was sent to a general email address without recourse to a list such as sales, marketing, IT staff, CEOs, CIO etc. However, the response rate could be improved if the invitation targeted desired groups, such as CIOs and IT staff.

DISCUSSION

The study results will provide useful insights for academics and professionals in cloud computing adoption by Australian SMEs. Currently, there are several difficulties in distributing and convincing people to participate in the online survey as well as in collaborating in the planned semi-structured interviews. It was assumed that participants might think the survey would be long. One of the reasons behind this assumption is because the invitation email was a trifle long and potentially couldn't convince recipients to participate. Another drawback in the old version was that there was no opt-out link to unsubscribe from the mailing list. This might lead some email servers to consider invitations as spams and thus avoid delivering them. Moreover this invitation started with a general audience with a "Dear Sir/Madam" appearing in the first sentence. This could be less attractive to participants than if the survey targeted a specific named individual.

NEXT STEPS

Currently we are investigating some specialised databases that can provide access to the contact information of specific groups. These groups include owners, Chief Information Officers (CIOs), Chief Executive Officers (CEOs), IT decision makers, IT department managers, and IT researchers. Also, the length of the questionnaire will be reviewed, and the invitations will be edited. In addition, the issue of starting emails by "Sir/Madam" will be solved via *qualtrics.com* that provide a feature of writing the exact name of recipients by reading them from the stored database.

CONCLUSION

Australian SMEs play an important role in the digital economy and national productivity, through the hiring of a significant number of employees in Australia. Utilizing cloud services has the potential to increase individual, organisational, and national productivity. The literature shows a clear gap in our knowledge on the take-up rate of cloud computing for SMEs in the Australian context and how cloud computing can be used for achieving competitive advantage. This research consists of two phases. In first phase, the study will attempt to address this issue by exploring take up rates and the critical success factors in adopting cloud computing amongst Australian SMEs. These factors will be categorized under three groups, which are technical, managerial and rational. The technical aspect will investigate data migration, and online availability; the managerial aspect will focus on the CSFs within the organisation such as business processes reengineering and teleworking; while the relational aspect will assess human relationships between cloud service clients and the service provider such as data protection and the trust between them. This phase will be based on a structured survey that will be distributed among Australian SMEs, and the results will help to establish the second part of this research. The questionnaire must be designed properly to increase the likelihood of participants' responses to the survey. All participants in the survey will be invited to an interview in the second phase of this project, and around five of them will be selected for a detailed interview which will focus on the challenges of adoption that will be examined in the Australian context as the second part of this research project.

The research will provide insights to both researchers and practitioners by establishing the take-up rate of cloud computing adoption in SMEs in the Australian context. The research will determine the critical factors that lead to the successful deployment of cloud based services, and focus light on the challenges facing the Australian business environment. Again, some industry-based studies show the limited utilisation of cloud services for the Australian SME sector, while the literature highlights the absence of clear academic studies on the take-up rate of cloud computing for this important sector. This gap will be examined in the proposed research framework, and consists of three aspects, which are studying the take-up rate; estimating the approximate rate of Australian SMEs utilisation of cloud computing - the critical success factors and the challenges in order to facilitate the cloud services adoption as well as increasing the take-up rate, that would lead to improvements in the digital economy.

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SMEs AND CLOUD COMPUTING: THE BENEFITS TO THE NATIONAL ECONOMY AND GLOBAL COMPETITIVENESS

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Abstract

Small and Medium sized Enterprises (SMEs) play an important role in national economies and global competitiveness. SMEs contribute to job creation and improve the socio-economic status of workers by providing work and supply goods and services for the economy. SMEs therefore directly contribute to increasing national Gross Domestic Product (GDP. Cloud computing has the potential to increase SMEs' productivity and outcomes by providing affordable and up to date access to information and communications technology (ICT). In addition, utilising cloud-based services improves business innovation in SMEs and opens a channel to the global market that gives firms more opportunities to compete and be successful. This study consists of three main sections: a national economy section to highlight the significance of SMEs and how cloud computing can boost business outcomes that could result in improving the local economy. The second part is an overview of the technologies for SME cloud adoption. The third section discusses a study of adopting cloud computing by Australian SMEs in the period (2014-2015).

The significance of this paper is twofold. Firstly, the paper provides a literature analysis to show how cloud computing contributes to the national economy. Secondly, the paper quantifies the adoption rate of cloud computing by SMEs in the Australian context.

Future research will establish the critical success factors and challenges for SMEs utilising cloud services. The Australian context is used because Australia has characteristics such as a large geographical footprint, small population and in a different time zone to many markets. The paper concludes by suggesting future research directions.

Keywords: Cloud computing, SMEs, Australian SMEs, Small and Medium sized Enterprises, National economy, competitive advantage, global competitiveness.

1 Introduction

The era of globalisation puts significant pressure on countries to improve their global economic position, which is associated with the rapid development in information and communication technologies (ICT). ICT has accelerated both developed and developing countries' economies and changed the global order of the fastest growing economies. Cloud computing is an ICT that potentially provides SMEs with the opportunity to compete in ways not previously envisioned.

Studies from the organisational perspective have shown that organisations contribution to the national economy. Small and medium sized enterprises (or Organisations), which are known as SMEs, have a significant impact on the national economy. As for large enterprises, SMEs rely on several factors that drive businesses to success and ensure achieving competitive advantage. On the other hand, many challenges face SMEs that could affect productivity and business outcomes. Digital technologies have the potential, as a success driver; and to avoid some of the possible limitations such as investment in the latest ICT (Lee et al. 2012; Luo and Bu 2016; Nelson 1993; Shurchuluu 2002).

The phenomena of cloud computing, as one of the recent digital technologies, could be a valued addition to business environments to facilitate online business and improve digital productivity. There is significant opportunity for organisations of all sizes to gain tangible benefits, such as affordability, maintainability, scalability, flexibility, and online operating service availability (Astri 2015; Avram 2014; Leavitt 2009; Mudge 2010). In particular, cloud computing provides opportunities for Small and Medium sized Enterprises (SMEs) to increase their productivity in which in turn influences the national economy.

There is an absence in academic studies of the cloud services status in Australian SMEs, including the utilisation rate, the critical success factors and the challenges in adopting cloud computing. This limitation led to the research question: *what is the adoption rate of cloud services for Australian SMEs?* This research paper addresses the main questions by investigating the adoption rate of cloud computing from 2014 to 2015 by Australian SMEs.

This paper provides insights on the significance of SMEs to national economies and how utilising cloud computing can add to the economy and global competitiveness. The paper provides data from a study on the status of Australian SMEs in the period (2014-2015) including the adoption rate, critical success factors and the challenges. It covers the approximate adoption rate of cloud computing by the Australian SMEs.

2 THE NATIONAL ECONOMY

Let us first discuss the economy as an enabling mechanism for reducing the associated cost with creation, adjustment, or dissolution (Hausken and Knutsen 2010), which could provide extra funds and create more opportunities. The economy is defined as the relationship between three main factors, which are trade, production, and the supply of cash in a particular region or country (Stevenson 2010) as in figure 1.

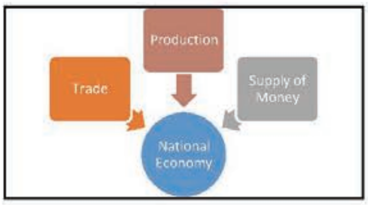

Figure 1: The main factors that affect the economy

Before going further in studying these three factors, it is better to discuss the status of the national economy, which is evaluated using different several methods and concepts. One of the most important economic principles is Gross Domestic Product (GDP), which shows the market value of all national products and services in a single value of the national economy in a specific period of time (Gans et al. 2011; Mankiw 2014). The global economic importance of the GDP rate leads countries to report the GDP periodically, mostly annually. From the Australian perspective, the Reserve Bank of Australia reports, the national economy scored annual GDP growth by 2.5% in 2015 (RBA 2016) that came after a closer growth rate by 2.2%, 2.3% and 2.7% in 2014, 2013 and 2012 respectively (RBA 2015), as shown in more details in table 1.

Quarter	GDP Growth (%)
Jun-2012	3.9
Sep-2012	3.2
Dec-2012	2.7
Mar-2013	1.8
Jun-2013	2.1
Sep-2013	2.0
Dec-2013	2.3
Mar-2014	3.0
Jun-2014	2.7
Sep-2014	2.5
Dec-2014	2.2
Mar-2015	2.1
Jun-2015	1.9
Sep-2015	2.5

Table 1: Australian GDP from Jan-2012 to Sept-2015. Source: (RBA 2015)

Table 1 shows that the Australian economy is growing steadily. However, research and business media claimed that this evolution is considered as a very weak growth (Jericho 2015), compared to many other countries. This issue led to investigate the possible opportunities to improve the national economy from different perspectives including information technology and more specifically cloud computing.

The World Bank has released a report shows the global annual GDP growth until 2014. The last year in the report showed that Turkmenistan and Ethiopia led the list by 10.3% that followed by The Democratic Republic of the Congo by 9%. However, Australia came very far behind in the order 108 with Guinea-Bissau, Slovak Republic Hong Kong, and Swaziland by 2.5% (WB 2015). The following table shows the highest 20 countries in the GDP growth:

Country name	2011	2012	2013	2014
Turkmenistan	14.7	11.1	10.2	10.3
Ethiopia	11.2	8.6	10.6	10.3
Congo, Dem. Rep.	6.9	7.2	8.5	9
Cote d'Ivoire	-4.4	10.7	9.2	8.5
Papua New Guinea	10.7	8.1	5.5	8.5
Myanmar	N/A	N/A	8.2	8.5
Uzbekistan	8.3	8.2	8	8.1
Palau	8.3	4.6	-2	8
Mongolia	17.3	12.3	11.6	7.8
Lao PDR	8	8	8.5	7.5
Dominican Republic	2.8	2.6	4.8	7.3
Chad	0.1	8.9	5.7	7.3
India	6.6	5.1	6.9	7.3
China	9.5	7.8	7.7	7.3
Mozambique	7.1	7.2	7.1	7.2
Mali	2.7	0	1.7	7.2
Cambodia	7.1	7.3	7.5	7.1
Timor-Leste	9.5	6.4	2.8	7
Tanzania	7.9	5.1	7.3	7
Rwanda	7.9	8.8	4.7	7

Table 2: Top global GDP rate. Source: (WB 2015)

3 NATIONAL PRODUCTIVITY

The Reserve Bank of Australia (RBA) in speeches and reports has highlighted the link between increased national GDP growth and increased productivity. Improving labour productivity is a major factor for improving GDP and the national economy (Kent 2015).

While production is the process of combining many inputs, as resources including people and physical assets, to produce the output and generating income, productivity in general is used to measure the production efficiency as the ratio of the output to the input (Coelli et al. 2005; Gordon et al. 2015; PC 2009). The *Australian Bureau of Statistics* describes productivity as the process of transforming a combination of inputs, including labour and physical assets, into the targeted outputs, such as goods and services, that improve the national production efficiency, which leads to better Australian living standards that ends up by the Australian ability to be competitive in the international market (ABS 2012).

The challenge for improving the national economy is based on three major factors. Any improvement in any of these factors could help in boosting the economy. Production is one of these factors, and production efficiency is affected by improving the productivity rate.

The following figure links the demand in improving the national productivity that could mostly end up by improving the national economy via increasing the production efficiency. The question in then is how ICT, and more specifically cloud computing, can contribute to improving national productivity?

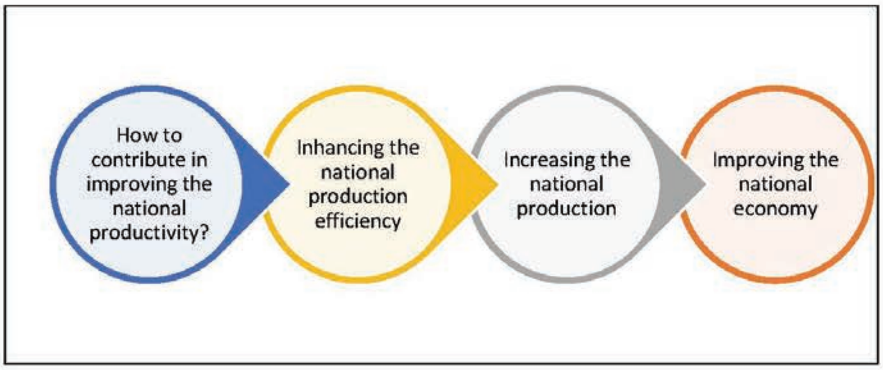

Figure 2: From national productivity to the national economy

National productivity has significant importance on the national economy. Improving national productivity involves focusing on increasing efficiency. Efficiency is based on three important factors, which are allocative, dynamic, and technical or cost efficiency that would improve the average income, and the provided services (Gruen 2012) leading to improved national economic growth. In 2015, the Australian government was continuing to focus on improving productivity as one of the important factors in boosting the national economy (Gordon et al. 2015). The focus on national productivity growth that will increase outputs, is affected by the available capital, workers, up to date technologies, and resource endowments (Gordon et al. 2015). Figure 3 shows the most important productivity factors from the Australian Government perspective.

More specifically at the organisational level, firms' productivity and improving their outcomes can add to national productivity as one of the major national economy drivers. Digital technologies and trends such as cloud can enhance organisational performance, in both of government and private sectors, which has a direct impact on national productivity and therefore the economy (Brynjolfsson and McAfee 2012; Busch et al. 2014; Gordon et al. 2015; Keeley et al. 2013).

4 THE SIGNIFICANCE OF SMES

The SME sector plays a significant role in driving the national economy globally in both of developed and developing countries from different perspectives. This importance leads many economists and researchers to focus on SMEs and their studies (Neumark et al. 2008). Globally, SMEs sector is considered as the "lifeblood" of the advanced economies that covers around 75% of the entire firms (Gunasekaran et al. 2011; Kostka et al. 2013) and gives the potential to countries and people as it employed 60% of workers around the world in 2012 (Du and Banwo 2015).

The high demand on raising the national economy and being globally competitive. These national goals require considering the key factors to be achieved. The potential of the up to date information technologies appeared in all of the discussed perspectives as a driver of the national economy and world competitiveness. Cloud computing, as one of the major current information technology's trends, plays a significant role in enhance the productivity and innovation in business organisations (Buyya et al. 2009; Marston et al. 2010) that would lead to improving the national economy and being competitive, which will be discussed in more details in this research. The significant importance of IT technologies, including cloud computing, to the global competitiveness and the national economy is summarised in figure 4. The end relationship leads to a reason study the national cloud computing status and the best practice of implementing cloud technologies including the benefits and the possible challenges, which is the key of this research study.

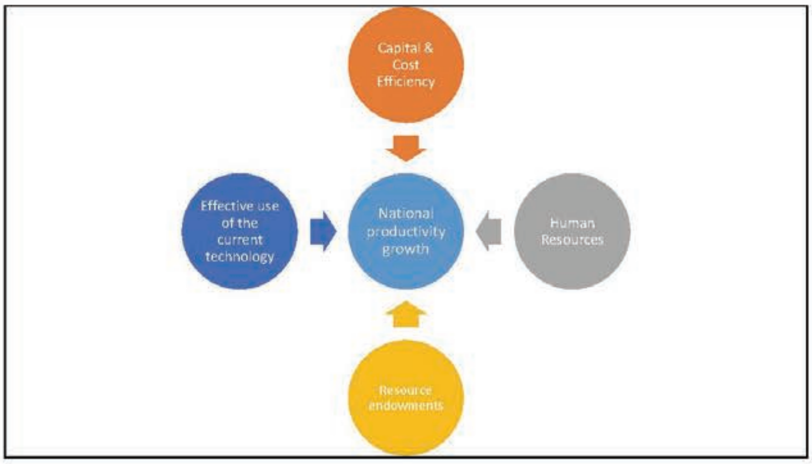

Figure 3: Some of the National Productivity Growth Factors

SMEs are considered as important gate of employment and a considerable national driver in reducing the poverty rate in several countries. A study showed that the SMEs sector contributed to the GDP rate by 60% in a form of employing more than 70% in the low-income countries and employs more than 65% with a contribution of 55% in the GDP rate in the high-income countries (Fida 2008). This importance also one of the national key player in presenting efficient national economy, tax revenue, efficient national resource allocation and better distribution income (Bies 2002; Fida 2008; Kongolo 2010).

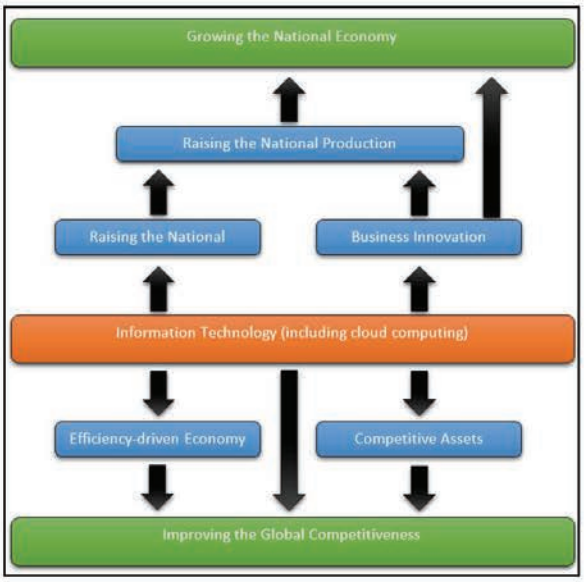

Figure 4: The Effect of Cloud Computing and Information Technology on Improving the National Productivity and the Global Competitiveness

In Australia, SMEs has the potential to improve national productivity because they employ 70% of the workforce and contributes more than AU$480 billion to the economy (ADIS 2011; Fakieh et al. 2014). There exists an opportunity for SMEs to adopt cloud services to develop flexible IT platforms at a relatively low cost. This is applicable by taking the advantage of any of the three cloud-based service delivery models, which are IaaS, PaaS and/or SaaS in providing the required IT resources for SMEs to take advantage of online services, such as e-commerce, without a massive investment in IT resources (Galer 2013).

The Australian Reserve Bank (2012) considers SMEs to be key players of the Australian economy. The bank reported the number of Australian businesses in 2011 was around 2,045,000. In more detail, statistics show that 96% of businesses in Australia were small businesses, and about 1,815,000 of those were micro businesses (Connolly et al. 2012; Kuruppu et al. 2013). Medium sized organizations represent 4% of Australian businesses with 81,000 companies. Large business represented only 0.3% with 6,000 enterprises (Connolly et al. 2012). The *Australian Department of Innovation Industry* supports these figures by reporting there were about 4.8 million employees working in small businesses (including micro businesses) by the end of June 2010 (ADIS 2011), some 47% of the total number of workers in Australia, 23% in medium organizations, and 30% in large enterprises (Connolly et al. 2012).

5 SMEs and Information Technology

SMEs play a continuous significant role in countries development among the history (Kongolo 2010). Many studies among the last decades showed that this sector has a significant impact on the national economy and the development of the country. SMEs creates heaps of job opportunities for both of urban and rural people, providing local communities many of the required goods and service for their life, as they depend heavily on SMEs, and leading to an innovative and stable economy (Abrahams 2003; Feeney and Riding 1997; Fida 2008). In addition, the decline in national living standards and the increasing of unemployment rate that lead to weaken the national economy is usually faced by SMEs that helps to increase the living standards and creating jobs (Abrahams 2003).

Even though, using digital technology is not well considered by SMEs in some countries (Parrilli and Elola 2012), utilising the required information and communication technology resources give SMEs the potential to grow up their businesses and expand it nationally and internationally. It may not the main business driver to success, but it is one of many factors in in giving more opportunities for SMEs to survival, success and compete. In addition, it opens the door for SMEs to build national and international business relationships that should be considered as a benefit of using information technology resources in SMEs sector. Some organisations stated in an Australian-based study that adopting information technologies to the firms would be costly at the installation phase, but comes with different strategical benefits if the adopted technologies been utilised professionally. Some of these benefits are reducing the operational costs, speeding up business processes, and could be considered in processes and strategic plans (Love and Irani 2004). In South Korea, domestic SMEs have a limited local market for their products. The international accessibly that rely heavily on information technology resources makes the global market is the main target for Korean businesses (Du and Banwo 2015; Lee et al. 2012).

6 SMEs and Cloud Computing

Cloud computing is one of the recent IT technologies that facilitate online business processes. Although utilising cloud computing might disrupt the legacy systems and processes in businesses, it opens the door widely for local firms to global businesses and markets. Also, cloud computing gives more chances to businesses, including SMEs, to grow up and being more competitive. Utilising cloud computing enables SMEs to sell cloud-based services worldwide and take the advantage of the wide spread of the end users' devices and technologies. Smart phones and tablets are examples of these technologies that use cloud-based services frequently to gain access to information and communication technologies and services globally (Ross and Blumenstein 2012; Ross and Blumenstein 2013; Sultan and van de Bunt-Kokhuis 2012).

Cloud computing became an important factor in boosting business innovation and entrepreneurship in SMEs. It gives small and medium firms the ability to overcome some of the common challenges that affect SMEs negatively more than large enterprises including the financial IT utilising and operational costs by hiring the required resources and pay for the used services only as SMEs usually rely on limited budgets comparing to large firms. In addition, having a specific IT department is not an easy option for SMEs that usually have limited spaces. This challenge can be solved by using cloud-based resources that give firms to run an entire IT department or even data centres remotely and use physical spaces to run their essential business activities. Moreover, cloud computing brings many other benefits to SMEs including scalability, accessing the global market and capital, and increasing SMEs global collaborations (Ross and Blumenstein 2013; Ross and Blumenstein 2015). These features allows SMEs to focus more on developing and growing their business that spending time and money in managing and operating the IT resources. The expected business innovation would also lead to product innovation that plays a significant role in improving business outcomes and competitiveness (Sabherwal and Becerra-Fernandez 2011).

7 WHAT IS CLOUD COMPUTING?

Cloud computing has many definitions that continue to emerge around the concept of cloud computing. Most of these definitions are based on two main powerful factors of cloud computing, which are IT hardware and software efficiency and business agility (Kim 2009). One of the generic technical definitions considers cloud computing as delivering everything as a service (XaaS) (Mladenow et al. 2012), where X means "everything". XaaS refers to the availability of the IT infrastructure, platforms, software, databases, and the other IT resources on the internet that can be accessed remotely (Winkler 2011). Another definition of cloud computing states that *"it is an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location"* (Marston et al. 2010). While the National Institute of Standards and Technology (NIST) defines cloud computing as *"a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction"* (Mell and Grance 2011).

The market of cloud computing provides several service delivery models to the business. However, there are three main service delivery models of cloud computing, which are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) (Mell and Grance 2011; Stammer and Wilson 2013; Sultan and van de Bunt-Kokhuis 2012). These models are usually created and administrated by cloud service providers (Tutunea 2014).

The fast revolution of cloud computing services led to derive other services to the market from the main three that mentioned above. Identity as a Service (IDaaS) is one of these derived services. Gartner defines IDaaS as *"service that delivers the access, administration and intelligence functions of identity and access management"* (Kreizman 2013). Storage as a Service (StaaS) is another derived service that depends mainly on the IaaS model with some utilising from SaaS. It provides a cloud based service to store data and files with the features of the reliability, performance, compatibility, and backup that can be accessed via web browsers, application program interfaces APIs, and/or mounted disk drives (Jamsa 2012). Communication as a Service (CaaS) is a cloud based model that allows consumers to utilise the internet based communication services, such as voice over IP (VoIP) and instant messages (IM) with no requirement to pay for the operational hardware or software (Stammer and Wilson 2013; Tutunea 2014).

From the business perspective, there is an additional service delivery model called Business process as a Service (BPaaS), which is used to deliver any vertical or horizontal business processes via the cloud, such as e-procurement, and business travel services, and business process monitoring (Isom and Holley 2012; Stammer and Wilson 2013).

8 SMEs and Cloud: Adoption rates and drivers

Briefly, much of the previous research explored the utilization of cloud computing by large sized enterprises. However, small and medium sized organizations need to be studied to better understand how cloud can improve business productivity and outcomes (Gupta et al. 2013).

It was predicted that the adoption rate of cloud computing in the U.S. and U.K businesses are 75% and 61% respectively (Flood 2013). In South Africa (not a member of the OECD), 52% of their SMEs consume cloud services (Hinde and Belle 2012). However, It is difficult to find academic studies investigating the adoption rate of cloud in Australia except an industry study that reported the adoption rate of cloud computing for Australian SMEs was only 20% (MYOB 2012).

The limited research relating to utilising cloud computing by Australian SMEs led to the research question: how does the adoption of cloud computing impact on national productivity? The data was collected in from 2014-2015

9 Methodology

The analysis in the previous sections lead to several important aspects that could be studied in order to improve the national economy. For example: (a) National productivity measures production efficiency, which is described by the Australian Bureau of Statistics (ABS) as the level of gaining the outcomes/output from available human and physical resources as input, which is represented in the increasing of an organisations' productivity (APH 2010). (b) SMEs play a significant role in the Australian national economy (Mohlameane and Ruxwana 2013). (c) The literature shows that SMEs seek to achieve competitive advantage factors (Isom and Holley 2012). (d) Cloud computing is important for assisting SMEs in achieving competitive advantage by improving productivity. From (a), (b), (c), and (d), cloud computing could play an important role in the economy as the following:

Successful utilising of cloud services → increasing SMEs output → improving the productivity → increasing the national economy.

In order to examine successful cloud computing utilisation, we need to explore the adoption rate of cloud computing by SMEs in Australia. It is appropriate as such after exploring the adoption rate to study the success parameters such as critical success factors and challenges in adopting and utilising cloud services - figure 5 illustrates this.

This study used *Resource Based Theory* (RBT) or the *Resource Based View (RBV)* of the firm, whereby an organizations' awareness of available resources and capabilities is used to achieve competitive advantage in reaching strategic goals (Grant 1991; Taher 2012; Wernerfelt 1984). The reason for selecting RBT as a base to this research is that it covers the aspects of this study from the successful adoption and utilisation of cloud services as critical resources towards achieving competitive advantage that would help in improving the national economy, which is assumed after the discussed analysis above. RBT works like a loop, where it starts by identifying the organisation's resources, followed by exploring the possible capabilities from these resources in order to determine the business directions. After that, organisations could understand the potential of their competitive advantages and develop strategies. Lastly, some gaps could be identified. The loop starts again, by re-identifying the new resources to fill the new gap, and so on.

The gap with regard to an organisations' need to increase productiveness and gain competitive advantage, could be filled by using RBT to explore the availability of an Australian SMEs' resources to achieve competitive advantage in the Australian business context through its use of physical assets, human resources, and external resources such as cloud service provision. The need to enhance a firms' competitiveness via cloud computing led to the use of RBT. It is assumed in this study that the availability of necessary resources could lead to successful utilisation of cloud computing which would help achieving competitive advantage.

According to this assumption, SMEs resources were investigated as a factor of successful cloud computing adoption. In addition and according to RBT, the absence of these resources would present a challenge or barrier to cloud services which in the end could slow down business progress leading to reduced competitiveness. Such a view is illustrated in figure 6. This research project uses a mixed-method of quantitative data collection in a form of survey and qualitative data collection via semi-structured interviews.

At this stage, the approximate cloud computing adoption rate by Australian SMEs was investigated and analysed. A future publication will show a detailed research model and the complete result of this study.

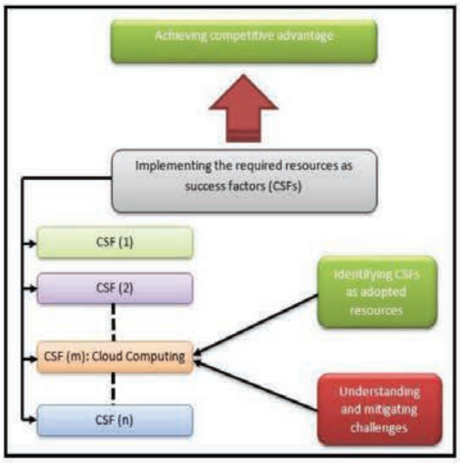

Figure 5: Studying resource, as CSFs, and challenges of utilising cloud services

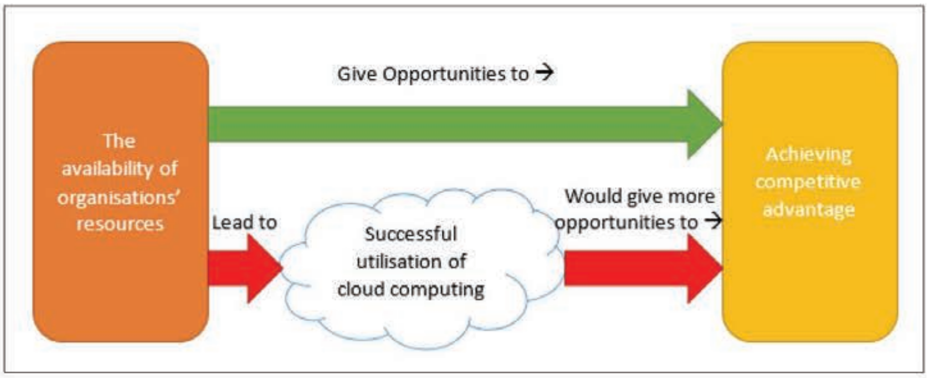

Figure 6: The use of RBT as a base to this research

9.1 Research Survey

This study were conducted in 2014 and 2015. The research questions investigated using a quantitative survey that was followed by qualitative interviews. The survey investigated 470 companies conveniently in six Australian cities, which were Sydney, Melbourne, Brisbane, Canberra, Wollongong, and Newcastle. The criteria of selecting those cities and businesses was based on the convenience sampling method. The survey targeted the following groups: (Chief Information Officers (CIOs) – i.e. the head IT person in any firm, Chief Executive Officers (CEOs) – if making IT decisions, Decision Makers with any IT decision-making authority, IT Department Managers). The survey consisted of three major components with detailed questions regarding cloud utilization challenges and the main reasons SMEs do not use cloud services. The first component investigated organizational general information, such as the location, number of branches, and number of employees to confirm the validity of the company under study.

The second component of the questionnaire asked technical background questions to investigate the status of cloud service use, while the third component explored the availability of organizational resources and capabilities to implement successful cloud computing. The survey was coded in *qualtrics.com*. The second part of the survey sought to explore the factors mentioned above. Participants were asked to specify the name of the cloud based service used to ensure respondents answered questions with sufficient understanding of the question. The third part of the survey asked SMEs using cloud services, to rate the most important factors guiding them in adopting a cloud approach.

10 RESEARCH RESULTS AND DISCUSSION

At this stage, the contribution of this paper appears in providing literature analysis to link the possible positive effect of cloud computing to the national economy. In addition, the study answers the following questions, which are: What is the approximate rate of adopting cloud computing by Australian SMEs? What are the top business sectors in adopting cloud-based services?

The largest proportion of SMEs sampled were from Sydney (the largest Australian city - population 4.8 million) with 110 businesses, followed by Canberra (population 0.42 million) 94, Brisbane (population 2.3 million) 87, Melbourne (population 4.4 million) 76, Wollongong (population 0.3 million) 50, Newcastle (population 0.4) 32, and the remaining cities (online) at 21.

The collected data were checked to exclude all invalid participations, such as incomplete surveys or large enterprises. The analysis showed that 48.7% of investigated Australian SMEs (229 of 470), utilized cloud services. The following table shows the adoption number and rate per each of the studied cities.

	Brisbane	Canberra	Melbourne	Newcastle	Sydney	Wollongong	Others
Yes	43	49	45	14	52	18	8
No	44	45	31	18	58	33	12
Total	87	94	76	32	110	51	20
% of Yes	49.43%	52.13%	59.21%	43.75%	47.27%	35.29%	40.00%
% of No	50.57%	47.87%	40.79%	56.25%	52.73%	64.71%	60.00%

Table 3: SMEs cloud computing adoption rate by each of the studied cities in Australia

This result was analysed in more detail according to the size of businesses, to explore the expected adoption rate in each sector. It would appear micro-sized organizations were less interested in adopting enterprise cloud services as 44 out of 135 businesses (32.6%) utilize cloud computing. Small organizations (not micro) scored the top rate using cloud enterprise services at 56.3% - some 98 out of 174 businesses. Medium organizations were also close to this ratio at 54% of 161 examined businesses.

The adoption rate has been calculated based on each of the included business sector in this study. From the top of the list, the result showed that recruitment agencies lead the others, where 81.8% of the studied companies are using cloud-based services. This number is followed by the IT and engineering sector by 78%. After that, wholesales, consulting, and finance sectors come by 71.4%, 62.9% and 58% respectively. Table 4 shows number of participated companies from each business sector, and the detailed results appear in figure 7.

The investigated companies concluded the major benefits as success factors of utilising cloud computing, as shown in table 5. Surprisingly, 79% are utilising cloud-based services to gain better security. Some of the participants justified that by stating that they have some fear, but they believe that cloud service providers, such as Microsoft, Amazon, Salesforce, and Google, are definitely have higher security. The second driver from adopting cloud-based technologies is to save the cost, which was important for 78%. To link this to the discussed literature above, cost saving is one of the main drivers, especially for small companies with limited budgets, that lead to increase the productivity and business outcomes, which would end up by a positive impact on the national productivity and the global competitiveness, which are the national targets. In addition, 76% of the studied businesses consider digital resource accessibility as the third important driver that give them the ability to operate businesses remotely. This gives more opportunities to SMEs, especially in the rural areas, to utilise the latest IT technologies to improve their outcomes.

No.	Business Sector	No. of Participated Companies
1	Finance	69
2	IT & Engineering	50
3	Education	43
4	Consulting	35
5	Legal Services	33
6	Medical services	33
7	Health and Beauty	30
8	Retailer	30
9	Recruitment Services	22
10	Trade	19
11	Buildings and public works	17
12	Hospitality	12
13	Real Estate	12
14	Import/Export	10
15	Migration Service	10
16	Manufacturing	8
17	Wholesale	7
18	Distributing	5
19	Government	4
20	Primary Producer	4
21	Research and Testing	4
22	Travel	4
23	Entertainment	3
24	Philanthropy	2
25	Environmental Non-Governmental Organization	1
26	Mining	1
27	Transport	1

Table 4: Number of participants from each business sectors

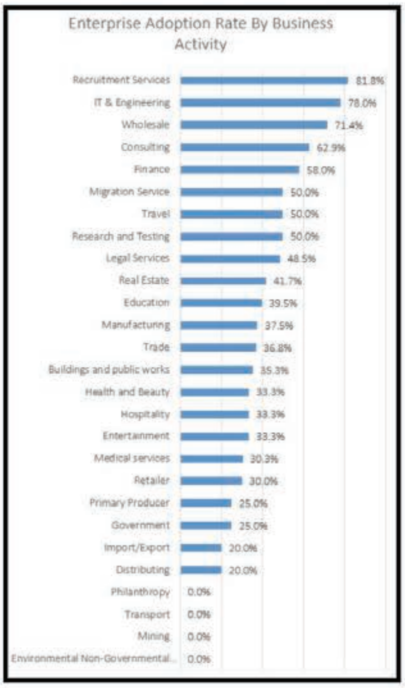

Figure 7: Enterprise Adoption rate by Business Activity

Factor	Security	Cost	Accessibility	Performance	Business process	Availability	Scalability	Setup time	Agility	Simplicity	Backup location	Hosting location
Average (%)	79%	78%	76%	75%	74%	74%	55%	55%	53%	47%	46%	44%

Table 5: The most important benefits of utilising cloud computing based on 470 surveys

11 Conclusion and Future Directions

SMEs has a significant importance in countries from different perspectives including GDP rate at the highest national level and down to creating employment opportunities that reduce the unemployment rate, and the poverty rate. This potential led experts and researchers from different views to study the possible chances to boost the outcomes and productivity of this sector, which is recommended to more investigation and research.

This study linked the significance of cloud computing to the national economy that led to investigate the adoption rate and some anticipated benefits of cloud computing by a critical sector in Australia, which is SMEs.

From the digital technology's view, cloud computing is one the key players in the IT industry that bring several benefits to businesses including SMEs. Therefore, the take-up rate, the benefits, and the challenges of cloud computing was studied in a quantitative method with a sample of 470 Australian SMEs. This paper showed sample of the analysed results, as the main goal of it is to highlight the significance of SMEs on the national economy. Recruitment services, IT & engineering, and wholesalers SMEs are the most utilisers of cloud computing among the studied organisations in Australia. Surprisingly, most of cloud utiliser firms in this study are looking for better security from relying on cloud based solutions. This influence is followed the desire to save the installation/operational costs, getting better accessibility and higher performance.

The detailed results will be discussed in another publication that will focus on the results of this study. In addition, a qualitative study of 20 semi-structured interviews were conducted to get more in-depth analysis to further exploring the key factors and the faced challenges of adopting cloud computing from the Australian Perspective.

It is recommended to focus more on each SMEs business sectors; especially the top utilisers of cloud computing; to get more understanding to their needs and goals from the cloud. In addition, the least adopting sectors in figure 7 are recommended to explore their reasons for not acquiring cloud based services and to find the possible solution to facilitate taking the advantage of cloud computing in order to target the main goals, which are gaining competitive advantage and; by the end; improving the national economy and productivity.

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Appendix 2: Survey Questions

MACQUARIE UNIVERSITY
SYDNEY ~ AUSTRALIA

CLOUD COMPUTING STUDY

SURVEY CONSENT FORM

You are being invited to participate in a research study about exploring the critical success factors and challenges of utilizing cloud computing for Australian small and medium organisations. This study is being conducted by Bahjat Fakieh, from the Department of Computing at Macquarie University as part of a PhD research project.

This research study targets Chief Information Officers (CIOs), Chief Executive Officers (CEOs), IT Decision Makers, IT Department managers and IT researchers. It would be appreciated to pass this invitation to the targeted group of your colleagues

There are no known risks if you decide to participate in this research study. There are no costs to you for participating in the study. The information you provide will be analysed in order to understand the factors that mentioned above. The questionnaire will not take more than 10 minutes to complete.

This survey is completely anonymous. However, you will be asked at the end of this survey to participate in a completely separated interview to listen from your experience about the best practice of overcoming cloud computing challenges. Even if you have decided to participate in the interview part of this study and wrote your contact information, your participation in this survey will remain anonymous.

Your participation in this study is voluntary, and you are voluntarily agreeing to participate. You are free to decline to answer any particular question you do not wish to answer for any reason.

If you have any questions about the study, please contact Bahjat Fakieh by phone on or via email on Bahjat.Fakieh@students.mq.edu.au.

The Human Research Ethics Committee at Macquarie University has reviewed my request to conduct this research. If you have any concerns about your rights in this study, please contact Dr. Peter Busch at +61-2-9850 9520 or email sci.ethics@mq.edu.au.

If you could take a few minutes to complete the questionnaire, that would be much appreciated.

MACQUARIE UNIVERSITY
SYDNEY ~ AUSTRALIA

Survey questions

Part One. Organisation Information

a) Location
   1- Business State (NSW , VIC, QLD, ACT, SA, WA, TAS, NT)
   2- Region (Metropolitan, Regional)
   3- City ( )
   4- Postcode ( )

b) Business Category (Primary Producer, Manufacturing, Buildings and public works, Import/Export/Distributing/Wholesale, Hospitality, Transport, Finance, IT & Engineering, Research and Testing, Education, Trade, Medical services, Entertainment, Other... please specify)

c) Organisation Size
   1- Head office location (Australia – Overseas)
   2- Does the organisation have international branch and/or marketing offices? (Yes – No)
   3- If it is an international enterprise, in how many countries is it located? ( )
   4- What is the total number of the organisation's branches? ( )
   5- If domestic, how many branches? ( ) in which states (NSW , VIC, QLD, ACT, SA, WA, TAS, NT)
   6- Number of staff? (0-4 , 5-19, 20-50, 51-100, 101-150, 151-199, 200+)

Part Two: Background cloud computing questions

d) Does the organisation have a dedicated IT data centre? (Yes/No)

e) Does the organisation use any enterprise cloud services/products, like AWS, MS. Windows Azure, Salesforce, or MYOB? (Yes / No)

f) Does the organisation use any enterprise version of consumer services via any of the public internet service providers (ISPs), including Hotmail, Gmail, Facebook, twitter or Office 365? (Yes/No)
   - If yes, could you specify (hotmail.com, gmail.com, office 365, other: Please specify)

g) Is the organisation using any individual consumer online storage services? (Yes/No)

h) If yes, what is the storage product name?
   - Dropbox
   - SkyDrive
   - Google Drive
   - Box
   - CustCloud
   - iCloud
   - Other

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i) Based on your answers from the previous four questions, could you rate the following reasons for your organisation's decision, where the scale from (1 – 10) indicates that 10 is very important and 1 is not.
   - Cost
   - Security
   - Business process
   - Setup time
   - Performance
   - Hosting location
   - Backup location
   - Availability
   - Scalability
   - Agility
   - Complexity
   - Accessibility
   - Other (Please specify with rate)

If your answer in (e) above was (No), please answer the following two questions, but if (Yes), go to the next page:

j) What are the reasons for not currently using cloud services? Please rate the following, where the scale from (1 – 10) indicates that 10 is very important and 1 is not.
   - Lack of executive support.
   - Lack of technical resources
   - Lack of management support
   - Lack of provided services
   - Lack of professional staff
   - Lack of overall trust
   - Lack of government regulation
   - In-house data control
   - Privacy issues
   - The international regulations
   - Operational issues
   - Implementation issues
   - Communication & internet issues
   - The business does not need any of the cloud services
   - Lack of understanding cloud computing
   - Other (Please specify)

k) How likely is your organisation to utilise cloud computing in the future? where the scale from (1 – 10) indicates that 10 is absolutely will utilise and 1 means never.
   Please go to Part Three at the end of the last page.

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If your answer in (e) was (Yes), Please answer the following questions.

l) What is the service model used in your company? You can select more than one.
  - Infrastructure as a Service (IaaS), where the organisation just rented the physical resources.
  - Platform as a Service (PaaS), where the organisation rented the physical resources plus operating systems and developing platforms.
  - Software as a Service (SaaS), where the organisation use one of the available cloud products.
  - Other (Please specify).
  - Not sure

m) What is the deployment model used? You can select more than one.
  - Public, where the information system is accessible by everyone.
  - Private, where the information system is accessible by organisation members only.
  - Hybrid, where a part of the information system is accessible by everyone.
  - Community, where the information system is accessible by group of businesses.
  - Not sure

n) What are the main purposes of using the specified deployment models that mentioned above? You can choose more than one.
  - Development
  - Testing
  - Production

o) What were the main reasons of considering cloud computing prior to using cloud services?, where the scale from (1 – 10) indicates that 10 is very important and 1 is not.
  - Operational time saving
  - Improving business outcomes
  - Improving the relations with customers
  - Supporting business strategies
  - Trusted vendor
  - Vendor services
  - Controlling IP
  - Better maintenance
  - Government regulation
  - Other (Please Specify)

Part Three: Interview contact information

We would like to conduct detailed face-to-face interviews for around 30 minutes, would you kindly accept our invitation to participate in an interview? (Yes/No)

If yes, could you please fill up the following details:

Name:

Phone:

Organisation:

Email:

Address:

Appendix 3: Interview Questions

Interview questions

a) What are the critical success factors of adopting cloud computing for SMEs?
b) What are the tangible benefits/drawbacks of adopting cloud computing in your organisation? If any.
c) What are the intangible benefits/drawbacks of adopting cloud computing to your organisation? If any.
d) What were the unexpected outcomes from adopting cloud services? Please specify.
e) How do you see the relationship between the estimated cost and the actual cost of utilising cloud services?
f) Based on your answers on the conducted online survey, I will talk about the major challenges about utilising from cloud computing. I will mention the major issues, and I wish if you specify whether your organisation has faced it or not. If yes, could you please describe how the organisation dealt with it?

** Technology **

1- Data Security
2- Data privacy
3- The integration with the legacy systems
4- Perceived loss of data control
5- Availability
6- Customisations
7- QoS for these services
8- Understanding the Technical Concepts

** Organisation **

9- Senior executive management support.
10- Cost and ROI calculating
11- Skilled personnel
12- IT governance
13- Organisation policy
14- Assigning service measures
15- The acceptance level from personnel to change
16- Fear of losing IT Jobs

** Environment **

17- Cloud service performance
18- Location of data centres
19- International regulation
20- Vendors regulation
21- Trust between the organisation and cloud vendor
22- Government requirements
23- Copyrights
24- National internet bandwidth

** Others **

25- Other (please specify)

Appendix 4: The Top Global GDP

Top global GDP rate. Source: The World Bank Report (2015)

No.	Country name	2011	2012	2013	2014
1	Turkmenistan	14.7	11.1	10.2	10.3
2	Ethiopia	11.2	8.6	10.6	10.3
3	Congo, Dem. Rep.	6.9	7.2	8.5	9.0
4	Cote d'Ivoire	-4.4	10.7	9.2	8.5
5	Papua New Guinea	10.7	8.1	5.5	8.5
6	Myanmar			8.5	8.5
7	Uzbekistan	8.3	8.2	8.0	8.1
8	Mongolia	17.3	12.3	11.6	7.9
9	Mali	7.7	11.2	7.0	7.8
10	Lao PDR	8.0	8.0	8.5	7.5
11	Mozambique	7.1	7.2	7.1	7.4
12	Dominican Republic	2.8	2.6	4.8	7.3
13	China	9.5	7.8	7.7	7.3
14	India	6.6	5.6	6.6	7.2
15	Cambodia	7.1	7.3	7.5	7.1
16	Niger	2.3	11.8	5.3	7.0
17	Rwanda	7.9	8.8	4.7	7.0
18	Tanzania	7.9	5.1	7.3	7.0
19	Fiji	-3.1	1.6	5.4	6.9
20	St. Kitts and Nevis	1.7	-1.2	5.8	6.9
21	Chad	0.1	8.9	5.7	6.9
22	South Asia	6.3	5.6	6.3	6.9
23	South Asia (IDA & IBRD)	6.3	5.6	6.3	6.9
24	Congo, Rep.	3.4	3.8	3.4	6.8
25	East Asia & Pacific (excluding high income)	8.4	7.4	7.1	6.7
26	East Asia & Pacific (IDA & IBRD countries)	8.4	7.4	7.1	6.7
27	Tajikistan	7.4	7.5	7.4	6.7

28	Benin	3.0	4.6	6.9	6.5
29	Maldives	8.7	2.5	4.7	6.5
30	Namibia	5.1	5.1	5.7	6.3
31	Nigeria	4.9	4.3	5.4	6.3
32	Philippines	3.7	6.7	7.1	6.1
33	Bangladesh	6.5	6.5	6.0	6.1
34	Panama	11.8	9.2	6.6	6.1
35	Low income	5.9	4.2	5.9	6.0
36	Djibouti	4.5	4.8	5.0	6.0
37	Malaysia	5.3	5.5	4.7	6.0
38	Vietnam	6.2	5.2	5.4	6.0
39	Togo	4.9	4.8	4.0	5.9
40	Cameroon	4.1	4.6	5.6	5.9
41	IDA blend	5.2	4.9	5.2	5.9
42	IDA total	4.8	4.8	5.5	5.8
43	Malawi	4.9	1.9	5.2	5.7
44	Grenada	0.8	-1.2	2.4	5.7
45	IDA only	4.2	4.5	5.8	5.6
46	Heavily indebted poor countries (HIPC)	4.9	5.7	5.7	5.6
47	Lower middle income	5.4	5.1	5.6	5.6
48	Timor-Leste	9.5	6.4	2.8	5.5
49	Least developed countries: UN classification	3.7	4.2	5.6	5.5
50	Bolivia	5.2	5.1	6.8	5.5
51	Bhutan	7.9	5.1	2.1	5.5
52	Nepal	3.4	4.8	4.1	5.4
53	Kenya	6.1	4.6	5.7	5.3
54	Ireland	2.6	0.2	1.4	5.2
55	Zambia	5.6	7.6	5.1	5.0
56	Indonesia	6.2	6.0	5.6	5.0
57	Sri Lanka	8.4	9.1	3.4	4.9

58	Antigua and Barbuda	-1.8	4.0	-0.3	4.8
59	Uganda	9.7	4.4	3.3	4.8
60	Angola	3.9	5.2	6.8	4.8
61	Moldova	6.4	-0.7	9.4	4.8
62	Pakistan	2.7	3.5	4.4	4.7
63	Paraguay	4.3	-1.2	14.0	4.7
64	Burundi	4.2	4.0	4.6	4.7
65	Sub-Saharan Africa (excluding high income)	4.3	3.6	4.7	4.6
66	Sub-Saharan Africa (IDA & IBRD countries)	4.3	3.6	4.7	4.6
67	Sub-Saharan Africa	4.3	3.6	4.7	4.6
68	Georgia	7.2	6.4	3.4	4.6
69	Sierra Leone	6.3	15.0	20.5	4.6
70	United Arab Emirates	5.2	6.9	4.3	4.6
71	Nicaragua	6.2	5.6	4.5	4.6
72	Bahrain	2.1	3.6	5.4	4.5
73	Sao Tome and Principe	4.8	4.6	4.2	4.5
74	Late-demographic dividend	6.6	5.3	5.1	4.5
75	Pre-demographic dividend	4.5	5.3	5.5	4.4
76	Colombia	6.6	4.0	4.9	4.4
77	Low & middle income	6.0	5.1	4.9	4.3
78	Iran, Islamic Rep.	3.7	-6.6	-1.9	4.3
79	Middle income	6.0	5.1	4.9	4.3
80	Gabon	7.1	5.3	5.6	4.3
81	Senegal	1.8	4.4	3.5	4.3
82	Palau	5.0	3.2	-2.4	4.3
83	Mauritania	4.7	5.8	6.1	4.2
84	IDA & IBRD total	6.0	4.9	4.8	4.2
85	Qatar	13.4	4.9	4.6	4.2
86	Guatemala	4.2	3.0	3.7	4.2
87	Kazakhstan	7.2	4.6	5.8	4.1

88	Pacific island small states	1.1	1.9	2.7	4.1
89	IBRD only	6.1	4.9	4.7	4.1
90	Belize	2.1	3.7	1.3	4.1
91	Luxembourg	2.6	-0.8	4.3	4.1
92	Burkina Faso	6.5	6.5	3.6	4.0
93	Kyrgyz Republic	6.0	-0.1	10.9	4.0
94	East Asia & Pacific	4.5	4.7	4.5	4.0
95	Ghana	14.0	9.3	7.3	4.0
96	Upper middle income	6.1	5.1	4.7	4.0
97	Dominica	0.0	-1.3	0.6	3.9
98	Zimbabwe	11.9	10.6	4.5	3.8
99	Guyana	5.4	4.8	5.2	3.8
100	Algeria	2.9	3.4	2.8	3.8
101	Early-demographic dividend	5.3	4.1	3.8	3.8
102	Kiribati	2.7	2.8	3.0	3.7
103	Ecuador	7.9	5.6	4.6	3.7
104	Hungary	1.8	-1.7	1.9	3.7
105	Lesotho	4.0	5.0	4.5	3.6
106	Saudi Arabia	10.0	5.4	2.7	3.6
107	Mauritius	3.9	3.2	3.2	3.6
108	Macedonia, FYR	2.3	-0.5	2.9	3.5
109	Costa Rica	4.5	5.2	3.4	3.5
110	Armenia	4.7	7.2	3.3	3.5
111	South Sudan	-4.6	-46.1	13.1	3.4
112	Korea, Rep.	3.7	2.3	2.9	3.3
113	Seychelles	7.9	6.6	6.0	3.3
114	Poland	5.0	1.6	1.3	3.3
115	Singapore	6.2	3.7	4.7	3.3
116	Uruguay	5.2	3.5	4.6	3.2
117	Botswana	6.0	4.5	9.9	3.2

118	New Zealand	2.7	2.7	1.6	3.2
119	Other small states	7.6	3.7	3.2	3.2
120	Madagascar	1.5	3.0	2.3	3.1
121	Sudan	-2.0	-2.2	3.3	3.1
122	Jordan	2.6	2.7	2.8	3.1
123	Honduras	3.8	4.1	2.8	3.1
124	Slovenia	0.6	-2.7	-1.1	3.0
125	Lithuania	6.0	3.8	3.5	3.0
126	Turkey	8.8	2.1	4.2	3.0
127	Romania	1.1	0.6	3.5	3.0
128	Estonia	7.6	5.2	1.6	2.9
129	Small states	6.5	3.3	2.9	2.9
130	Oman	-1.1	7.1	3.9	2.9
131	United Kingdom	2.0	1.2	2.2	2.9
132	Cabo Verde	4.0	1.1	1.0	2.8
133	Haiti	5.5	2.9	4.2	2.8
134	Central Europe and the Baltics	3.1	0.5	1.3	2.8
135	World	3.1	2.5	2.4	2.6
136	Hong Kong SAR, China	4.8	1.7	3.1	2.6
137	Israel	5.0	2.9	3.4	2.6
138	Guinea-Bissau	9.3	-1.8	0.8	2.5
139	Slovak Republic	2.8	1.5	1.4	2.5
140	Australia	2.4	3.6	2.4	2.5
141	Middle East & North Africa	3.7	4.2	2.2	2.5
142	Canada	3.1	1.7	2.2	2.5
143	Swaziland	1.3	3.0	2.9	2.5
144	North America	1.7	2.2	1.6	2.4
145	United States	1.6	2.2	1.5	2.4
146	Morocco	5.2	3.0	4.7	2.4
147	Peru	6.5	6.0	5.9	2.4

148	Latvia	6.2	4.0	3.0	2.4
149	Vanuatu	1.2	1.8	2.0	2.3
150	Tunisia	-2.4	3.7	2.3	2.3
151	Sweden	2.7	-0.3	1.2	2.3
152	Mexico	4.0	4.0	1.3	2.3
153	Egypt, Arab Rep.	1.8	2.2	2.1	2.2
154	Norway	1.0	2.7	1.0	2.2
155	Tonga	2.0	0.5	-2.7	2.1
156	Arab World	3.3	6.6	2.9	2.1
157	Comoros	2.6	3.0	3.5	2.1
158	Albania	2.6	1.4	1.1	2.0
159	Azerbaijan	0.1	2.2	5.8	2.0
160	Tuvalu	8.5	0.2	1.3	2.0
161	Czech Republic	2.0	-0.9	-0.5	2.0
162	Switzerland	1.8	1.1	1.8	1.9
163	Chile	5.8	5.5	4.0	1.9
164	Suriname	5.3	3.1	2.8	1.8
165	Iceland	2.0	1.2	3.9	1.8
166	Lebanon	2.0	2.2	0.9	1.8
167	High income	1.8	1.3	1.2	1.8
168	Montenegro	3.2	-2.7	3.5	1.8
169	OECD members	1.7	1.2	1.1	1.8
170	Europe & Central Asia (IDA & IBRD countries)	5.2	2.6	2.4	1.8
171	Belarus	5.5	1.7	1.1	1.7
172	Post-demographic dividend	1.6	1.1	1.1	1.7
173	Germany	3.7	0.4	0.3	1.6
174	Middle East & North Africa (IDA & IBRD countries)	-0.7	2.8	0.9	1.6
175	Middle East & North Africa (excluding high income)	-0.6	2.9	0.9	1.6
176	Europe & Central Asia (excluding high income)	5.3	2.9	2.6	1.6
177	Bulgaria	1.6	0.2	1.3	1.6

178	South Africa	3.2	2.2	2.2	1.5
179	Solomon Islands	12.9	4.7	3.0	1.5
180	El Salvador	2.2	1.9	1.8	1.4
181	Europe & Central Asia	2.3	0.1	0.6	1.4
182	Spain	-1.0	-2.6	-1.7	1.4
183	European Union	1.8	-0.5	0.2	1.4
184	Afghanistan	6.1	14.4	2.0	1.3
185	Belgium	1.8	0.2	0.0	1.3
186	Caribbean small states	1.2	1.2	1.3	1.3
187	Denmark	1.2	-0.1	-0.2	1.3
188	Kosovo	4.6	2.8	3.4	1.2
189	Samoa	5.8	0.4	-1.9	1.2
190	Bosnia and Herzegovina	0.9	-0.9	2.4	1.1
191	Bahamas, The	0.6	2.2	0.0	1.0
192	Netherlands	1.7	-1.1	-0.5	1.0
193	Latin America & the Caribbean (IDA & IBRD countries)	4.7	3.1	2.9	1.0
194	Latin America & Caribbean	4.6	3.0	2.8	1.0
195	Latin America & Caribbean (excluding high income)	4.3	3.2	2.8	1.0
196	Portugal	-1.8	-4.0	-1.1	0.9
197	Euro area	1.6	-0.9	-0.3	0.9
198	Gambia, The	-4.3	5.9	4.8	0.9
199	Thailand	0.8	7.2	2.7	0.8
200	Trinidad and Tobago	0.0	1.4	1.7	0.8
201	Russian Federation	4.3	3.5	1.3	0.7
202	Liberia	8.2	8.0	8.7	0.7
203	Jamaica	1.7	-0.6	0.5	0.7
204	St. Vincent and the Grenadines	-0.4	1.4	1.7	0.7
205	Greece	-9.1	-7.3	-3.2	0.7
206	St. Lucia	0.7	-1.1	0.1	0.5

207	Argentina	8.4	0.8	2.9	0.5
208	Guinea	3.9	3.9	2.3	0.4
209	Austria	2.8	0.8	0.3	0.4
210	France	2.1	0.2	0.6	0.3
211	Barbados	0.7	0.3	0.0	0.2
212	Brazil	3.9	1.9	3.0	0.1
213	Japan	-0.5	1.7	1.4	0.0
214	Equatorial Guinea	2.0	5.7	-6.5	-0.3
215	Italy	0.6	-2.8	-1.7	-0.3
216	Croatia	-0.3	-2.2	-1.1	-0.4
217	Fragile and conflict affected situations	-6.9	12.1	3.0	-0.6
218	Finland	2.6	-1.4	-0.8	-0.7
219	Macao SAR, China	21.7	9.2	11.2	-0.9
220	Marshall Islands	0.2	2.8	2.3	-1.0
221	West Bank and Gaza	7.8	14.5	-4.3	-1.1
222	Central African Republic	3.3	2.9	-37.0	-1.3
223	Kuwait	9.6	6.6	1.1	-1.6
224	Serbia	1.4	-1.0	2.6	-1.8
225	Iraq	7.5	13.9	6.6	-2.1
226	Brunei Darussalam	3.4	0.9	-1.8	-2.3
227	Cyprus	0.4	-2.4	-5.9	-2.5
228	Micronesia, Fed. Sts.	2.1	0.6	-3.6	-3.4
229	Venezuela, RB	4.2	5.6	1.3	-3.9
230	Ukraine	5.2	0.2	0.0	-6.6
231	Libya	-62.1	104.5	-13.6	-24.0
232	Aruba				
233	Andorra	-4.8	-1.8	-0.1	
234	American Samoa				
235	Bermuda	-3.3	-4.8	-2.5	
236	Channel Islands				

237	Cuba	2.8	3.0	2.7	
238	Curacao				
239	Cayman Islands				
240	Eritrea	8.7			
241	Faroe Islands				
242	Gibraltar				
243	Greenland				
244	Guam				
245	Isle of Man	4.8	6.2	4.5	
246	Not classified				
247	Liechtenstein				
248	St. Martin (French part)				
249	Monaco				
250	Malta	1.4	1.1	2.9	
251	Northern Mariana Islands				
252	New Caledonia				
253	Nauru				
254	Puerto Rico	-1.9	-2.8	-0.6	
255	Korea, Dem. People's Rep.				
256	French Polynesia				
257	San Marino				
258	Somalia				
259	Sint Maarten (Dutch part)				
260	Syrian Arab Republic				
261	Turks and Caicos Islands				
262	British Virgin Islands				
263	Virgin Islands (U.S.)				
264	Yemen, Rep.	-15.1	2.5	4.2	