University of Wollongong
School of Information Systems & Technology

Understanding the Effect of the National Broadband Network on the Productivity and Growth of Small to Medium Enterprise in Regional Australia >>>

ROBERT ESTHERBY

Understanding the Effect of the National Broadband Network on the Productivity and Growth of Small to Medium Enterprise in Regional Australia

A thesis submitted in partial fulfillment of the requirements for the award of the degree of

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Robert Stephen Estherby (3278116)
Supervisor: William Tibben

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Thesis Certification

I, Robert Stephen Estherby, being a candidate for the degree of Bachelor of Information and Communication Technology (Honours), hereby declare that the work described in this thesis is my own original research, and has not been submitted for any other degree at the University of Wollongong or for a degree in any other university or institution.

Robert Estherby
October 2010

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Abstract

Australia is currently embarking on a unique infrastructure project, the National Broadband Network, that may change the nature of "*Last Mile*" access to Australian telecommunications forever. Much of the argument for building this "super fast" broadband network has been based on the premise that increased Internet bandwidth will increase Australia's productivity and growth. There is however very little evidence which links, increases in bandwidth to increases in productivity and growth.

As over ninety percent of Australian Businesses are classified as small to medium enterprise (SME) many of which are located in the regional areas, much of this increase in productivity and growth would take place in these businesses. The question is, Will access to "last mile" fibre increase productivity and growth, especially in regional SME's? This research uses the Delphi Method to examine veracity of the claim that the NBN will increase the productivity and growth of SME's in regional areas specifically.

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Chapter 1 : Introduction

Australia is currently embarking on a unique infrastructure project that may change the nature of "*Last Mile*" access to Australian telecommunications forever. The Australian geographical context is unique and encourages greater reliance on telecommunications infrastructure. Australia is both isolated from the rest of the world and isolated from itself, with small concentrated pockets of population surrounded by much larger areas of sparse population. This distribution of population coupled with the harsh natural landscape has caused a digital divide to grow between metropolitan and non-metropolitan areas of Australia and the National Broadband Network's goal to close this gap is ambitious.

Much of the argument for building this "super fast" broadband network has been based on the premise that increased internet bandwidth will increase Australia's productivity and growth. There is however very little evidence which links increases in bandwidth to increases in productivity and growth.

As over ninety percent of Australian businesses are classified as small to medium enterprise (SME), many of which are located in the regional areas, much of this increase in productivity and growth would take place in these businesses. The question is, Will access to "last mile" fibre increase productivity and growth, especially in regional SMEs? This research uses the Delphi Method to examine the veracity of the claim that the NBN will increase the productivity and growth of SMEs in regional areas specifically, and the conditions that either prevent or promote this oft quoted hypothesis.

1.1 Background to the Research

1.1.1 Australian Broadband History

Australia has been connected to global research network since the mid 1970, however it was not until the early nineties that the first commercial Internet Service Provider offered the public access to the World Wide Web, reselling bandwidth from the Australian Academic & Research Network (AARNET). In 1995 the Australian Vice Chancellor's Committee (AVCC) who controlled AARNET, sold the commercial traffic to the then Government-owned-monopoly Telstra Corporation Limited (Clarke 2004).

In addition to taking over the commercial Internet in 1995, Telstra was also investigating the expansion of "high speed" Internet in Australia. In 1995 the Telstra Research laboratory conducted trials of various customer access network (CAN) technologies including Fibre Optics and xDSL. In a report published concerning the changing nature of Telstra's internet service it was stated:-

> *"Fully integrated services demand broadband network capability and the long-term adoption of optical fibre to replace the copper medium"*(Hawkins, Muirhead et al. 1994).

However, despite successful trials of fibre technology in Cordeaux Heights, New South Wales (Hsieh RC, Lampard G et al. 1995), Telstra chose not to invest in a new CAN, but instead capitalised on their existing infrastructure.

In 1997 the government of the day, despite the recommendations of the Senate Committee's report "Telstra, to Sell or not to Sell?" began the process of privatising Telstra. This was done in an attempt to increase market competition, by removing the telecommunications duopoly and the government's participation in it (O'Leary 2003).

The privatization of Telstra made no provision for structural separation, essentially giving Telstra total control of all Australian telecommunication's infrastructure, positioning them in the dominant market position, which led to alleged anticompetitive market practices, such as restricted access to profitable exchanges(Australian Competition and Consumer Comission 2009). This has lead to stagnation in infrastructure development, since the privatisation.

1.1.2 The National Broadband Network

In March 2007, the Australian Labour Party (ALP) launched its broadband policy, promising to roll out a fibre to the node (FTTN) broadband network, providing a minimum bandwidth of 12Mbps (Australian Labour Party 2007). After the ALP was elected in November 2007, they began implementing this policy extending a request for proposal (RFP). These proposals however were rejected by the government's expert panel, and the government instead developed a new plan to establish a government controlled company to build a $43 Billion wholesale fibre network (Rudd 2009). This network is designed to provide 100Mbps to 98% of Australia, with the rest being covered by wireless or satellite connectivity of at least 12Mbps (Rudd 2009).

1.2 Research Problem, Propositions/Research Issues and Contributions

1.2.1 The Question

It can be seen that the history of broadband in Australia is filled with political posturing, and as such it has been increasingly difficult to distinguish political rhetoric and propaganda from fact. One such "factoid" is that increased bandwidth will increase productivity and growth. An examination of the literature finds many references to the Internet increasing productivity, but no causal link or evidence of any kind to support these claims. Given the importance of SME's in regional areas to the Australia this research will therefore investigate whether the National Broadband Network will increase the productivity and Growth of Small to Medium Enterprise in Regional Areas.

1.2.2 Parent Theories and Classification Models.

The "Productivity Paradox" is a well-established theory in the literature attempts to explain the apparent gap between Information Technology investment and productivity (Brynjolfsson 1993).

With regard to the social study of technology, an often used theory is that of technological determinism. Technological determinism is the theory that the technology itself determines its success, thus a good technology will have users and become a dominant technology. However this theory does not always hold true. An example of this would be the Sony Betamax system, which was superior technology, but not a commercial success.

In contrast to Technological determinism, is social constructivism, which holds the opposite view that social collectives determine the utility and success of a technology.

1.2.3 Focal Theories and Conceptual Framework

A better conceptual framework for this research is the Actor-Network Theory (ANT). This does not advocate the priority of social factors over technological factors or *vice versa,* neither does it advocate that they be held in equilibrium. Instead the theory stresses that social and technical factors are actors in a network of factors. In this network each factor is heterogeneous and thus certain factors within the network must be stressed at different times.

1.2.4 Propositions

This research seeks to answer the following questions.

- "Will the NBN have an positive or negative effect on the growth and productivity of SME's in Regional Areas?"
- "What factors (if any) relating to the NBN will have a negative or positive impact on the growth and productivity of SME's in Regional Areas?"
- "What conditions need to be in place to ensure that the NBN will have a continued positive impact on the growth and productivity of SME's in Regional Areas?"

1.2.5 Research Objectives

To answer the research questions this study must address the following objectives:

- To conduct a comprehensive literature review to understand the reported relationship between Internet Provision and Productivity as well as Small to Medium Enterprise and The Australian Economy.
- To carry out initial interviews with experts in the field of Small to Medium Enterprise, Economics, Regional Development, Information Technology and Telecommunications, to discover their expert opinion of the research question, and the factors that they believe will affect it.
- To conduct as secondary phase follow up online web-based survey of the initial expert panel to gain a consensus view of the relative importance of each factor; and
- To combine and synthesize the data collected in the both rounds of the Delphi study as well as the literature review, in order to determine the impact of the NBN on the productivity and growth of SME's in regional areas

1.3 Justification for the Research

Australia is about to spend $43 Billion on a new Fibre Optic, Customer Access and Backhaul Network. The Government has repeatedly suggested that this will increase productivity and growth and make small business more competitive in the global economy (Australian Labour Party 2007).

While some studies indicate that the use of IT can increase productivity and growth it is far from a linear link of cause and effect, these are in contrast to others that advocate the productivity paradox. With 95% of SMEs currently connected to broadband internet (Australian Communication and Media Authority 2009) it is not clear that there will be any increase in the productivity and growth of these SMEs with the implementation of the NBN. Currently the most common activity performed by SMEs is communication via email (Australian Communication and Media Authority 2009), however this an

asynchronous transactional application, which has no reliance or need for anything above broadband speeds to function effectively (McCabe 2007).

This research contributes valuable information to both the National Broadband Network debate, within Australia and to the academic body of knowledge.

Currently there has been no academic research that links productivity or growth to increase in bandwidth. While this study will not provide empirical evidence it will report the views of industry experts, and collect valuable information regarding the contributing factors and conditions that lead to the success or failure of large scale broadband networks, and the NBN's ability to provide increases in productivity and growth for regional Small to Medium Enterprise. The natural choice of methodology to conduct this type of research would be the *"Delphi Method"*.

1.4 Methodology

1.4.1 The Delphi Method

Undertaking research on this topic is somewhat difficult. While an empirical method could be used to measure productivity before and after the implementation of NBN, this is not possible due to the time constraints of this project. In addition much of the value of research comes from examining this question before the larger scale roll out of NBN. This presents a problem, "how can you measure the potential effect of a program such as the NBN?" The answer is the Delphi Method sometimes known as 'Crystal Balling' (as it looks into the future).

This research will use a two round Delphi Method, which will consist of interviewing experts from the fields of Telecommunication, Small and Medium Business, Regional Development, Information Technology.

The first round will ask the experts in the field to give their opinion on whether or not they believe that the National Broadband Network will effect the productivity or growth of SME's in regional areas and why. In addition they will be asked to identify any key factors they feel will aid the effect of the NBN on SME's in regional areas.

These factors will then be tabulated and presented to the experts in the second round. The experts will then be asked to rank the factors in order of importance, and make any further comments.

This two stage process will provide a consensus of expert opinion in the field as well as a list of prioritized factors which must be taken into account in the implementation of the NBN, in order to deliver the best outcomes for small to medium enterprises.

The further comments will provide the experts with a final chance to make observations regarding these factors, which will add a further richness to the research.

1.5 Outline of the Report

This research is broken up into five chapters.

Chapter one provides an overview to the research, focusing on the background and theoretical framework within which the research is based. In addition the introduction provides a clear indication as to the significance of the research and how it contributes to the wider body of knowledge. Finally the first chapter defines the concepts used within the research, as well as defining the scope of the research as well.

In contrast Chapter Two, focuses on the existing body of knowledge, providing a clear indication of where this research fits within the wider body of knowledge. This chapter attempts to synthesis the knowledge from the areas of electrical engineering, economics, political science and information technology to provide an understanding of where the current state of knowledge is surrounding this topic. Unfortunately, as this topic does not sit within one school of knowledge exclusively there is very little written on this topic, except several government reports. However these two are analysed and the research gap is clearly established.

Chapter Three clearly sets out and justifies the methodology that this research uses. This chapter provides a clear rationale for the use of the Delphi method, as well as clearly setting out the method that will be followed during the research. This includes the list of industry experts and rationale for inclusion, the standard list of questions each expert was asked, how the information was analysed, the details of the second round of the Delphi method and an explanation of all ethical considerations.

The Results of the research undertaken with the method from Chapter Three are contained in Chapter Four. This chapter as well as displaying the individual options of each expert and a collective consensus of the experts, will provide an analysis of the results and any limitations on the results.

The Results contained in Chapter Four are then discussed in Chapter Five. This chapter examines the validity and practical effect of the results contained in Chapter Four. In addition this chapter examines the limitations of the research and sets out the directions for further research in the area.

Chapter Six provides a summary of the findings of the research.

1.6 Definitions

1.6.1 Working Definition of Small to Medium Enterprise

In the Australian context there is no clear definition of a Small to Medium Enterprise. While the Australian Bureau of Statistics clearly defines Small Business as a business employing between 1 and 20 employees(Australian Bureau of Statistics 2001), there is no such definition of a medium sized business. In addition, despite this authoritative definition, a different definition is used in current government legislation, specifically the Fair Work Act 2009, which defines a small business as having 1 to 15 employees. Due to this uncertainty this research will adopt the definition used by the Australian Media and Communications Authority (ACMA) for research in the area of Small and Medium Business Communications. This is that a Small to Medium Business in the Australian context is a business employing between 1 and 200 people.

1.6.2 Working Definition of Regional Australia

The term regional is somewhat tacit, in that many Australians have an implicit understanding of the term but it is rarely defined. In 2001 the Australian Parliament's Joint Sitting on Migration was unable to find a satisfactory definition of regions, calling it an "elastic term" which could be applied based on a number of factors from resources to lifestyle (Australia. Parliament. Joint Standing Committee on Migration. and May 2001).

Australian Government Departments and Agencies use the Australian Bureau of Statistics Remoteness Structure to define regional areas. The Remoteness Structure forms

part of the Australian Standard Geographical Classification (ASGC) which classifies all of mainland Australia into six areas "Major Cities of Australia", "Inner Regional Australia", "Outer Regional Australia", "Remote Australia", "Very Remote Australia" and "Migratory"(Austrailian Bureau of Statistics 2010).

This classification is based on the Accessibility Remoteness Index of Australia Plus (ARIA+). The Australian Bureau of Statistics (ABS) creates a $1km^2$ matrix over all of Australia. An Australian Remoteness Index of Australia (ARIA) score is then given to each of the $1km^2$ quadrates(Austrailian Bureau of Statistics 2010). An ARIA value is based on how far a location is away, by road, from a various types of service centres in comparison to the rest of Australia and is measured on a scale of 0 (no distance) to 15 (large distance)(Australian Bureau of Statistics 2001). The Remoteness Structure is generated by calculating the average ARIA+ value of a Census Collection Districts (CCD) and each CCD is then classified in the following way:

Remoteness Structure Classification	Average ARIA+ Range for a CCD
Major Cites of Australia	0 to 0.2
Inner Regional Australia	Greater than 0.2 and less than or equal to 2.4
Outer Regional Australia	Greater than 2.4 and less than or equal to 5.92
Remote Australia	Greater than 5.92 and less than or equal to 10.53
Very Remote Australia	Greater than 10.53 and less than or equal to 15
Migratory	Off shore (Excluding Tasmania)

Table 1: ARIA+ and Remoteness Structure

However, this Remoteness Structure is not entirely appropriate for two main reasons. Initially, the Remoteness Structure is an abstract geographical construct that is counter intuitive. The term regional, by the ABS's own admission, is a term that often means "very different things to different people and are either undefined or have conflicting meanings in different applications" (Australian Bureau of Statistics 2001) and thus, in the context of a Delphi Study, this a factor that must be taken into consideration. In illustration of this point take the City of Wollongong, which is considered by most people as a Regional Centre, as is Newcastle. However both of these cites are defined within the scope of the Remoteness Structure as "Major Cities of Australia", while areas which would be traditionally defined as rural are classified as "Outer Remote"

The second major issue with this definition is the nature of the ARIA measurement itself. The ARIA measurement takes into account how far it is necessary to drive to access services such as Education and Health (of varying levels) as well as Police, Financial, Postal, Waste Disposal, Government, Retail, Wholesale, Manufacturing, Accommodation, Religious, Entertainment and Recreation Services (Austrailian Bureau of Statistics 2001). It does not measure how "Technologically" isolated they are especially as the Internet can now provide access to many of these services in some form.

A better definition for regional, in the context of Telecommunications research, may possibly be dependant on connection speeds and choice of providers available from a given telephone exchange. Such a remoteness structure is instead based on technological distance rather than physical distance, and thus someone who is in the inner city using dialup may in fact be more isolated than a user in Dubbo with ADSL1. Such a remoteness structure may look like this:

Remoteness Structure Classification	Speed	No. Providers
Major Cites of Australia	12Mbps or Greater	10 +
Regional Australia	2 – 12 Mbps	5-10
Rural Australia	512Kbps – 2Mbps	1-5
Remote Australia	512 Kbps	1-2
Very Remote Australia/ Migratory	Satellite only	N/A

Table 2: Technological Remoteness Structure

However this too is counter intuitive.

As neither solution is satisfactory, the following definition has been created as being the correct balance of intuition, while still remaining within the framework of the Remoteness Structure and the ASGC. For the purposes of this research a regional area is any Statistical Division not containing a capital city and 40% of it component CCD's are classified as Inner Regional using the ASGC Remoteness Structure.

1.6.3 Working Definitions of Broadband

This report will use the ABS and the OECD definition of broadband which is "an 'always on' Internet connection with an access speed equal to or greater than 256 Kilobits per second (Kbps)". This definition has been chosen in the interests of clarity as it has long since become antiquated, as consumers and industry experts would no longer consider 256 Kbps a broadband connection.

In addition we will define high speed broadband as being an " '*always on*' internet connection with access speeds equal to or greater than 12Mbps".

1.6.4 Working Definition of the National Broadband Network

The National Broadband Network will be defined as the open, wholesale layer two fibre optic, customer access and backhaul network being built by the Commonwealth Government.

1.7 Scope and Unit of Analysis

This research is limited to the effect the National Broadband Network will have on the growth and productivity of Small to Medium Enterprises (as defined in section 1.6.1) within Regional Australia (as defined in section 1.6.2) as this is both a statistically and economically significant segment of Australia.

In Australia, Small to Medium Enterprises account for over 98% of all business (Australian Communication and Media Authority 2009). This equates to a 46% contribution to GDP(Australian Bureau of Statistics 2010). SMEs employ 42% of the Australian working population(Austrailian Bureau of Statistics 2010). In addition, the majority of SMEs are located in regional areas.

It is for these reasons that I have selected Australian Regional Small to Medium Enterprise as my unit of analysis.

1.8 Conclusion

Australia is currently embarking on a unique infrastructure project that will change the nature of "*Last Mile*" access to Australian telecommunications forever. The claimed increases in productivity and growth would help to empower regional Small to Medium enterprise, which is the powerhouse of the Australian economy.

However there is division in the literature regarding the increase in productivity and growth. This research aims to ascertain using the Delphi Method whether or not we can expect to see these promised increases in productivity and growth as a result of the introducing the National Broadband Network. In addition we hope to gain a consensus amongst the experts as to which factors and conditions will allow or prevent the NBN from delivering these promised goals.

Chapter 2 : Literature Review

2.1 Introduction

This chapter examines the previous research into the effects of broadband networks on productivity. Broadband has been a feature of international telecommunications markets since the mid 1990's. Over this 15 year period very little academic work has been done surrounding this topic. By contrast there is a wealth of information of varying quality that has been published by Governments, Consultants and Research Centres around the world. Much of this research examines the benefits of broadband but does not distinguish between High Speed Broadband and Broadband. Further, much of the economic research fails to separate broadband from other Information Communications Technologies, or else to examine some of the social factors in the work place that may reduce productivity gains.

2.2 The Claim

The claim that Broadband increases productivity is quite prevalent throughout the literature both academic and some examples include:

> *"…the productivity gains associated with this investment, the full benefits will continue to flow for decades beyond the completion of the project"(Rudd 2009).*

> *"…broadband also enhances the productivity of many existing processes, leading to better wages and better returns on investment. Governments at all levels have recognised the impact that broadband may have on everyday lives and are committed to ensuring that its benefits are made available to all"(Commission of the European Communities 2006).*

> *"Increased broadband usage is delivering greater efficiency and productivity and is opening up new markets for regional and metropolitan businesses."(National Broadband Strategy Implementation Group 2005).*

However, the relationship between productivity and broadband is not as straight forward and technologically determinist as these authors would suggest.

2.3 Social Theories of Information Technology

2.3.1 Technological Determinism

Technological Determinism is a reductive theory, which seeks to explain social, historical and economic phenomena in terms of a single principle or determining technological factor (Chandler 2000). A brief review of the examined literature shows the extent to which this views is held, particularly within the economic literature on the topic.

The New Zealand based research group Motu Economic and Public Policy Research (made up of private enterprise, government officials and academics from the University of Waikato) wrote a paper in 2008 entitled "The Need for Speed: Impacts of Internet Connectivity on Firm Productivity". This paper focuses solely on the broadband technology as a driver of productivity and does not account for other political, economic and social factors, which may influence productivity of broadband.

The following papers show, to a greater or lesser extent, a technologically determinist tone, that suggests that the Technology itself will shape the society and economy, rather than the opposite.

- Collins, P., D. Day, et al. 2007, *The economic effects of broadband: an Australian perspective*, Department of Communications Information Technology and the Arts, Canberra
- Commission of the European Communities 2006, *Bridging the Broadband Gap*, Brussels
- Fornefeld, M., G. Delaunay, et al. 2008, *The Impact of Broadband on Growth and Productivity*, European Commission - Directorate General Information Society and Media, Brussels
- Litan, R. E. and A. M. Rivlin 2001, 'Projecting the Economic Impact of the Internet', *The American Economic Review*, vol. 91, no.2. pp 313-317.
- National Broadband Strategy Implementation Group 2005, *Yearly Update*, Department of Communication Information Technology and the Arts, Canberra

2.3.2 Social Constructivism

In stark contrast to Technological Determinism stands Social Constructivism. While it too is a reductive theory, it holds the opposite premise, that there are identifiable social factors which explain social, historical and economic phenomena. This too is also visible in the literature, particularly describing the productivity paradox, such as:

- Brynjolfsson, E. 1993, 'The productivity paradox of information technology', *Communications of the ACM*, vol. 36, no.12. pp 66-77 and
- Sharma, S. K. and J. N. D. Gupta 2004, 'Improving Workers' Productivity and Reducing Internet Abuse', *The Journal of Computer Information Systems*, vol. 44, no.2. p 5.

2.3.3 Actor – Network Theory

While not prevalent in the literature, possibly a more suitable way of examining the network is using Actor-Network Theory. This theory was developed in France during the 1980's by researchers in the Science and Technology Studies (STS) discipline, namely Michel Callon, Bruno Latour and John Law (Law 1992).

In contrast to Social and Technological Determinism, Actor-Network Theory (ANT) holds that neither social nor technical factors are superior. Central to ANT is that social, organisational, economic and technical agents or actors are all part of a heterogeneous network. These actors and agents may be people, objects or even context (Law 1992). In some case a network may be "black boxed" meaning that is simplified to a single entity(Law 1992). The Internet is a prime example of this, as most people in today's society have no idea of the complexity of the network behind the Internet. They see it as another service, in the same way they see the telephone.

There is a danger of black boxing the National Broadband Network. This can already be seen in the political and economic dogma that is circulating regarding it.

> *"High speed broadband ... will help drive Australia's productivity, improve education and health service delivery and connect our big cities and regional centres" (Rudd 2009)*

This quote shows the way in which the National Broadband Network has been reduced to a black box, into which money is placed to return productivity. However this black box conceals a much more complex process in which a wealth of social, political, economic and technical factors will interact as part of associating and disassociating networks.

The final component of the ANT involves the idea that the success of any network depends on it strength to resist disassociation (Law 1987). This is very pertinent to the National Broadband Network. The NBN's political, social, economic and technical agents create a strong network. However the recent pledge of the opposition leader to "*scrap the National Broadband Network*"(Rodgers 2010) places the strength of this network in question, as Australia approaches the 2011 elections. From this we can see that the network is not just heterogonous in terms of its make up (Law 1987), but also in the relative importance and power that each of the actors has over the network.

While this study is limited to the impact of the NBN on the productivity and growth of SME in Regional areas, the productivity and subsequent growth are less likely to occur in a weak network.

2.4 Broadband Productivity

Despite the political dogma that "*Broadband increases Productivity*" there is in fact surprisingly little reliable evidence to prove or disprove this theory. This is due to several factors amongst the studies conducted.

2.4.1 ICT or Broadband Productivity

The first issue that confuses the area of research into broadband productivity is the lack of consistent terms.

The term ICT is often a cause of Mismeasurement, when examining the effect of Broadband on productivity. ICT (Information Communication Technology) or GPT (General Purpose Technology) are two collective terms that are often used in the literature relating to Internet Productivity (Collins, Day et al. 2007). Statistics based on these terms are misleading in the context of this study as they do not apply exclusively to Internet, but rather to Office Computers, Telephone Systems, Fax Machines, Internal Networks, e-Commerce and the Internet. Therefore measures based on these terms also dilute statistics, as not all the productivity gain can be associated to the Internet.

While ICT may be a more significant unit of analysis in the context of an overall economy, this aggregation of technologies into a single statistic is inappropriate for determining the effect that the Internet and Broadband, in particular, have upon the economy. Despite this, claims about the productivity of broadband have been made in several government reports based on such statistics (Broadband Advisory Group 2003; National Broadband Strategy Implementation Group 2005; Commission of the European Communities 2006; Australian Labour Party 2007; Productivity Commission 2009).

2.4.2 The Productivity Connection

Litan and Rivlin suggested in 2001 that there was indeed the potential that the Internet could improve productivity (Litan and Rivlin 2001). However, in contrast to other research of the time, they suggested that the increase would not come from e-business, but rather from what they called the "*Old Economy*". They held health care and government as prime examples of where there could be changes in the flow of information. However, rather than productivity, they saw the Internet making a greater impact on consumer convenience (Litan and Rivlin 2001). Despite this, based on their research, they estimated a 0.2 - 0.4% increase in productivity per year. While they acknowledged that these figures were by their nature speculative, however they did not believe that they were "unduly so" (Litan and Rivlin 2001).

Following the Lisbon summit in 2005, the European Commission's Director General Information Society and Media, commissioned MICUS Management Consulting GmbH to conduct indepth research into *"the impact of Broadband on Growth and Productivity"* (Fornefeld, Delaunay et al. 2008). Unlike other research conducted in the field, which tended to focus on macro or micro economic statistical analysis this study instead used a two-step methodology.

The first step uses a mixture of qualitative case studies and previous datasets to analyse the productivity effects at the company level. This information is then used to evaluate the productivity impact of broadband by multiplying the general company level case across the European economy (Fornefeld, Delaunay et al. 2008).

The second step of this method seems not take into account the heterogeneous nature of broadband development within the European Union (José Luis Gómez-Barroso and Claudio Feijóo 2010), however the the first step of the methodology seems sound.

In addition, this report also determines the productivity gains of the Broadband by efficient use of online services (Fornefeld, Delaunay et al. 2008). This too seems flawed; as some possible productivity gains from broadband do not come from online services, such as Voice over Internet Protocol (VoIP) or Virtual Private Networks.

However, despite these issues the report does find a correlation between the introduction of broadband and productivity and subsequent growth (Fornefeld, Delaunay et al. 2008). This correlative link between broadband and productivity has been further established in a 2009 paper published by the Motu Economic and Public Policy Research Centre in New Zealand. Using statistical analysis on data collected by the Statistics New Zealand over a four year period, they were able to identify a 10% increase in productivity moving from no broadband to the slowest rate of broadband access (Grimes, Ren et al. 2009).

They found no distinguishable increase in productivity from those moving from a slow broadband connection to a faster one (Grimes, Ren et al. 2009). However the paper warns that this must be interpreted with care as four key factors may have an effect on this result. Firstly there may have been confusion as to the definition of fast and slow broadband. Second, there may have been a lack of technical understanding amongst the respondents. Firms that have recently introduced cable Internet may be suffering from *"productivity lag", (*see section 2.5.2). Finally the benefit gained from a faster internet connection may only be applicable to a small number of firms (Grimes, Ren et al. 2009).

2.4.3 Bandwidth and Broadband Applications

While Grimes, Ren et al. (2009) suggest that their finding that slow broadband is no less productive than fast broadband, is not conclusive. It nevertheless proves that there is as yet no causal or correlative link between bandwidth and productivity.

It could be argued that their first finding of a 10% increase in productivity moving from no broadband to the slowest rate of broadband access (Grimes, Ren et al. 2009) included dial-up. It would then follow that because broadband has greater bandwidth than dial-up that there is a correlative link between broadband and productivity. This argument is

fallacious, and technologically determinist. While some increase in productivity can be attributed to the speed increase, it can also be attributed to other factors, such as *"always on connectivity"* (enabling the user to talk on the phone and work on the internet), reduced times for establishing connections, and lower cost. If any increase in productivity is to be found in moving from slow broadband to fast broadband, it will not have any of these factors associated with it.

It then follows that should there be a correlation between bandwidth and productivity it is necessarily not one to one.

Further, there may be little added benefit in increasing speed for many of the current Internet applications. Network traffic can be broadly categorized into three main categories: Real-time, Asynchronous and Interactive (McCabe 2007).

Traffic Type	Characteristics	Bandwidth Intensive	Example
Real-Time	o Strict time relationship between source and destination. o Data is useful for a limited time frame.	Yes (To ensure QoS)	Video Conferencing
Asynchronous	o Time Insensitive	No	Email
Interactive (Burst)	o Between Asynchronous and Real-time o Fast as possible o The network causes predominant delay. o Server and client can process faster than they can transmit and receive.	Yes	SSH or Telnet Viewing Websites
Interactive (Bulk)	o Between Asynchronous and Real-time o Fast as possible o Processing causes the predominant delay o Network can transmit and receive faster than the data can be processed. o Often the case with large files	Yes	File Transfers, Bulk Transactions.

Table 3: Characteristics of Network Traffic Types (McCabe 2007)

Table 3 shows the characteristics and bandwidth requirements for types of network traffic. While this table would suggest that the majority of network traffic requires larger amounts of bandwidth, this is not necessarily the case with Australian Small to Medium Enterprise.

The majority of SME's Internet traffic can be classified as Interactive Burst see Table 4.

Activity	Percentage of SMEs	Traffic Type
Communicate via email	98%	Asynchronous
Look for information about products and services	89%	Interactive Burst
Get reference information or research data	85%	Interactive Burst
Internet banking	83%	Interactive Burst
Access telephone directory	81%	Interactive Burst

Table 4: Top 5 SME Internet Activities Source:(Australian Communication and Media Authority 2009)

This suggests that increases in bandwidth may significantly increase productivity in SME's, as the majority of their current activities are interactive burst in nature. However, with the speeds proposed by the NBN the slowest part of the overall transaction is the human. *"Indeed the rapid speed up enabled by IT can create unanticipated bottlenecks at each human in the information processing chain"* (Brynjolfsson 1993). This may negate a large proportion of the productivity gained from using the NBN.

2.5 Productivity Paradox

"we see computers everywhere except in the productivity statistics."
Nobel Laureate Economist Robert Solow

Regardless of the actual figure, there has been over the last 20 years a discrepancy between the productivity figure and investment in "productivity tools". Erick Brynjolfsson in his seminal work "The Productivity Paradox" (1993) identified four possible explanations for the paradox.

2.5.1 Mismeasurement

The effects of ICT and Broadband in particular are hard to quantify. The traditional measure of productivity is: -

$$\boldsymbol{Productivity} = \frac{Output}{Input}$$

Equation 1: Productivity (Flamm, Friedlander et al. 2006)

However, the measure of these inputs and outputs is hard to quantify due to the intangible nature of ICT's (Brynjolfsson 1993). This problem effects certain sectors more than others, as manufacturing can see the productivity results of investing in Information Technology, by an increase in the units it produces. However this is not the case in the services sector, where measuring outputs is harder due again to the intangible nature of the work. In these sectors increased quality, speed and responsiveness have been

attributed to ICT and Broadband in particular but these factors are poorly accounted for in productivity statistics (Brynjolfsson 1993).

Government statistics have traditionally used Multi Factor Productivity see Equation 2.

$$MFP = \frac{Output}{Weighted - Average\ (Capital, Labour, Energy, Materials, Services)}$$

Equation 2: Multifactor Productivity (Flamm, Friedlander et al. 2006)

However this too has flaws. The first is that this calculation measures ICT or Broadband as a service, and then combines them with the other weighted input to determine the MFP value. This does not provide an accurate measure by which to calculate the increase in productivity as a result of ICT and especially broadband, as the increase in MFP could be related to an increase in Capital, Labour, Energy, Materials or any other service just as easily as it could be related to ICT's. This is only a valid measure if all other input variables remain static. This issue is further confused by the use of term ICTs which further reduces the relevancy of such findings, see section 2.4.1.

> *"The contribution that ICTs have made to productivity growth has been somewhat of a conundrum for researchers over recent years. Many have thought that the contribution of ICTs has appeared lower than expected, especially given the widespread use of ICTs. Recent research by internationally renowned experts in productivity measurement has suggested that a major cause of the conundrum is the inadequacy of sector data to support this type of measurement for ICTs."(Collins, Day et al. 2007)*

In order to address this issue the then Department of Communications Information Technology and the Arts, commissioned an occasional economic paper, which examined all the current models for the calculating of Internet or ICT productivity. It concluded that the while the current models are flawed, there is are no better alternative (Department of Communications Information Technology and the Arts 2005).

2.5.2 Lag

Lag, is the gap between the implementation of a Technology, such as broadband, and a measureable increase in productivity. This lag has been suggested to be anywhere up to a decade (Brynjolfsson 1993). A range of social and technological factors can explain this lag. Technologies can take several years to fully mature, especially if they are developed

in-house. Furthermore, in the case of the some solutions, the improvements in technology are catalysts for innovation. In some cases, one of these innovative solutions, when combined with the increase in Internet speed, may enable a further increase in productivity.

Social factors also play a part in lag. Users need experience in the new system before they can become proficient (Brynjolfsson 1993).
It is for these reasons that the productivity of any technology and especially broadband should be conducted over a long period of time, as short term studies may not reflect the long term effects of the technology on productivity.

2.5.3 Redistribution

This suggests that although the introduction of the information technology may be beneficial to an individual firm, it may not have an effect on industry-wide productivity, to which Brynjolfsson (1993) proposes two arguments.

The first is that IT may be used in areas such as market research and marketing that do not add anything to the companies output, thus effecting the productivity measurement (Brynjolfsson 1993). However this argument is flawed, as the effort required to sell the current output has lessened the use of IT, effecting the input side of the equation.

The second argument is that IT is more susceptible to "*Rent Dissipation*" which is where one firm's gains come at the expense of another's. This results in increases in productivity in some firms, a reduction in productivity in others and no change to the aggregate productivity statistics of the industry(Brynjolfsson 1993).

One example can be seen with WalMart, who mandated that its top one-hundred suppliers start to use RFID in the WalMart supply chain. This increased the productivity of WalMart, who had a reduction in their input, while the suppliers up the chain had an increase in their input reducing their productivity. We can see from this example that the overall productivity of the supply chain has remained stable at the supplier's cost.

It is possible that broadband could affect the economy, especially small to medium enterprises in this way. By increasing the capacity of the communication channels it is possible that some companies will experience productivity growth at the expense of their "information suppliers". As more and more business processes are placed online, it is possible that large businesses, for example a supermarket, will require their suppliers to provide invoices in a specific electronic format to integrate with their business systems. They would in turn move the data entry work traditionally handled by the supermarket to the supplier, who used to fax the handwritten invoices to the supermarket. In this case the change may have, as in the case of WalMart, a negative effect on the SME's productivity, while increasing the productivity of the supermarket.

This highlights the complex and unpredictable nature of the implementing such a large-scale network. There is a high possibility that unintended outcomes result.

2.5.4 Mismanagement

The last factor that Brynjolfsson (1993) suggests may be causing the productivity paradox is mismanagement. This is where decision makers may not make the decisions that are in the best interests of the company. Three suggestions are given to account for this mismanagement.

The first is that the decision makers are building inefficient systems. Anecdotally this is often attributed to technical ignorance, or lack of technical knowledge at the decision making level. However it can also stem from the digitalizing of existing inefficient work practices.

The second suggestion is that decisions are made based on out-of-date criteria.

> *"Our current institutions, heuristics and management principles evolved largely in a world with little IT"(Brynjolfsson 1993)*

This is often because the managers of today are operating using management models that are not designed for today's modern knowledge economy, but rather on a model developed in the industrial age (Drucker 2002). This has a profound impact on the way information technologies and broadband are used. One example is a management heuristic from the 1960

> *"'get all readily available information before making a decision." The same heuristic today could lead to information overload and chaos"(Brynjolfsson 1993)*

The final issue surrounding mismanagement, is when managers use the increased productivity gained from the technology not to increase output or reduce cost, but use it instead to "increase their slack" (Brynjolfsson 1993).

2.5.5 Cyber Slacking

The issue of the Productivity Paradox has been further expanded by U.S. researchers Sharma and Gupta (2004) in their article "*Improving Workers' Productivity and Reducing Internet Abuse"* where they discuss its application to the Internet. They suggest that one of the key productivity losses surrounding Internet technology is a phenomenon called known as *"Internet Abuse"* or *"Cyber Slacking"(Sharma and Gupta 2004).*

"Cyber Slacking", is when an employee, uses the company's Internet on the company's time, for their own purposes, such as surfing the web, conducting internet banking, online shopping, using Facebook and exchanging personal emails. These may or may not be against the company's polices, but have may have adverse effects on productivity in the workplace (Sharma and Gupta 2004).

> *"Some estimates report that 60% of all online purchases and 70% of all Internet Porn traffic occur during business hours"(Sharma and Gupta 2004)*

Sharma and Gupta suggest that this non-business related internet activity cost *"U.S. companies millions of dollars in lost productivity"(Sharma and Gupta 2004)*. They suggest that regardless of the attempts made to prevent this activity employees will still find time to access the internet for their personal uses (Sharma and Gupta 2004).

They do however suggest that the companies decrease *"cyber slacking"* and increase productivity by increasing the employees' workload, which would force them to spend more of their "slack time" working (Sharma and Gupta 2004).

However, not all experts agree, Chamorro-Premuzic (2008), suggests that an *"ebreak"* similar to a *"Tea Break"* or *"Smoko"* can in fact increase productivity. He further suggests that firms banning private Internet surfing could be loosing up to £4 billion a year.

2.6 The Australian Experience

2.6.1 Australian Studies

While there are some studies which *"provide evidence that ICTs have contributed significantly to productivity growth, none address the issue of the contribution of broadband directly. None provide any evidence of the quantum of the contribution that broadband has made to the contribution that ICTs have made to productivity growth"(Collins, Day et al. 2007).*

In 2005-6 *"State of the Regions"* report suggests that the regions with high quality broadband are more economically successful than others (Australian Labor Party 2007). This however could be equally attributed to a number of other factors such as proximity to major cites, and services.

Further, the National Broadband Strategy report suggests that, based on a Nielsen study, there is a perception amongst users that broadband technology increases their productivity (National Broadband Strategy Implementation Group 2005). More interestingly, this report suggests that SME productivity is enhanced through the use of broadband. This is based on a report called the "Broadband Barometer" which is no longer available. The report was compiled by Pacific Internet and therefore may have issue of bias that cannot be examined without the report.

In 2007 the then Department of Communications, Information Technology and the Arts compiled a report to be presented to an OECD conference in London called "The economic effects of Broadband and Australian perspective". It suggested that we must be careful when speculating about the economic effects of broadband, so as not to create "economic dogma"(Collins, Day et al. 2007). It suggests that although Broadband greatly contributes to the area of *"ICT's"*, it does not follow that the *"ICT"* productivity gains can be used to suggest that increases in Broadband speed are going to improve productivity. They made the recommendation that before any definitive statement about

the productivity benefits of broadband could be made, more research was necessary (Collins, Day et al. 2007).

Further research was undertaken by Access Economics on behalf of the Telstra Corporation in 2009. This research was the first Australian research to examine the economic benefits of a high-speed broadband network. However, this research concluded that although there would probably be economic benefits, these were subject to a high degree of uncertainty (Access Economics Pty Ltd 2009).

2.6.2 Regions, Small to Medium Enterprise and Broadband

Several themes have emerged from the research relating to the regional areas and SMEs. The first is that SMEs are not aware of the potential benefits of Broadband to their business (Fornefeld, Delaunay et al. 2008). This may not be the case in Australia with 95% of SMEs using broadband connections (Australian Communication and Media Authority 2009). This however does not mean that they are fully realizing the potential of these connections.

The second theme was that there are mixed messages from SMEs about their need for speed. The ACMA reports that of 1,800 SMEs surveyed none felt that "speedier internet" was necessary for the business in the coming year. This is in contrast to businesses interviews in Cornwall, UK who said they are *"…convinced of the necessity of a higher speed (fibre-optic) broadband connection"* (Fornefeld, Delaunay et al. 2008).
It is possible that there is some element of bias in the ACMA report, as the source of their results is the Sensis Business Index (Sensis being a subsidiary of Telstra).

2.7 The Gap

The existing literature paints a complex picture which suggests that broadband productivity is difficult to capture because a wide range of complex factors, from the Productivity Paradox, to different forms of measurement. The NBN is a fundamentally unique. There is not another network that has been built on such as scale, to cover 98% of Australia's population is a huge task. There are two differences that make the NBN different to all the networks that have been examined so far in the literature, speed and ubiquity.

Currently the literature uses mainly statistical analysis of pre-existing government or industry statistics on broadband. With the broadband definition of the OECD still *"an 'always on' Internet connection with an access speed equal to or greater than 256 Kilobits per second (Kbps)"* this provides the researcher with very little information what speed are being referred to when the term broadband is used. Within the literature the highest speeds were approximately 20Mbps based on current ADLS and Cable technologies (Fornefeld, Delaunay et al. 2008). The National broadband network however will be running at 100Mbps (Rudd 2009), five times faster than current networks. Therefore it may not be appropriate to base the productivity of this network on research of on much slower networks.

The second difference is ubiquity; this network is designed to reach 98% of the Australian population. Unlike other networks examined in the literature this will have a network externality factor that could also have an enormous impact on productivity, especially to SME in regional areas.

As a result we are left with a complex set of uncertainties, what better way to address this than through a Delphi Study.

Chapter 3 : Methodology

3.1 Introduction

This chapter is split into two sections. The first section examines in detail the Delphi Method, its history, distinguishing features as well as the reasons for its use in this research. The second section sets out the exact methodological framework for research, including sampling techniques, numbers of rounds, the research techniques used in each round as well as the limitations of the methodology and how the data from each round will be analysed.

3.2 The Delphi Method

The Delphi Method derives its name from the Oracle of Delphi. In ancient Greece, the city states would consult the Oracle of Delphi who would prophesy and tell the cities the will of the gods. While neither the Delphi Method nor this research claims to interpret the will of the gods, the Method was developed to gain valuable insight into the future. Today the Delphi Method is "*intended for use in judgment and forecasting situations in which pure model-based statistical methods are not practical or possible because of the lack of appropriate historical/economic/technical data, and thus where some form of human judgment is necessary*" (Rowe and Wright 1999).

Originally the Delphi Method was developed to *"obtain the most reliable consensus opinion of a group of experts" (Rowe and Wright 1999)* for the purposes of determining the likely targets of a Soviet first strike on the United States (Skulmoski, Hartman et al. 2007). It has since been applied to a wide range of research areas including health, business, defence, business, education, transportation, engineering and information technology. This is due in part to its flexibility in combining qualitative and quantitative research into a single methodology (Skulmoski, Hartman et al. 2007).

The technique has four distinguishing features:

3.2.1 Anonymity of Participants

Anonymity is one of the key features that distinguished this method from a focus group. This anonymity places each expert in a situation where they feel that they can express their opinion without pressure of fear of humiliation. In effect it removes the social pressures that are present within a focus group, and allows the experts to consider ideas on merit alone (Rowe and Wright 1999).

3.2.2 Multiple Rounds

Multiple rounds allow participants to refine their views in the light of the group's work from round to round (Skulmoski, Hartman et al. 2007).

3.2.3 Feedback to Participants

After each round participants are provided feedback based on the responses of the other participants (Skulmoski, Hartman et al. 2007).

3.2.4 Opportunity for Participants to change their view.

Giving the experts the opportunity to change their view, allows experts who have been persuaded by the evidence presented in each round to change their position (Rowe and Wright 1999). This is vital, as the expert may be presented with a new and worthwhile idea, which alters their position thus changing the outcomes of subsequent rounds.

3.2.5 Which Delphi?

There are two major forms of the Delphi studies in major use.

The first is the *"Delphi Exercise"* sometimes referred to as the *"paper and pencil"* Delphi. This is the traditional form of the study (Linstone and Turoff 1975). It involves a first round in which the experts are asked to respond to an open ended questions. This data is collected by the monitoring team, which then designs a questionnaire to provide the experts with feedback on the first round and the option to evaluate or re-evaluate their response in light of the feedback. This information is the collected and collated by the monitoring team which, dependent on the number of rounds, then either uses the information to create another round of questionnaires, or, if consensus has been reached, further rounds are terminated and the findings are evaluated (Linstone and Turoff 1975; Skulmoski, Hartman et al. 2007).

The second type is the *"Delphi Conference"* or *"real-time Delphi"*. This differs from the *"Delphi Exercise"* by substituting the monitoring team for a computerised system. The experts respond to the questions online, where the results of each are automatically summarised by the system, allowing the all rounds to be done in a short time frame. The system continues the rounds until a consensus condition is met (Linstone and Turoff 1975).

A further variation to the Delphi Method exists which seeks not to form consensus, but instead define areas of contention amongst the experts (Linstone and Turoff 1975).

3.2.6 Why Delphi?

The Delphi Method is ideal for research that:

- Is predictive (Linstone and Turoff 1975; Rowe and Wright 1999)
- Is time sensitive (Linstone and Turoff 1975)
- Requires broad heterogeneous input (Linstone and Turoff 1975)
- Is not suited to precise analytical techniques (Linstone and Turoff 1975; Skulmoski, Hartman et al. 2007)

This is therefore the natural method to use for this research.

3.2.6.1 Predictability

The National Broadband Network was proposed in 2007 (Australian Labor Party 2007), announced in 2009 and is due to be built between 2010 and 2018 (Rudd 2009). As it is impossible to measure the effects of a network that has yet to be completed, research into the NBN is necessarily predictive.

3.2.6.2 Analytical Nature

NBN is a unique network, in respect to both its speed, ubiquity and distribution area and consequently, previous literature may not be applicable. Further, there is currently no study that investigates the effect of high-speed fibre optic broadband networks on the productivity of Australian Regional SMEs. This is further reinforced by the lack of reliable measurements available for the measuring of broadband productivity, either from Government or Industry sources. This renders this study unsuited to analytical techniques.

3.2.6.3 Sample Consistency

The cross-disciplinary nature of this research requires expert opinion to be gathered from an economic, social, political and technological standpoint. This requires the gathering of information from a wide range of inherently heterogeneous sources.

3.2.6.4 Temporal Factors

This research must be completed by October 2010, which prevents the use of an in-depth longitudinal study or statistical analysis, because of time constraints.

3.2.6.5 Further Benefits

While it could be suggested that a focus group could also be used, the Delphi Method has two advantages over a focus group within this research.

The Delphi Study uses experts to reach a consensus. However due to the nature of their work and the disparity of their locations, it is extremely hard to find a universally convenient time and location to hold a focus group discussion. The Delphi Method, by comparison allows for the interview and surveys to be arranged at a time that is convenient for both the researcher and expert.

In addition, the Delphi model allows for anonymity. This allows experts, regardless of their employers' positions on an issue, to provide their personal expert view without fear of repercussions. Further, the anonymity provided by the process removes any social factors that would cause a bias in the results.

3.3 Research Design

This section of the chapter provides a detailed methodology for the research that will be undertaken to answer the questions raised by the literature.

3.3.1 Research Approach

In order to attempt to answer the questions raised in 0 this study will conduct a two round Delphi Study, with an optional third. The third round will only be used in the event a consensus is not reached as a result of the second round. The first round will consist of a semi-structured interview with the experts in order to determine what, if any, effect the NBN will have on the productivity and growth of regional small to medium enterprise. In addition the expert participants will be asked to define the factors that they believe influence it. In addition they may be asked to respond to factors found in the literature.

The second (and optional third rounds) will take the form of a short online survey. During the second round experts will be given feedback on the factors that were identified during the first round, and then asked to rank the these factors in order of significance.

In the event of no clear consensus being reached during the second round a third round will be conducted. This again presents feedback on the results of the previous round. The experts will then be able to rank the factors again in order of significance; with the option to change their position should they so desire.

The results of this final round (whether second or third) will be collected, analysed and compared with the literature in order to draw conclusions regarding the effect of broadband on the productivity of regional SME's.

3.3.2 Sample Selection

The purpose of this Delphi Study is to make a prediction about the productivity effects of the NBN. Experts are used as a central part of the Delphi Method because they are assumed to have greater insight and practical experience in their area of expertise. This enables them to make more accurate predictions regarding their area of expertise (Rowe and Wright 1999). This requirement renders the standard probabilistic sampling inappropriate for this study. Instead a subset of purposeful sampling called *"Expert Sampling"* is used (Trochim 2006).

Four factors were considered when determining the selection of participants in the Delphi study: - knowledge and experience, capacity and willingness to participate, sufficient time to participate and effective communication skills (Linstone and Turoff 1975; Rowe and Wright 1999)

3.3.2.1 Knowledge and Experience

Experts were selected from the telecommunication, small to medium enterprise and information communication & technology sectors as well as regional development organisisations, academia and government bodies.

To be considered an expert the participant must be:

- A prominent analyst from the in one of the sectors mentioned above
- A representative of an Australian Telecommunication Company
- A representative of a leading Small to Medium Enterprise
- A representative of a respected industry body
- A regional development officer
- A academic with at least one peer-reviewed journal article in this space

This broad range of experts provides a highly heterogeneous sample. Delbecq (1975) warns that *"heterogeneous groups can greatly increase the complexity and difficulty of collecting data, reaching consensus, conducting analysis and verifying the results "* and a larger group is required. It is further stated that three or more rounds may be required to gain a consensus amongst a heterogeneous group (Delbecq 1975).

3.3.2.2 Sample Size

While the majority of Delphi Studies to date have contained between 15 and 20 participants(Ludwig 1997), this study will contain only 13. This is not unprecedented, as the original Delphi Study conducted by RAND, had only 7 participants, and still provided a reliable prediction (Dalkey and Helmer 1963). In addition, while research into the Delphi method shows that there is a correlation between the number of participants and reliability, it also shows that *"correlation coefficient approaching .9, was found with a group size of 13"* (Ludwig 1997).

3.3.2.3 Capacity and Willingness to Participate

Experts will be contacted by the research team and invited to voluntarily take part in the study. The nature of this research, requires the approach to be very expert-centric, thus it is important to ensure that no expert is disadvantaged from participating because of time or distance constraints. To complete the second and third rounds, experts will use an online survey, which will require access to a computer and the Internet. If required a laptop with Internet connection can be arranged for the participant.

3.3.2.4 Sufficient Time to Participate

Due to the nature of the expert's work, it is necessary to ensure that they have sufficient time to partake in the study. Each participant will be provided with an information sheet, which will outline the approximate times that each stage of the study will take. It is estimated that each initial round one interview will take approximately one hour, and each subsequent round will take no more than thirty minutes each. Thus the total time required from each participant to participate should be between one and two hours, depending on whether a third round is required.

3.3.2.5 Effective Communication Skills

This study will only require experts to use their verbal communication skills. While in traditional *"Delphi Exercises"* the respondents would be required to have highly developed writing skills to articulate their point of view, the initial round will be conducted as verbal semi-structured interviews, and the second and possible third rounds will be conducted as online surveys with very few if any written responses.

3.3.3 Round One: Semi-Structured Interviews

The first round of the study takes the form of semi-structured interviews to gather qualitative information (see Appendix A). These interviews will consist of eleven open ended questions. These questions will be carefully formulated to prevent leading the expert to one conclusion or another.

These questions ask the expert to identify what effect, if any; the NBN will have on the productivity and growth of Australian regional SME's. They will then be asked to reflect and give their opinion on various factors that may effect productivity that have arisen from the literature, such as *"cyber slacking"*, *"productivity lag"* and *"mismeasurement"* (see sections 2.4, 2.5 and 2.6). As some of these terms may not be regular use outside of the literature, explanations will be given if necessary.

Wherever possible interviews will be conducted face-to-face, either at the expert's offices, the University of Wollongong or another mutually convenient location. If a face-to-face meeting is impractical due to distance or time, a phone interview may be substituted. Due to the busy schedules of the experts, each meeting will be limited to one hour, allowing an average time of 6 minutes per question.

Experts will be issued with the information and consent prior to the interview and permission will be re-sought in every interview to record using a digital voice recorder. In addition the researcher will take notes during the interview.

Content Analysis will be used to examine the expert's responses to each open question for key factors. These factors will form the basis of the second round.

3.3.4 Round Two: Online Survey

The second round, by comparison, takes the form of an online survey and is used to collect quantitative data. This round will consist of the twenty questions (see Appendix B). These questions are formulated from the information given in the open answer questions in the first round.

Each question will correspond to the questions asked in the first round interview. The experts will then be asked to rate the answers on a Likert scale, or to answer a multiple choice question. This provides them with feedback from the other experts, whilst maintaining anonymity. The software used will automatically display each of the possible factors in a random order. By rating these factors, a consensus regarding the relative importance of each factor should be reached.

The online survey should take each expert no longer than 30 minutes to complete, making the time for each question 3 minutes on average. Software allows for drag and drop ranking reducing the effort and time taken to answer each question.

The experts will be given a 14-day window in which to complete the online survey. If a participant has not responded by the 7th day they will be sent a reminder email. If the responder has not completed the survey by the 10th day they will be followed up with a telephone call reminder. After the 15th day, if there has still been no response they will be called again to determine whether they have forgotten or whether they wish to discontinue their participation the study.

This will provide quantitative data, which can be subjected to statistical analysis to discover trends in order to determine a consensus as to the relative importance of the various factors identified by the experts both within the literature and the first round of the Delphi study.

3.3.4.1 Attrition of Experts

With the heterogeneous nature of the sample of experts it is necessary to minimize the attrition of experts between each of the rounds. Three main techniques will be used to reduce the attrition of experts

Set Expectations

- Each participant will be given a sheet that explains the form that the Delphi study takes, and how long they can expect to spend completing each round, when each round should be completed, and how and when they will be contacted.

Explain Consequences

- Each participant will be given a explanation of the importance of the research and the problems that occur if a participant cannot continue with the research, however it will be stressed that they can decide withdraw at anytime.

Provide Reminders

- Participants will be provided with reminders of face-to-face interviews, and the availability of a round two online survey via email, no more than once a week. If a online survey has not been completed within 4 days of the deadline, a phone call will be made to ascertain whether the participant has decided to discontinue the study or whether there are any other problems which can then be dealt with.

3.3.5 Optional Round Three: Online Survey

The third round will only be used in the event that no clear consensus can be reached during the first and second rounds of the study. It will follow the same process as the round two online surveys, however the feedback will be based on the responses from round two.

3.3.6 Data Analysis

This research makes use of both qualitative and quantitative techniques to gather data. This combination of different types of data is common amongst Delphi Studies. Such studies often gather qualitative data in the first round and use subsequent rounds to gather quantifiable data. This use of the quantifiable data represented as descriptive statistics helps to provide a clear understanding of the qualitative data presented.

The first round makes use of a set of open-ended questions in semi-structured interviews, which are utilized to collect qualitative data. This information will then be analysed using a form of content analysis. Content Analysis is *"a systematic, replicable technique for compressing many words of text into fewer content categories based on explicit rules of coding"*(Stemler 2001). While traditional content analysis focuses on the examination of the data for key words or phrases this research will use a slightly different approach. Rather than searching for key words or phrases, this content analysis will examine the data (using a form of emergent coding) for key themes and factors.

The second and possible third rounds will be used using statistical analysis and presented as descriptive statistics, and qualitative data. This data is used to discover and illustrate the consensus amongst the participants. This approach is prevalent amongst previously conducted Delphi studies (Hsu and Sandford 2007).

Consensus is highly subjective with no clear or common definition being provided by previous studies, however it can be generalized as agreement between 70 – 80% of the respondents (Hsu and Sandford 2007). The second phase of the research uses both four and five point delphi scales. For four point scales this research will use the criteria suggested by Hsu & Stanford being "... at least 70 percent of Delphi subjects need to rate three or higher on a four point Likert-type scale and the median has to be at 3.25 or higher" (2007). For five point scales in this research will adapt this criteria, defining consensus in 5 point Likert-type scales as at least 70 percent of Delphi subjects need to rate three or higher on a five point Likert-type scale and the median must be at 4 or higher.

In addition the factors may be ranked. This will be done by sorting the responses first on number of experts taken to form consensus, and then by the score of each of the points on the Likert-type scale in descending order.

3.3.7 Methodological Limitations

There have been several papers written about weaknesses in the Delphi Method such as low response rates, consumption of large amounts of time and the molding of opinions through the use of leading questions (Hsu and Sandford 2007). These issues have been addressed throughout the design of the study.

However there still remain several limitations to this method.

3.3.7.1 Sample Size

As explained in section 3.3.2.2, the sample size of 13 is both reliable and close to the majority of Delphi Studies which have between 15 – 20 participants. However the research suggests that the greater number of participants the more reliable the results (Ludwig 1997). In contrast however Skulmoski, Hartman et al. (2007) suggest that when the sample is hetrogenous, a larger sample size is required while at the same time noting that larger sample sizes increase the difficulty of gaining consensus. This research has therefore chosen to compromise using a medium sample size as time limitations prevent the use of a larger sample.

3.3.7.2 Number of Rounds

The second major limitation on this research is the number of rounds. Again due to the time constraints of this research, the method uses two rounds with the option of a third, if the second round reaches no consensus. While Delphi studies to-date have predominantly used two to three rounds (Skulmoski, Hartman et al. 2007), it is accepted that the greater the number of rounds the more reliable the consensus (Linstone and Turoff 1975).

3.3.7.3 Semi-structured Interviews

It is possible that the use of semi-structured interviews could constrict the scope of the interview, allowing the participant to only respond to the question asked. The use of open questions is intended to overcome this limitation by allowing the participant to freely respond to the questions without prompting. Further open questions such as:-

> *"Do you have any further observations that you would like to make?"*

help to encourage the participant to offer views, observations and factors that they believe are important to the research, but felt did not belong to any particular questions.

3.3.7.4 Structured Survey

The structured nature of the survey may limit the participant's ability to offer further insight into the factors in the second and third stages of the research. The survey will consist mainly of questions that request the participant to rank the factors in order of importance. However, to overcome this methodological limitation a separate box at the bottom of each question will be provided for the participant to add any pertinent remarks or insights regarding the question.

3.4 Conclusion

The Delphi method has been used since the 1950s as a trusted method for quickly defining a consensus on a given topic from a group of experts. This enables the conduct, predictive and time critical research, even when input is required from a broad range of experts and precise analytical data is not at hand. As such the Delphi Methodology is uniquely suited to this research project.

Chapter 4 : Results

4.1 Introduction

This chapter reports the results collected during the data collection stage of this research. This data was collected as described in Chapter 3, that is using a multi-round Delphi method. This method first employs expert interviews to gather qualitative information and distinguish trends, then uses surveys of those same experts to "peer-review" the collected data to ensure the veracity and merit of the data.

Having secured a consensus after the first "survey round" (that is to say the second Delphi Round), it was unnecessary to proceed to the optional third round planned in section 3.3.5. Therefore this chapter will be split into two sections each reporting the results that were collected in the first and second rounds respectively.

4.2 Sample Selection

The final sample consisted of thirteen experts from the areas of Government, Small to Medium Enterprise, Academia and Telecommunications. During the sample selection phase twenty-two experts were approached of which thirteen accepted (a 59% acceptance rate). It should also be noted that there was hesitation amongst many experts due to the political uncertainty surrounding the 2010 Federal Election. This is discussed further in section 6.3.2.

4.3 Round One: Semi-Structured Interviews

The first round of the study took the form of semi-structured interviews and used twelve open-ended questions to gather qualitative information. These survey questions are provided in Appendix A .

4.3.1 General Questions

First three questions in round one were general questions regarding how a high-speed broadband network such as the NBN would affect the productivity of Australian regional SMEs. These questions also explored any factors or conditions, which also may effect this.

4.3.1.1 Question One

Question one was "*What effects do you think a high-speed broadband network such as the NBN will have on the productivity of Australian regional SMEs?*". Overwhelmingly the answer from all experts was that it would have a positive effect on the productivity of regional SMEs. In addition to this the experts also gave reasons and examples as to why this positive effect would occur.

These included: -

- There will be equity and parity of service between regional and metropolitan areas.
- It will encourage the development of new broadband applications.
- It will remove geographical boundaries allowing regions to compete with major cities
- It will provide a consistent, reliable broadband connection in regional areas.
- It will provide ubiquitous access to a standard high-speed broadband infrastructure.
- It will provide equity in pricing through a national price.
- It will enable GPs (an SME) to participate in e-Health initiatives.
- It will facilitate the establishment of virtual shop-fronts regardless of warehouse location.
- It will increase the ability to telework in regional areas.
- It will encourage the development of new information-based industries in regional areas.
- It will allow the introduction of high definition video services for conferencing, collaboration etc.
- It will provide SMEs with the ability to connect to new and existing markets.
- It will lead to higher regional workforce retention.
- It will enable greater use of software as a service (SaaS) in regional SMEs.
- It will increase the efficiency of regional e-commerce.
- It will provide Australian regional SMEs with an international competitive advantage.

  It will allow "instant access" to Internet-based information.
- It will provide access to "unlimited speeds".
- It ill provide access to online education and training for businesses regardless of location.

It was also noted by a number of experts that some of the applications of the NBN that will have a positive effect on the productivity and growth of regional SMEs, may not be perceivable now, but they will be enabled by the NBN.

In addition to this several other observations were added including: -

- As the NBN becomes central to business information will become a tradable object.
- The NBN will improve quality of life and this will have an indirect but positive effect on productivity.
- We have attributed previous productivity gains to telecommunications technologies, and thus it would be reasonable to expect similar gains as a result of the NBN.
- The level of productivity increase will depend largely on the type of business.
- Regional areas rely on infrastructure for their continued survival.
- Businesses must actively engage in utilizing the NBN in order to gain any benefit.
- By retaining a regional workforce, the NBN will bolster regional economies, as there will be more disposable income within the region to contribute to its economy.

In addition it should be noted that there was one significantly differing opinion. The expert suggested that the NBN would bring regional SMEs into competition with other SMEs and large enterprise from other Australian regions, Australian metropolitan areas, and the international market. The positive or negative effect of this competition will depend on the economic health of the region and the business. A weak business or region may find that the competition enabled by the National Broadband Network will have a detrimental effect, hastening the demise of the business or region.

These effects enumerated by the experts, were then condensed into the following general effects which were the peer-reviewed by the experts in the online survey see section 4.4.1.

- Connect regional SMEs to NEW markets
- Better connect regional SMEs to EXISTING markets
- Enable the building of information economies in regional areas
- Decrease the relevance of geographical location
- Provide "instant access" to new and existing (High and Low Bandwidth) information
- Improve the reliability of communication, collaboration, e-commerce and other internet based activities.
- Provide parity of access amongst regional & metropolitan business.
- Provide essential infrastructure for the sustainable growth or survival of regional areas.

4.3.1.2 Question Two

The second question was "*What factors, if any, relating to the provision of a high speed broadband network such as the NBN do you believe will have negative or positive impact on the growth and productivity of SMEs in regional areas?*". The responses to this question contained a mixture of positive and negative factors, although generally the experts focused on the positive factors as opposed to the negative.

The positive factors included: -

- Ubiquity, removing the constraints of distance and location.
- Provision of a consistent and standardized network environment.
- Attraction of skilled workers into regional areas during the construction phase, and into the future.
- Greater bandwidth.
- Competition from multiple retail service providers in regional areas.
- A high level of e-commerce adoption will be enabled.
- The speed of roll out.
- The prioritization of regional areas during roll out (remediation of the digital divide)
- Open access to the network, by the Retail Service Providers (RSP).
- The minimum access speed of 12 Mbps regardless of location.
- The selection of appropriate technologies for the network (fibre 93%, satellite and wireless 7%).
- The selection of an appropriate demarcation point between fibre, satellite, and wireless technologies.
- Business' level of confidence in the network's performance and reliability.
- The collaboration between NBN Co., retail service providers and businesses.
- The SME's understanding of the strategy and vision for the NBN.
- Treatment of the NBN as a utility.
- Trans-sector use of the NBN in innovative ways.
- Attractive, competitive & nationally uniform pricing.
- The non-distance limited nature of fibre optics.
- Party of access for metropolitan and regional areas.
- The usability of the services.

The negative factors suggested include: -

- Obstructive local and state planning laws.
- Political pressure.
- Lengthy roll out times.
- Difficulty with service provision in multi-dwellings (Such as office blocks and flats).
- Issues surrounding data security and privacy.
- Lack of SME understanding of technology and its benefits.
- New competition from external SMEs and large enterprise.
- The reintroduction of a single monopolistic infrastructure provider may be of concern to long-term competition.
- Misinformation suggesting that wireless is an equivalent technology to fibre.

A further comment was made that the productivity of a regional SME would not depend on the technology itself, but how it uses the technology to exploit the other attributes of its region. In other words a SME in Wollongong could exploit the region's high youth unemployment to create a cheap data entry business service that could service business far beyond the Illawarra Region.

These factors enumerated by the experts, were then condensed into the following general factors which were the peer-reviewed by the experts in the online survey see section 4.4.2.

- Competition
- Ubiquity
- Speed/Bandwidth
- Standard Platform
- Regional Focus
- Roll out Speed
- Consultation with Stakeholders
- Vision & Strategy
- Pricing

4.3.1.3 Question Three

"*What conditions need to be in place to ensure that our high-speed broadband network such as the NBN will have a positive impact on the growth and productivity of SMEs in regional areas?*" This question focused on the conditions that were necessary to ensure the success of the NBN. This question received responses that covered a broad range of areas from policy and economics to technology.

The Responses to this question in included: -

- Education and awareness surrounding the benefits of the NBN (similar to the digital TV switch over campaign) need to be provided..
- Business should be provided with case studies to illustrate benefits of the NBN.
- Regulations or guidelines surrounding security and privacy need to be developed.
- Education surrounding security and privacy needs to be provided.
- Due consideration must be given to cultural issues such as the age of users.
- The Government needs to stimulate private-sector innovation and product development for the NBN.
- Government and industry groups need to hold forums to discuss the applications and benefits of the NBN (this should include governments, private businesses, end users, special interest groups etc.).
- Ensure that the NBN remains an open access to the wholesale network.
- Ensure effective competition amongst application service providers, through competition policy.
- Ensure adequate competition especially in regional areas.
- Ensure competitive access too in the backhaul network.
- Ensure the demarcation point between wireless, satellite and fibre is correct and sufficiently flexible.
- Ensure expert consensus about network design and roll out method.
- Ensure both the RSPs and NBN Co. understand the specific requirements of users through engagement and consultation.
- The Government must commit to moving to a digital economy.
- Private companies must investigate ways in which they can utilize the NBN effectively.
- Allow for the removal of policy inhibitors (such as lack of Medicare billing for digital consultations).
- Conduct a cost benefit analysis focusing on the cost, as the benefits are hard to quantify.
- Provide a standard access mechanism.
- Ensure engagement of service providers, content providers, e-health implementers, smart grid operators etc.

- Ensure parallel implementation of new applications, RSP offering, and the NBN.
- Provide education and awareness of the technologies that the NBN can help to utilize.
- Ensure the ease of use of the NBN offerings.
- Develop appropriate pricing ensuring that it is justifiable, acceptable & affordable.
- Provide education in the appropriate skills to the use of the NBN especially for SME operators.
- Provide examples of how an SME can exploit the capabilities for SME exploitation of regional assets.

These conditions enumerated by the experts, were then condensed into the following general conditions which were the peer-reviewed by the experts in the online survey see section 4.4.3.

- Open Access
- Ubiquity
- Competition Government sponsored innovation into applications, services and product development (In addition to building the Network)
- Community & SME education to ensure awareness of visions and benefits of the NBN
- Appropriate Pricing
- Skill Development for Regional SME Workers in the Use of the NBN
- Government use of the NBN to deliver services
- Ensuring Economic viability of the NBN
- Ensuring the development of practical digital privacy and security policies and products.
- Removal of current legislative & policy inhibitors to allow new applications
- Universal Service

4.3.2 Productivity Paradox Questions

The next three questions were derived from the literature surrounding productivity paradox which can be found in section 2.5. These questions attempt to determine to what extent the productivity paradox, initially developed to explain ICT's apparent absence from productivity statistics, is also applicable to broadband related productivity.

4.3.2.1 Question Four

This question for asks the experts to consider the applicability of the productivity paradox to the national broadband network. And the question is *"Do you believe this [productivity paradox] is also applicable to high-speed broadband networks such as the National Broadband Network? Why?"*

The answers to the first part of question were quite varied. Of the thirteen experts interviewed, ten said "yes" they thought that a productivity paradox would apply to the NBN, one said they were "not sure", one said that it "would not" and one said that the idea was "nonsense". In addition to these responses, several reasons for their answers were given.

Some of these reasons include: -

- Depends on other economic factors, and cannot be measured midway through the roll out.
- There must be complimentary revelatory and economic frameworks to gain the best benefit from the technology, which might take time to implement.
- We currently do not have an adequate baseline or counterfactual case. This will make measurements of productivity differences difficult.
- The productivity benefits will vary from industry to industry.
- The benefits of the NBN will be diffused by several factors being changed in the competitive make-up of the marketplace, the long timescale needed to measure the productivity of this project, and the difficulty distinguishing the make up of the productivity benefits (i.e. whether they are as a result of the NBN or ICTs in general).
- It is hard to quantify the benefits to productivity, which result from the use of the NBN in public service delivery such as health or employment.
- In order to see productivity benefits we will have to look over a much longer time frame (life of the network).
- Many of the benefits of NBN will be in the area of social cohesion which in turn may lead to a more productive society. However this will be very hard to measure.

- The productivity may be visible, may even be measurable, however it may not meet or exceed the original expectations.
- The technology may not be used in the originally envisioned way, thus causing unforeseen difficulties with measurement.
- The productivity of an individual SME is likely to be affected by how effectively they use the technology at their disposal. For example, connecting to the NBN will not necessarily guarantee an increase in sales.
- The productivity paradox is nonsense! While the productivity rate may not accelerate, that does not mean that the NBN or telecommunication's technologies in general are not providing productivity increases. Telecommunications have contributed to the ongoing historical productivity growth since the 1980s. In addition, there is an issue with measurement, as productivity is measured in terms of real value added which is based on the profitability of the firm. With the event of globalization Australian companies have had to cut prices to compete in the global market. Telecommunication's technologies have enabled Australian business to maintain their levels of profitability while cutting prices.
- There may be a slow growth in productivity because applications that take advantage of higher speeds to improve productivity may take a while to develop.
- The NBN will develop slowly as a fully integrated ecosystem. However, some elements of the ecosystem will be dependent on other elements thus causing the NBN to lag.
- There is an instinctive understanding that the Internet has improved productivity. It has become a utility and as such we don't generally think of the productivity of utilities, we just assume their benefits are a "given".
- We need to be practical about our view of broadband. Broadband itself is no use it must be coupled with general-purpose technologies such as computers and printers etc. We also need to realize that people don't need high bandwidth, applications do. How and what we measure is important but hard to determine.
- The productivity benefits will be mixed in with other economic factors. This will be very hard to measure because of the layering of the infrastructure, technologies, service provider offerings, and actual applications.
- The productivity will only be seen in longer-term trends, it will therefore be necessary to measure the productivity over a long period.
- It will be necessary to work with the Australian Bureau of Statistics and New Zealand (with whom we share statistical classifications) to ensure we have the best possible set of classifications surrounding technology, which may distort the measurement.
- We may see short-term increases in productivity followed by drops in productivity because of a relapse into old habits on the part of regional SMEs. However over a longer period we will see the NBN integrated into SME business practice. This fluctuation may be reduced by education, support and mentoring of SMEs.

4.3.2.3 Question Five

Question five followed on from question four. This question was designed to have experts comment on four main factors that were suggested by Brynjolfsson as being possible factors contributing to the perceived difference between real and measured productivity. The question asked was "*Do you believe that lag, mismeasurement, mismanagement or productivity redistribution will effect the productivity of regional SMEs under a high speed broadband network such as the NBN? Why?*".

These potential factors will be addressed one by one.

4.3.2.3.1 Lag

During this round one, of the thirteen experts that were interviewed, eleven said that lag was a likely factor, and the following explanations were given: -

- Lag will definitely be a factor when trying to measure productivity. We can attempt to reduce this lag effect by investing in the early discovery of productivity enhancing applications. However it is unlikely that applications available in the early days of the NBN will deliver high levels of productivity benefits.
- The lag can also reduced by equipping firms to be comfortable enough to absorb new technologies as they appear. Sponsoring projects that demonstrate the advantages of these new technologies and working with businesses to ensure that they understand how these technologies can be implemented are two ways this can be achieved.
- The NBN will not be fully rolled out (reach ubiquity) for up to eight years. During this time you may be able to get regional snapshot but this may be hindered by the fact that take-up will not be instantaneous. It is necessary to understand that the effect of the NBN on productivity will be a "slow burn", and so we cannot expect to see a transformation overnight. It is more likely however that these effects occur over a generation, as they are a national structural change.
- Lag is a potential issue because even after the fibre is turned on it is highly likely that all SMEs will have used a telephone connection, Internet connection and possibly some video channels (triple play). It will not be until application developers catch up with the possibilities of the NBN that we're likely to see productivity changing broadband applications.
- As Australia is a test bed for this type of national broadband network it will take a while for innovators and developers to come online with new ideas for this new technology.
- We saw in the past that there was a "lag" between the introduction of a new technology and its adoption despite the compelling benefits. There is no reason to believe that this will not occur with again.
- Lag would definitely occur, many SMEs are already seeing a lag within existing technological systems, such as e-commerce sites, where they have introduced the infrastructure but are yet to see a return on their investment.

- It is probable that will see about an eight to ten year lag from the start of implementation. This will be largely due to the time it will take for retail service providers to develop services, take-up of these services and the development of next-generation applications.
- While there will be a lag this may only be a very short period of time. We are seeing a rapid decrease in the adoption times of many new technologies such as iPhones, Facebook and so on.
- Yes there will be a lag, but this may be reduced by correctly handling the launch. For example if the NBN is launched with complementary applications that demonstrate the productivity benefits of the NBN this may reduce the lag time.
- It is also possible that due to the lag there will be political point scoring.

4.3.2.3.2 Mismeasurement

During this round one, of the thirteen experts that were interviewed, eleven said that mismeasurement was a likely factor, and the following explanations were given:-

- We currently do not have a standard measure which can measure the multiple facts relating to broadband productivity.
- We have two problems relating to the measurement of productivity and the NBN. The first is as a result of the Australia's and New Zealand's inadequate statistical classifications for information technologies. The second is that by the time statistics are measured, the results are irrelevant because of the high speed at which information technology moves.
- Mismeasurement is possible because it is necessary to collect both firm level and aggregate level statistics relating to the productivity of the NBN. In addition, this needs to be conducted over a long period and if the period is not long enough the results may not reflect all the productivity benefits.
- Clearly in order to gain a clear understanding of the productivity gains as a result of the NBN on regional SMEs, measurement really needs to be done before and after the implementation of the NBN. However, currently we do not have these measurements.
- I believe there will be a level of Mismeasurement just because of the difficulty that we will have in determining where the productivity actually comes from.
- Even the OECD has difficulty in measuring the productivity of broadband networks. In reality the NBN should be viewed as a utility. We generally do not measure the productivity of utilities because it is a "given", if I don't have electricity I can't work, and these days the same can be said about the Internet.
- Mismeasurement may be an issue as generally regional SME operators are likely to measure their firms level of productivity by their profit and stress levels. These may not be immediately useful when comparing across sectors or the economy.

4.3.2.3.4 Mismanagement

During this round one, of the thirteen experts that were interviewed, nine said that mismanagement was a likely factor, and the following explanations were given:-

- Mismanagement is unlikely to occur within the telecommunications industry however there may be instances of mismanagement within the customer base.
- There will be a certain amount of mismanagement relating to the NBN as with all technologies. To draw an analogy there was only a very small usage case for the personal computer initially and so some businesses resisted implementing this technology.
- There are always people who are ready to dismiss new technologies as 'fads' and end up managing against the technology, out of fear, uncertainty and doubt. Companies that do this are not likely to see the productivity benefits as quickly as a company that embraces the technology.
- Many SME operators especially in regional areas are not trained in how to effectively use and manage technologies in their business. Without education or assistance with this, there may be a certain level of mismanagement of these technologies.
- Mismanagement is more likely to occur in the area of NBN policy development.
- Some applications, which are enabled by the NBN, may be mismanaged, such as teleworking. This has been traditionally discouraged by Australian management who cling to industrial age management methods, always wishing to be able to observe the work that is going on.
- I do not believe that the NBN, or any technology, can itself be mismanaged. You may mismanage the applications that you run over it but not the medium itself.

4.3.2.3.5 Redistribution

During this round one, of the thirteen experts that were interviewed, seven said that redistribution was a likely factor, and the following explanations were given: -

- There may be instances where the productivity benefits bypass parts of the value chain. This may have an impact on our measurement productivity.
- I do believe that there will be some sort of redistribution with a temporary distortion of markets. This may disadvantage SMEs in the short term but provided they find their own usage case and can utilise the NBN, I believe that this will eventually be balanced out.
- Yes, there will be some redistribution because of the way in which some businesses better understand how the technology can be leveraged to increase the productivity, whereas others do not.
- I don't think redistribution is a large issue, as the benefits of the NBN will fall across the economy.
- There could quite easily be a certain level of redistribution of productivity however I think that it will be relatively equal. For example while a business may have to enter its own

data into an online form when ordering supplies from the supplier their productivity maybe enhanced by: -

  - Not having to mail the form.
  - Not having to ring up, wait on hold, speak to order supplies over the phone.
  - The ability to place orders when it is convenient to them.
  - See the details of a product without having to travel to see samples or wait for a catalogue.

- I would not be surprised to see a redistribution of productivity, however it is very hard to predict due to the complex nature of the interaction of various facets

These effects enumerated by the experts in questions four and five, were condensed into the following general effects which were the peer-reviewed by the experts in the online survey see section 4.4.4.

- Different SMEs will have different levels of productivity, because they are different types of businesses
- Expansion of markets broaden the boundaries of the economic model
- Granularity of the measurement & statistics
- Non-traditional use of technology
- NBN may increase quality but not output
- Lag
- Measurement Problems
- Mismanagement of Technology (For example investment in technology does not lead to an increase in output, or sales)
- Redistribution of productivity benefits (externalities)
- Timing of Measurement
- Productivity may be affected by regulation or other external forces
- Lack of current data to use as a baseline or counter-factual case.

4.3.2.5 Question Six

This question focused on the issue of cyber-slacking, which was suggested in the literature as a reason for lower-than-expected productivity (see section 2.5.5). The experts were asked, "*Do you believe that the efficiency of regional SMEs is likely to be affected by an increase in cyber slacking as a result of increased speeds? Why?*"

This question intrigued many of the experts, however a consensus was formed that cyber-slacking was essentially a management issue. That is, that regardless of speed or connection type, this would occur in some form.

In addition several observations were made:-

- Abuse of the company's Internet resources can easily be controlled through the use of company policy and filtering technologies (if required).
- If people have time on their hands they will find a way to 'slack off'.
- Increases in speed may in fact reduce the time people spend "slacking off", because they will complete these online tasks faster.
- The use of company's Internet for personal purposes is a part of 'work-life balance'. Just as people spend time at home working, they will also need to spend some time during office hours tending to personal matters. It is a matter of give and take and companies need to set clear expectations about what is acceptable personal use.
- It is better for someone to do their internet banking on the work's internet (which might take 5 minutes) than spending half an hour to go down to the bank in person, during office hours.

4.3.3 Additional Questions

4.3.3.1 Question Seven

Question seven examines the argument put forth in the ACMA's report into small to medium enterprise and their use of telecommunications, that SMEs neither want nor need higher Internet speeds (Australian Communication and Media Authority 2009).

The experts were asked the following question, *"Current research from the ACMA report that the majority of SME Internet use is general webpage traffic and e-mail which is predominantly transaction. Why will SMEs need faster Internet connections?"*

The following responses were collected as answers to this question: -

- The NBN is not about faster Internet but rather a high-speed broadband connection, which has more applications than simply the Internet.
- Value will not come from current generation technology applications.
- Focus groups of SMEs repeatedly say "we don't know how we will use it, but we want it"
- New services like cloud computing, high-definition video and converging communications will work more effectively on high speeds. Currently in many regional areas, current generation Internet connections are unsuitable for these applications.
- The NBN will enable a change in the nature of business applications converging on the Internet.
- Although some businesses are not bandwidth intensive, there is an increasing number of bandwidth intensive businesses such as design, engineering, media (such as PR, film industry, recording industry, game design and so on).
- It also enables a richer online experience. ten years ago it was common not to download pictures on Internet sites because of bandwidth restrictions, today people choose not to download video of webpages because of bandwidth restrictions, even in business environments but they would not go back to not downloading pictures. However video is a medium that is being increasingly used to deliver complex information especially in the business context. One good example is Cisco's use of video to explain their complex feature sets of the various technologies.
- Bandwidth can compensate for various qualities of service provisions. For example it can reduce jitter, lag and retransmission times in the event of an error. This makes the connection more reliable than current generation broadband networks.
- It will enable next-generation video services such as high-definition streaming and real-time interactive video (tele-presence). Such technology will allow inter business video collaboration and enable e-health initiatives such as online consultations or video diagnosis. Interactive video applications such as these would be impossible without high bandwidth broadband connections.
- Over the next 10 years there will be a change in both business and consumer traffic profiles. We are already seeing the early stages of this with more businesses and consumers using large amounts of video content.
- The speed is of secondary concern to the confidence in the connection. Small to medium enterprise want to be confident that the connection will be there but also that it will be reliable and that it will provide a nationally competitive speed.
- As SMEs adopt new applications that are bandwidth intensive they will require faster speeds.
- SMEs need to be able to link outside of the region in a competitive speed.
- If a region does not have a competitive speed they will not be able to effectively compete with regions or metropolitan areas that do.
- The type of SME will more determine what type of applications they choose to use. Some SMEs may not fully understand the possibilities of a connection to the NBN and mainly use it for simple business management.

- The NBN will facilitate greater interaction between SMEs, free from speed, distance or cost restrictions.
- Retail service providers or application providers may themselves provide a bottleneck, which reduces the speed of their application or service.
- If we compare the technology and infrastructure of the present day to the past we can see that over the past ten years there has been an exponential growth in the speed requirements of telecommunications. From this we could easily surmise this trend will continue and thus SMEs will need faster Internet.
- We will see an evolution of technologies alongside the evolution of the NBN. As these higher bandwidth applications evolve, businesses will move to use them.
- The research by the ACMA suggests that SMEs are either unaware or have yet to imagine the possibilities of high-speed broadband for their particular business.
- SMEs may be reluctant to use high-speed broadband if they believe that their customer base does not have sufficient bandwidth to utilize such services.
- The NBN will enable new video collaboration paradigms enabling multi-party conferencing, practical remote diagnosis, true-colour transmission with reduced likelihood of jitter or other forms of service degradation.
- Remote conferencing will reduce the regional SMEs need to travel for meetings and so on.

These applications enumerated by the experts, were then condensed into the following general applications which were the peer-reviewed by the experts in the online survey see section 4.4.5.

- Real-time interactive collaboration.
- Real-time High Definition interactive video for training, Diagnosis and Conferencing.
- Newly evolving high bandwidth applications .
- Removal of geographical business limitations, such as communications.
- Reliable, Consistent, High Quality broadband service (reducing jitter, re-transmission times etc.).
- Cloud Computing and Software as a Service (SAAS).
- Teleworking.
- Convergence of Technologies.

In addition, the experts throughout round one enumerated these limiting factors. They were then condensed into the following general factors which were the peer-reviewed by the experts in the online survey see section 4.4.5

- SME's Security and Privacy Concerns
- Type of SME (For example sector or age of owners)

- Long delays in transitioning from one Retail Service Provider (RSP) to another ("Churning")
- SMEs waiting for customer adoption of High Speed Broadband
- Individual SME's lack of technological vision.
- Individual SME's lack of understanding of the technologies.
- Uncompetitive pricing amongst RSPs

4.3.3.2 Question Eight

Question eight attempts to determine the timeframe in which we will see a measurable increase in productivity as a result of the NBN. To this end the experts were asked the following question *"How many years do you think that it will take for us to see the NBN's effect on productivity in regional SMEs ?"*

The following time frames were given in response to the question: -

- We will see two main trends. Firstly, in areas where there is currently poor Internet connectivity (dial up, ADSL1) the NBN will have an immediate impact on the productivity of those businesses providing parity with metropolitan areas. This is sensitive to the deployment schedule of the NBN. The second trend will occur towards the end of the NBN rollout where productivity may begin to become visible (about eight years). This will follow a general trend of experimentation in the first few years.
- This will be a gradual process, which will take between five and ten years to see reflected in the statistics.
- We will see this occur within five years.
- This will largely depend on the business model that the company uses. A model such as a we have for e-commerce, where a front-end a is accessible regardless of the location of the warehouse, will visibly effect the company's productivity in the short term because it is an established business model. The use of interactive video services and other emerging high bandwidth applications may take a much longer time to have an effect on productivity. This is largely due to their emerging nature and lack of standardization. On a national level however we should be able to see measurable productivity within four to five years.
- We may see some individual short-term cases (particularly surrounding e-commerce), the broader national picture will only be visible in the long term.
- This will largely depend on the sector. Different sectors will have different take up times. For example, the transport sector may take five to six years and the retail sector two to three years and so on.
- We may never see a perceptible change as the productivity benefits will continue to support the "historic growth" in productivity. The failure to invest would show a plateau and decline in productivity by contrast.
- Times will vary, four to five years sounds right. At this point the NBN will be half to three quarters complete. It will also be effected by the take-up of NBN.

- This will depend on the sector, the application and the business. There will be strong growth in some small active companies in the short term especially with "bolt on" solutions, however other regional SMEs may have different generational make up, skills and work culture. In addition there are also slow sectors. In some cases it will take up to 30 or 40 years for the culture and work practices of particular sectors of businesses to change and adopt NBN-related technology and thus improve their productivity.
- The full productivity effects of the NBN cannot be realized until everyone is connected to the network. This network externality gives a value and will help to increase productivity on a national level. The productivity of an individual business or user will increase immediately they are connected to the network.
- The adoption speeds of technology are getting shorter and shorter. It is reasonable to assume that the take-up of the technology will be very quick and the productivity effects will soon follow.
- The NBN will take approximately 5 years for large-scale take-up. However it should be noted that the speed of technology adoption is increasing.
- The timeframe is hard to lock down because, while the rollout will take 8 to 10 years to complete, certain regional areas will be rolled out first. So once the NBN is in a region, it will probably take between three and five years to see a productivity increase, although this could be longer as a result of application lag. In terms of national economy, it will take longer and would have to be measured against a counterfactual case.
- We will not see the productivity benefits at a national level until well after the completion of the roll-out phase. While there will of course be some short-term examples such as cottage industries selling to international markets, the take-up will be relatively slow. It is because people take up services as they see the benefits to themselves, so until relevant applications are available for regional small to medium enterprise they are unlikely to take it up. An exception to this may be specific vertical industries such as health where take-up of the NBN to increase productivity is driven by specific outcome.

4.3.4 Supplementary Political Questions

The following questions were developed in response to recent developments in the political situation surrounding the National Broadband Network (see section 6.3.2). In answering these questions the experts were giving only their personal opinion and not the opinion of their employer or organization. There was no obligation for experts to provide an answer to these questions.

4.3.4.1 Question Nine

This question was designed to determine the importance of the Telstra/NBN Co. financial heads of agreement for the take-up and subsequent productivity of regional SMEs. The question was as follows *"Do you think that the Telstra – NBN Co. financial heads of agreement, will have a significant effect on the speed of NBN take-up, and will this have a significant impact on productivity?"*

This question is one of three that reached consensus during the interview stage. Of the thirteen experts interviewed nine chose to answer the question (without qualification). Of the remaining nine, eight (89%) agreed that the Telstra-NBN Co. agreement would have a significant impact on the take-up and productivity of the NBN. The main reason for this was that it will allow a quick transition from and decommission of the existing copper CAN. In addition it will move more subscribers on to the NBN increasing the network's value. Other highlighted benefits of these included reductions in build issues (through access to ducts).

Several other comments were made by experts in the form of proviso statements of their agreement. The first was that while it is important that Telstra participate and has an indirect positive effect on the network, it was not essential for the successful implementation of the NBN, as the government could clearly overbuild Telstra's network. The second comment was that the impact of the heads of agreement would depend on the individual customer's current platform and business type.

A single dissent was recorded, which suggested that the productivity would be based on applications and if there were no perceivable benefits or value to the users as a result of moving to the NBN infrastructure, there would be no advantage.

4.3.4.2 Question Ten

The following question was devised during the 2010 Federal Election campaign to gauge the relative merits of either major party's is broadband policy in regards to the productivity and growth of regional small to medium enterprise. The question put to the experts was *"Do you believe that the Liberal-National coalition's plan released during the 2010 Federal Election would have provided the same levels of productivity as the proposed NBN?"*

There's question was answered by all except one expert. The response to this question was a resounding and unanimous "no". In some cases experts passionately described the "alternative" plan as "dishonest", "setting us back in five years", "laughable", "a Band-Aid solution", "a waste of money in the long term", "lacking vision" and "not a viable alternative". It should be noted that amongst colourful expressions some more substantive points were made.

1. Wireless has technical limitations, which limit its suitability.
    a. Comparatively low bandwidth over long distances.
    b. It is a shared medium, which degrades with increasing number of users.
    c. The wireless spectrum is limited.
2. Wireless is a complementary rather than an opposing technology to fibre optics.
3. Neither major political party has a full understanding of the Technology.
    a. The Labor Party has a vision and strategy for an information economy.
    b. The Liberal Party is perpetuating a failed telecommunications model.

4.3.5 Conclusion

With the exception of questions six, nine and ten, which already have provided a consensus of opinion, it is necessary to peer review the individual contributions of each of the experts interviewed. From the information collected in the first round, generalizations of the responses were used to develop the questionnaire which is explained along with its results in section 4.4.

4.4 Round Two: Online Survey

The first round of the study took the form of an online survey Twenty-one questions to peer-review the general trends found during the round one interviews. This survey used a mixture of Likert-Scale and Multiple Choice questions to collect quantifiable results about the trends. The order of answers were randomized to remove possible issues of bias, and open-ended questions were provided at the end of each section for the experts to provide additional information or make comments.

4.4.1 Effects of the NBN on Productivity.

4.4.1.1 Question One

> *"The following effects of the NBN on Regional SMEs were generalised from data collected during interviews. Please rank the likelihood of each of these effects on the productivity of Regional SME's. The NBN will:- "*

This question provided the experts with eight effects that were generalized from the effects given by them during the first phase of the research. The result for each factor is given below.

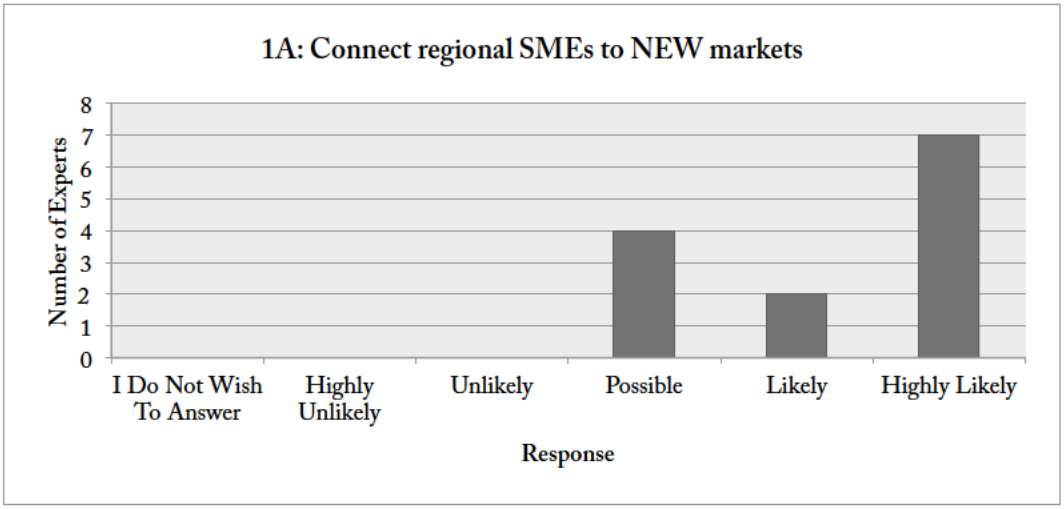

Figure 1:Response to Question 1 A

In response to Question 1 A, there was a consensus reached that the NBN will enable be likely the connection of regional SME's to new markets, with the majority of the experts indicating that this would be highly likely. All thirteen experts answered this question, and there was a median of 5 (Highly Likely).

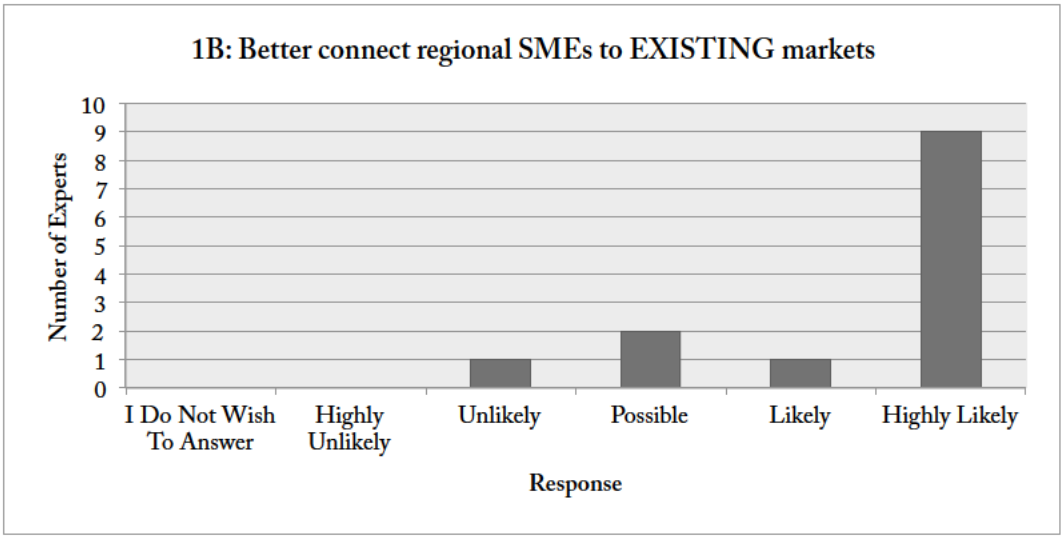

Figure 2: Response to Question 1 B

In response to Question 1 B, a strong consensus was formed. The experts agreed that the NBN will better connect regional SMEs to existing markets was highly likely. All thirteen experts responded to this question and a median of 5 was recorded.

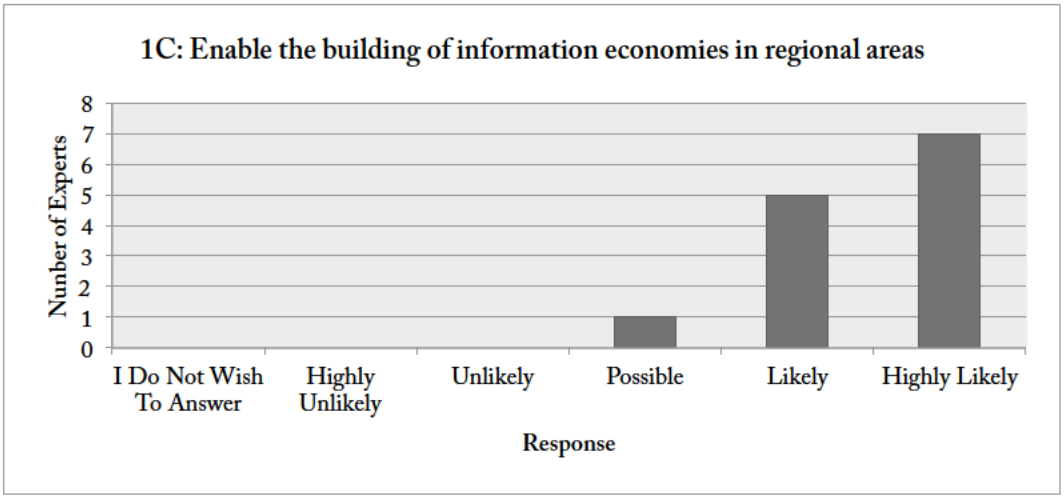

Figure 3: Response to Question 1 C

In response to Question 1 C, there was a consensus formed, with all thirteen experts contributing responses and having a median value of 5. Ninety-two percent of experts responding to this question indicated that it was likely that the NBN would enable the building of information economies in regional areas, with the majority responses suggesting that this is highly likely.

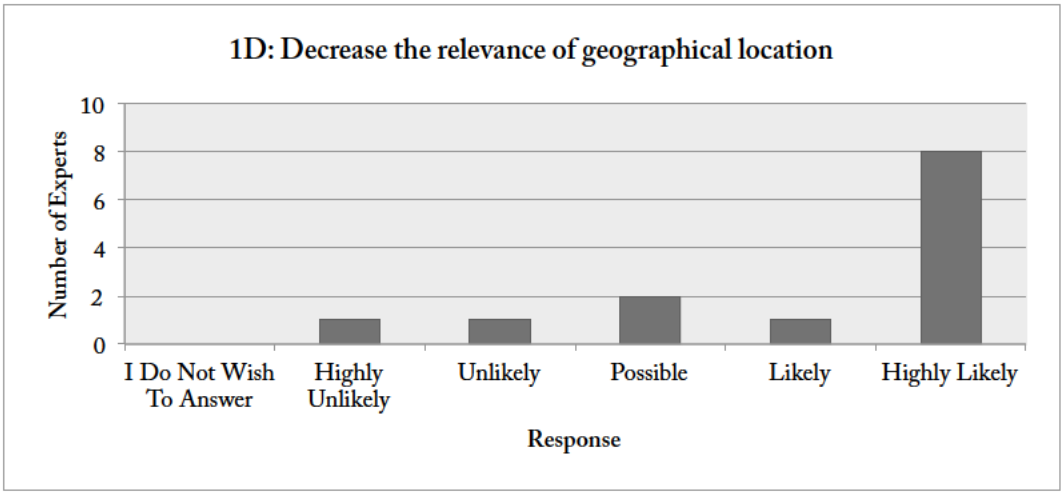

Figure 4: Response to Question 1 D

While a consensus was formed in response to this question, it was not strong. All thirteen experts responded to this question attaining a median value of 5 and a comparatively high standard deviation value of 1.38. The consensus reached was that the NBN was likely to decrease the relevance of geographical location. The majority of the experts also agreed that this effect was highly likely to occur.

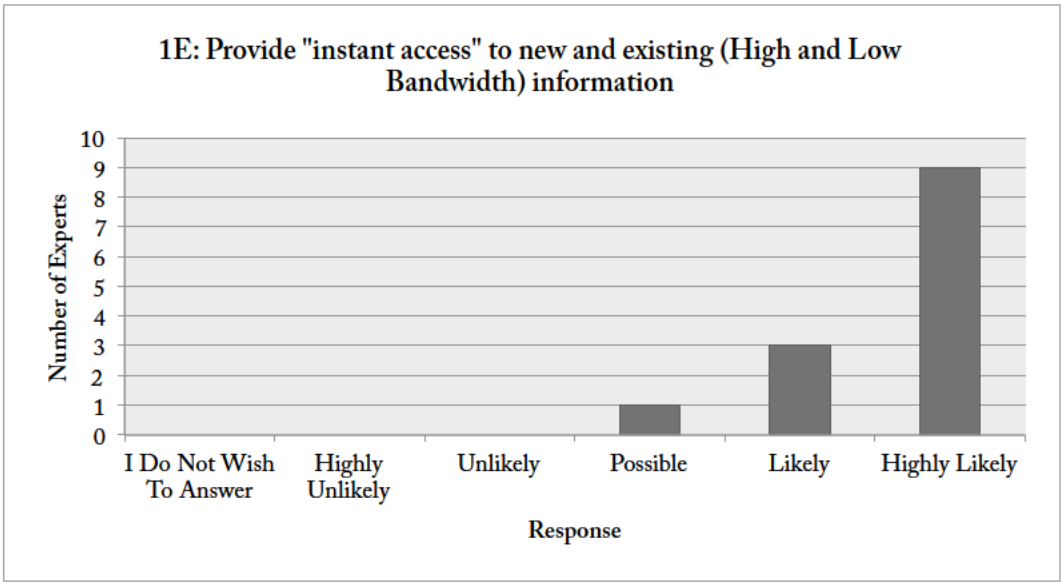

Figure 5: Response to Question 1 E

Figure 5 shows that a strong consensus was formed in relation to this effect. Twelve of the thirteen (Approximately 90%) experts suggested that the NBN was likely to provide "instant access" to new and existing (High and Low Bandwidth) information. In addition approximately 70% of the experts suggested that this was highly likely, leading to additional level of consensus on this point. The median value for this effect was 5.

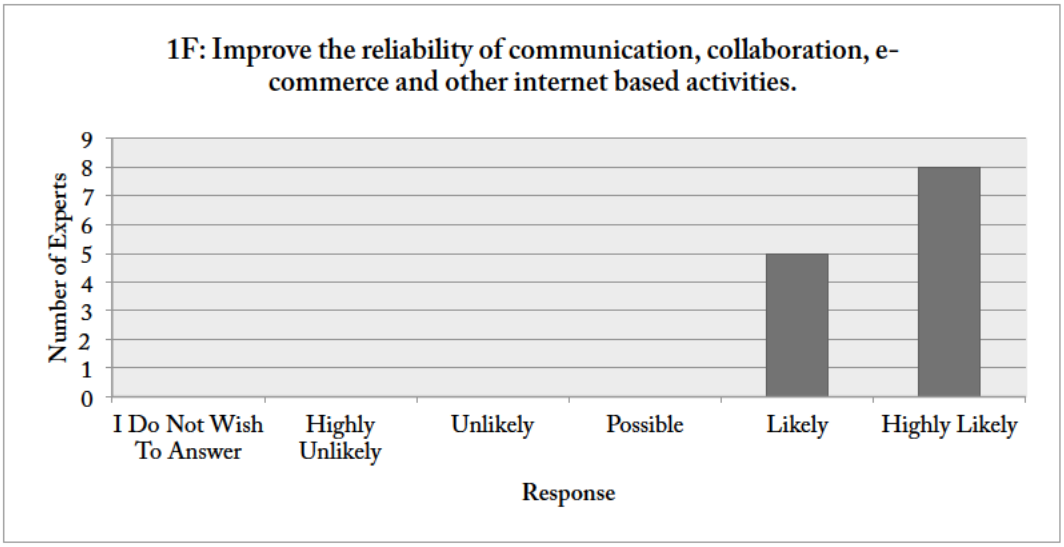

Figure 6: Response to Question 1 F

The experts formed the consensus that the NBN was likely to improve the reliability of communication, collaboration, e-commerce and other Internet based activities. Of the thirteen experts, the majority suggested that this was in fact Highly Likely. The median value for this response was 5.

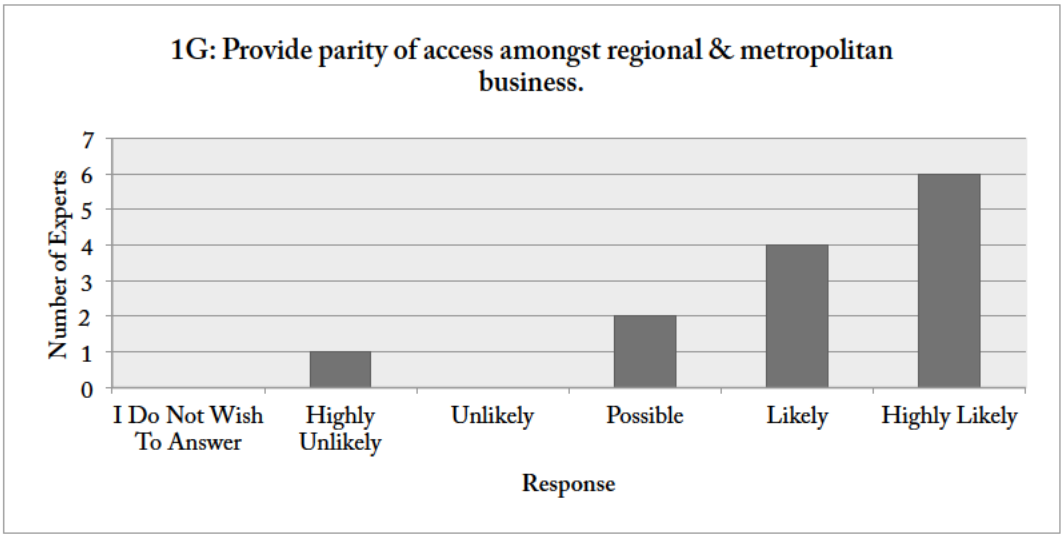

Figure 7: Response to Question 1 G

A consensus was formed amongst the experts was that it was likely that the NBN would provide parity of access amongst regional & metropolitan business. All thirteen experts answered this question. The median value of this was four (likely) and a comparatively high standard deviation of 1.39 recorded.

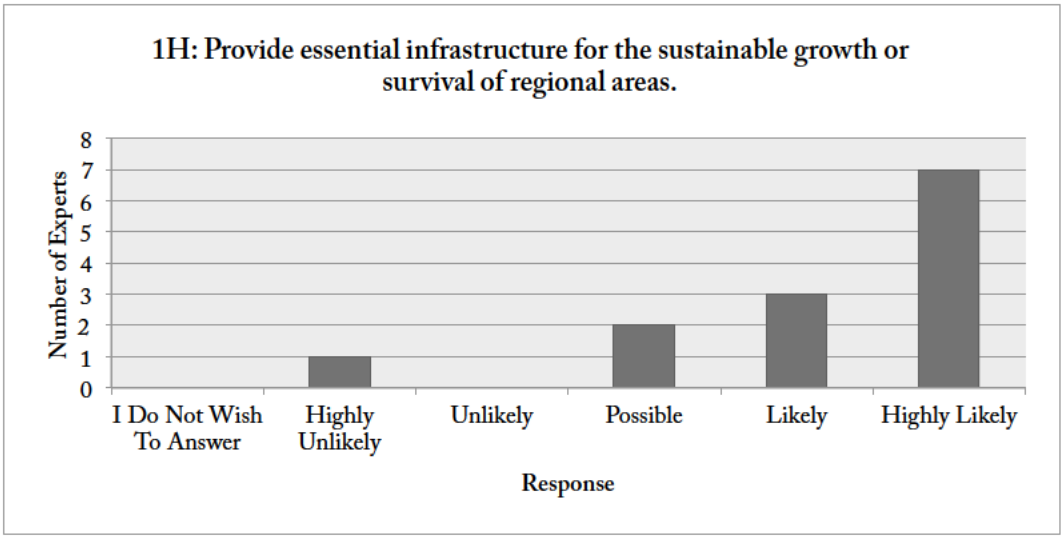

Figure 8: Response to Question 1 H

Figure 8 shows the consensus that has been formed in response to Question 1 H. All thirteen experts responded to this question and a median value of 5 recorded. The consensus was that that the NBN is likely to provide essential infrastructure for the sustainable growth or survival of regional areas, however the majority of respondents stated that the effect was highly likely.

4.4.1.2 Question Two

> *Do you believe that the effect of the NBN on the productivity of a regional SME will depend on the type of regional SME?*

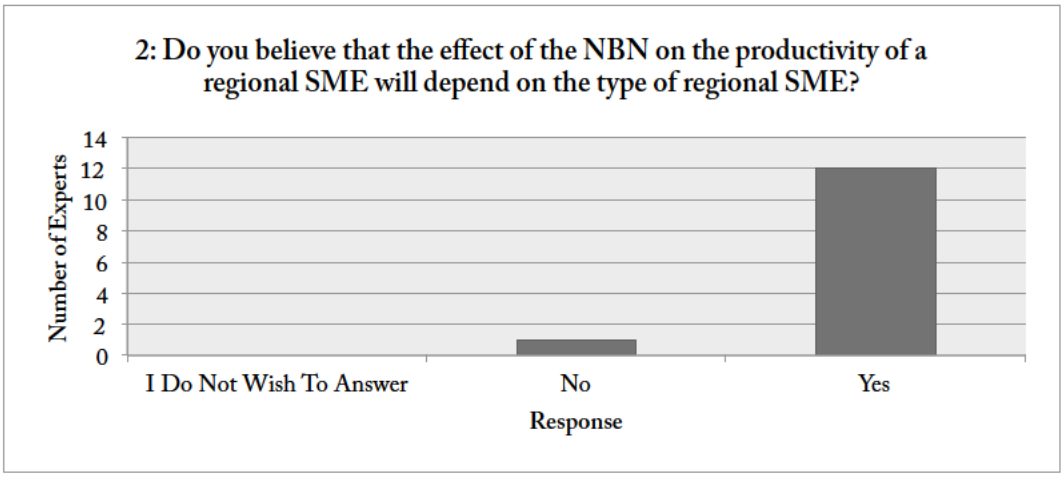

Figure 9: Response to Question 2

A clear and strong consensus was reached in this question, twelve of the thirteen experts believed that the type of regional SME would affect the NBN ability to effect the productivity of a regional SME. The median value for this question was 2 (Yes).

4.4.1.3 *Question 3 Do you believe that the NBN will bring regional SMEs into competition with metropolitan and global companies, and will that have a positive, negative or neutral effect on their productivity?*

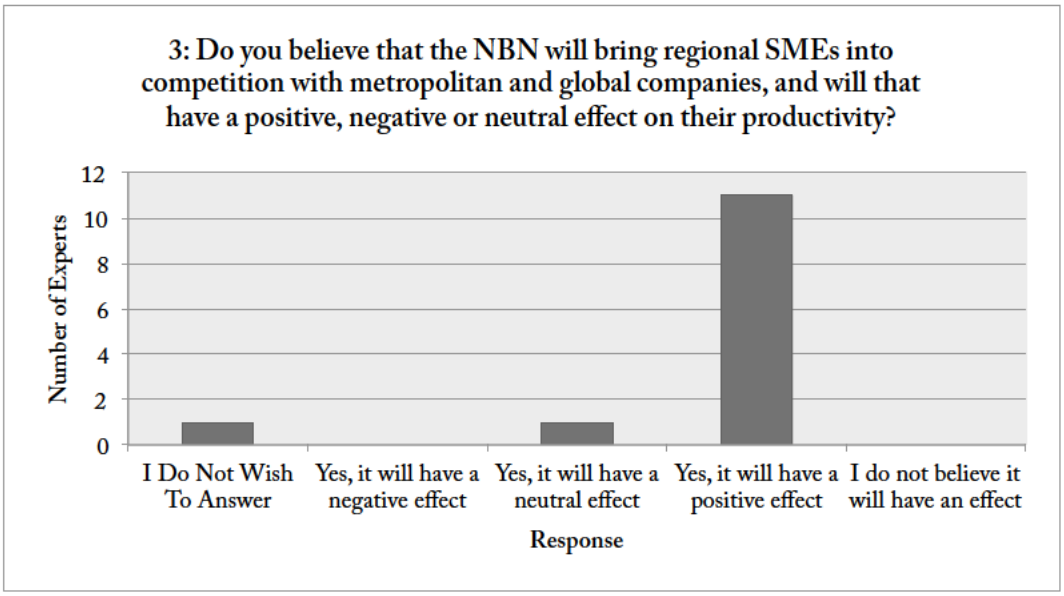

Figure 10: Response to Question 3

Of the population of thirteen experts only twelve of the experts chose to give an answer, with one selecting "I Do Not Wish To Answer". Of the remaining experts, eleven formed the consensus that the NBN will bring regional SMEs into competition with metropolitan and global companies, and this will have a positive effect on their productivity. The median value for this question was 3 (Yes, it will have a positive effect).

4.4.1.4 *Question 4*

Please write any further comments you wish to make about the effect of the NBN on regional SMEs in the space provided.

Of the population of thirteen experts, five chose to complete this optional question. The following values were reported.

Response No.	Response
1	Regional SME's will ~~be the~~[sic] enjoy a step change as a result of the NBN. The NBN alone will not achieve this ~~achieve~~[sic]. It will require innovation, ~~now~~ [new] business models and new applications for the benefits to be fully realised.
2	The impact of the NBN on SMEs will depend upon the industry in which the SME operates. For example, industries in which global "on the spot" pricing information is important will likely see a significant impact arising ~~form~~ [from] deployment of the NBN. However industries which are very localised (eg. local hairdresser) will see less or only marginal impact. This means that [the] regional SMEs that wish to leverage ~~from~~ the NBN may need to re-assess their business model and operations.
3	Obviously in the end it all depends on the SME itself. You can provide all the tools you want but if they are not used it won't have an effect.
4	The infrastructure is only the first step - work needs to be done on skills, policies, incentives and regulations to achieve the full benefits for SMEs
5	The success of the NBN in regional areas will only work if there is a clear demonstration around improving business process, transaction and operational activity within the particular business - to do this it is essential that end users are educated about this PLUS there is a need to provide access to specialists who can deliver business applications for the end user, within their particular industry. This is critical.

Table 5: Responses to Question 4

4.4.2 Contributing Factors on the NBN & Productivity

The next two questions focused on the factors that will contribute to an increase or decrease in the Productivity of a Regional SME.

4.4.2.1 Question 5

> *The following factors, relating to the provision of a High Speed Broadband Network such as the NBN were suggested as having a positive or negative impact on the growth and productivity of SMEs in Regional Areas.*
>
> *Please rate the significance of these factors (Please Note: Each of these factors is described in further detail at the bottom of the page).*

This question asked the experts to rate the significance of nine factors, generalized from the response given in question two of the round one interviews (see 4.3.1.2). The descriptions of these factors have been included as Appendix D The results for each of these factors detailed below.

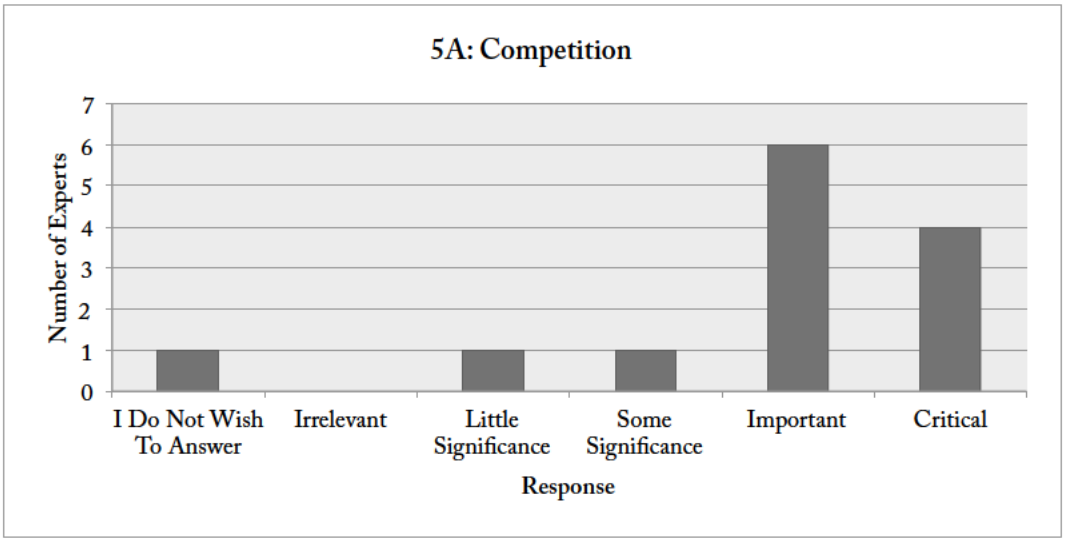

Figure 11: Response to Question 5 A

A consensus was formed amongst the experts that effective Competition and Competition Policy surrounding the NBN and the Retail Service Providers (RSPs) was important. In addition 30% of the experts suggested that this was critical. Of the thirteen experts, twelve chose to respond, with one expert electing not to answer. The median value of for this factor was 4 (Important).

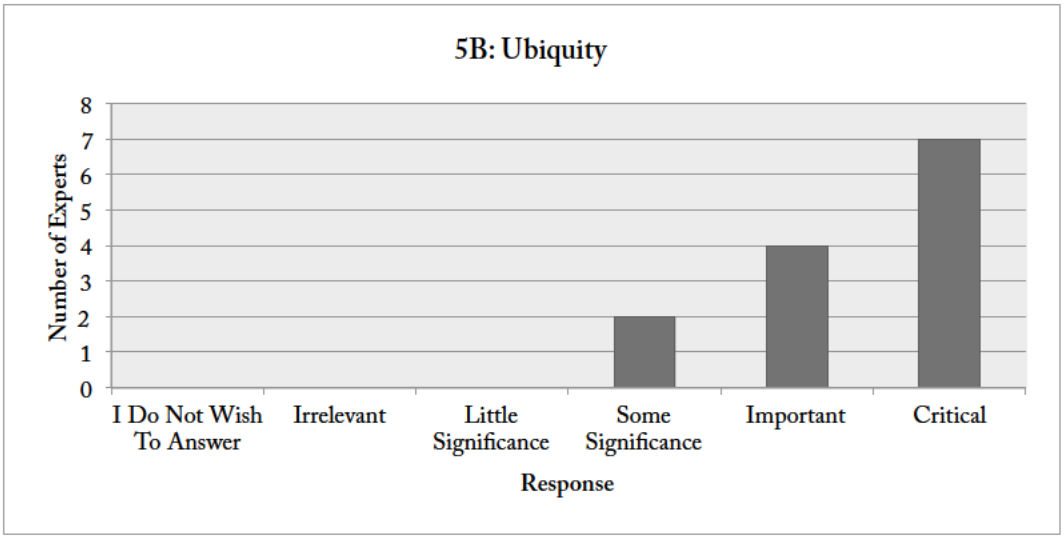

Figure 12: Response to Question 5 B

A consensus was reached that Ubiquity (i.e. the provision of an effective High Speed Broadband Network to 100% of the Australian Network) was an important factor. In addition the majority of experts suggested that it was critical. All thirteen experts responded to this question and the median value of this factor was 5.

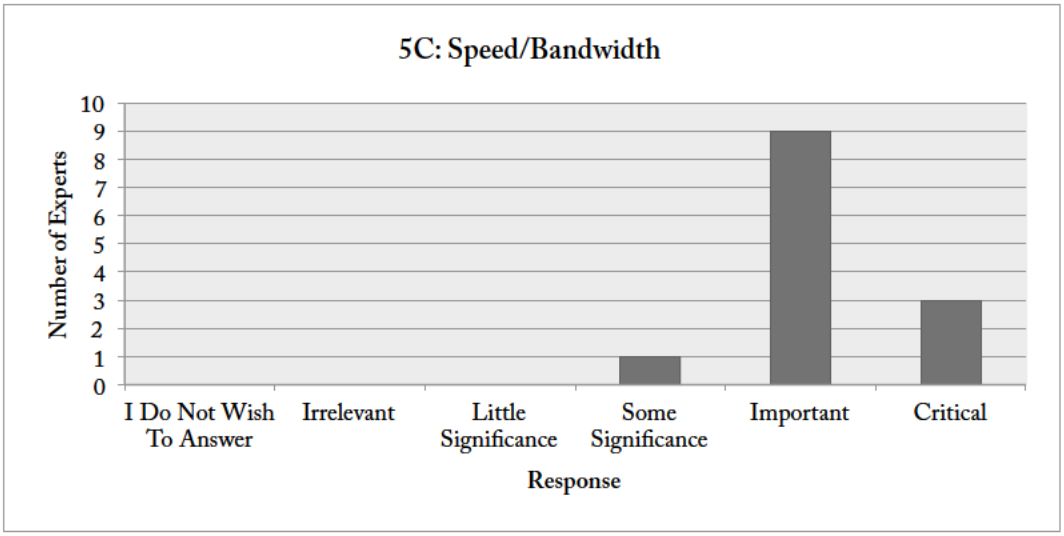

Figure 13: Response to Question 5 C

There is a strong consensus that Speed and Bandwidth (i.e. the provision of speeds between 12Mbps and 100Mbps) is important. In addition four experts suggested that this factor was in fact critical. The median value recorded for this factor was 4.

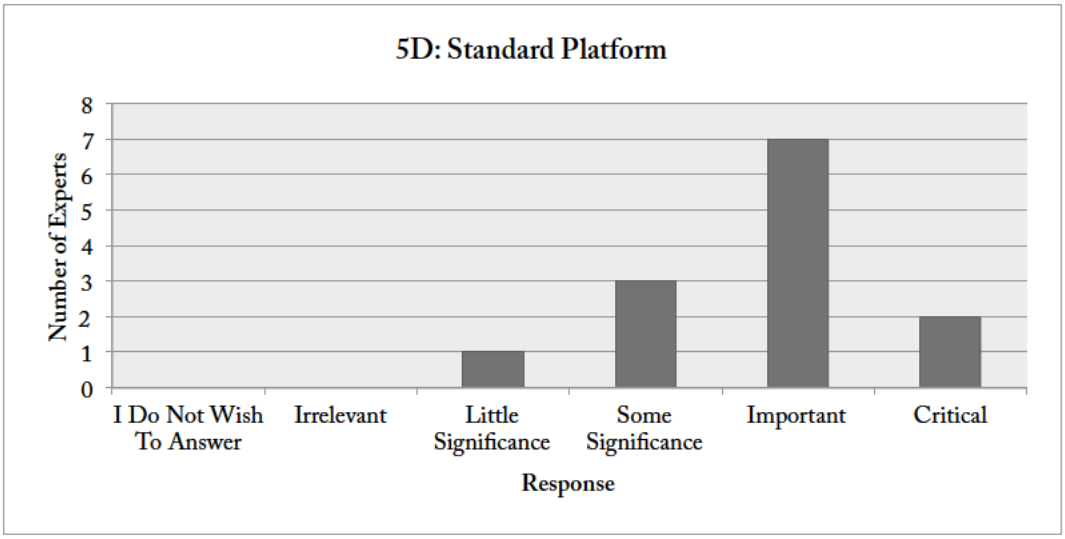

Figure 14: Response to Question 5 D

A consensus was formed among the experts who agreed that a standardized network, encompassing providing set speeds to set percentages of the population, without gradual service degradation based on distance, was important. All thirteen experts responded to this question and a median value of 4 was recorded.

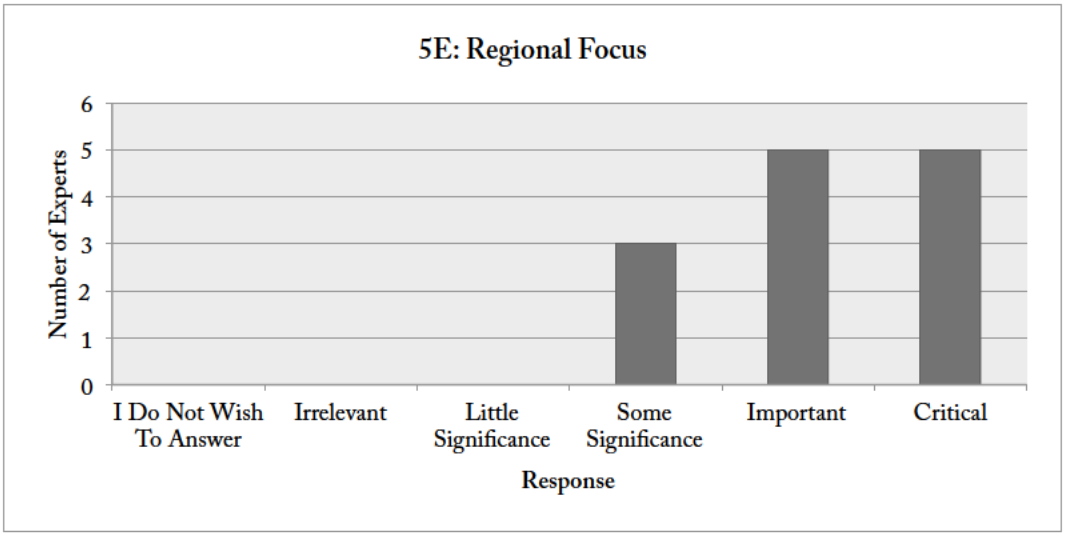

Figure 15: Response to Question 5 E

A consensus was formed amongst the experts that a regional focus (i.e. such as a preferential roll out to regional areas, equality of service and equity schemes to reduce the digital divide) was important. However it should be noted that while the median value recorded for this factor was four (Important) there was an equal split in between the experts who believed that it was important and those who believed that it was critical. All thirteen experts responded to this question.

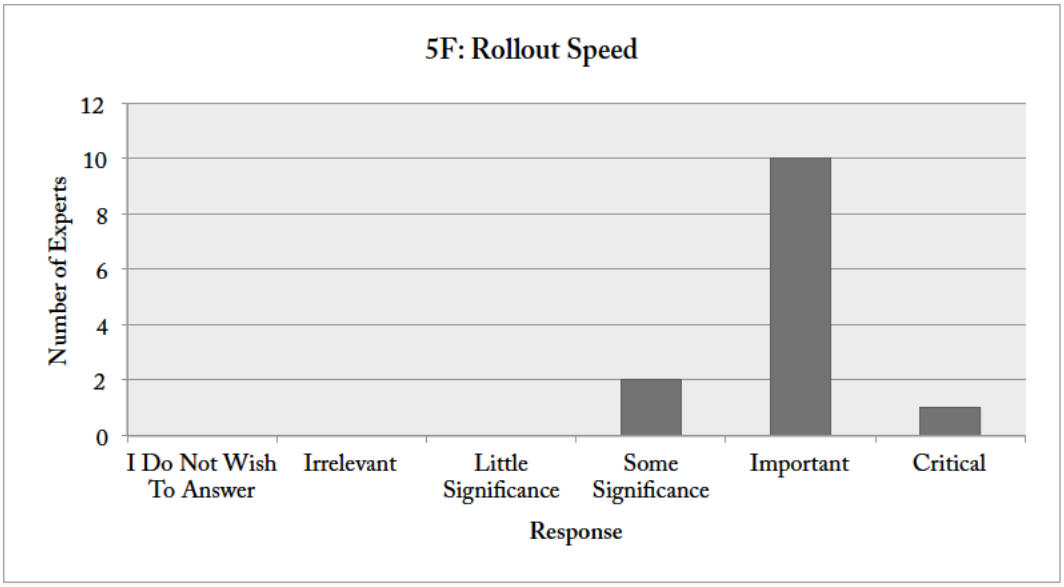

Figure 16: Response to Question 5 F

A strong consensus was formed in response to this factor, with the experts concluding that Rollout Speed was an important factor. All experts responded to this question and a median value of four was recorded.

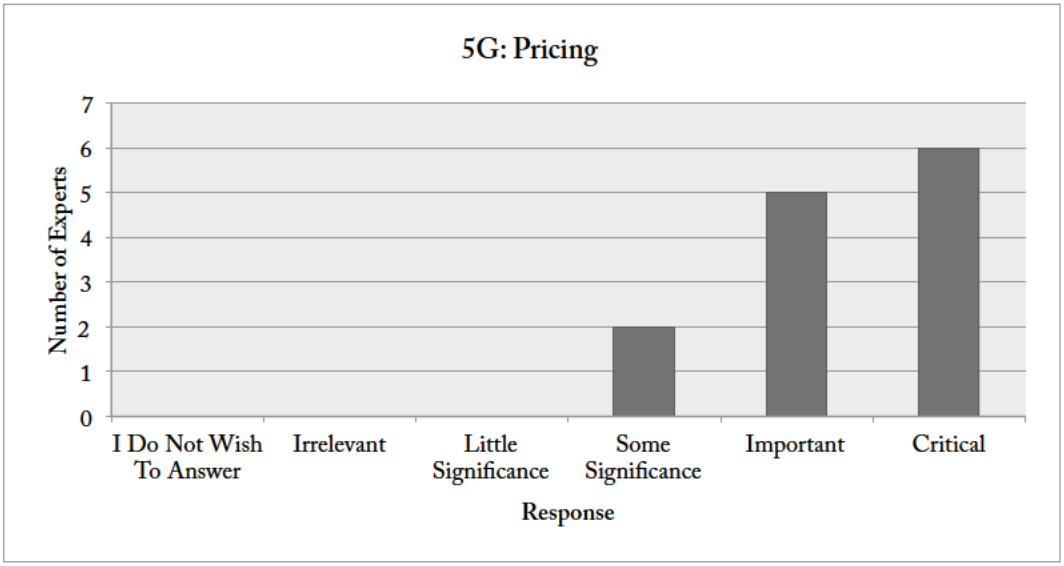

Figure 17: Response to Question 5 G

The experts came to the consensus that development of a reasonable pricing model, which is competitive, standardized and affordable is an important factor. It should be noted however that the highest scoring single response was that it was a critical factor. All thirteen experts responded to this question and a median value of 4 was recorded.

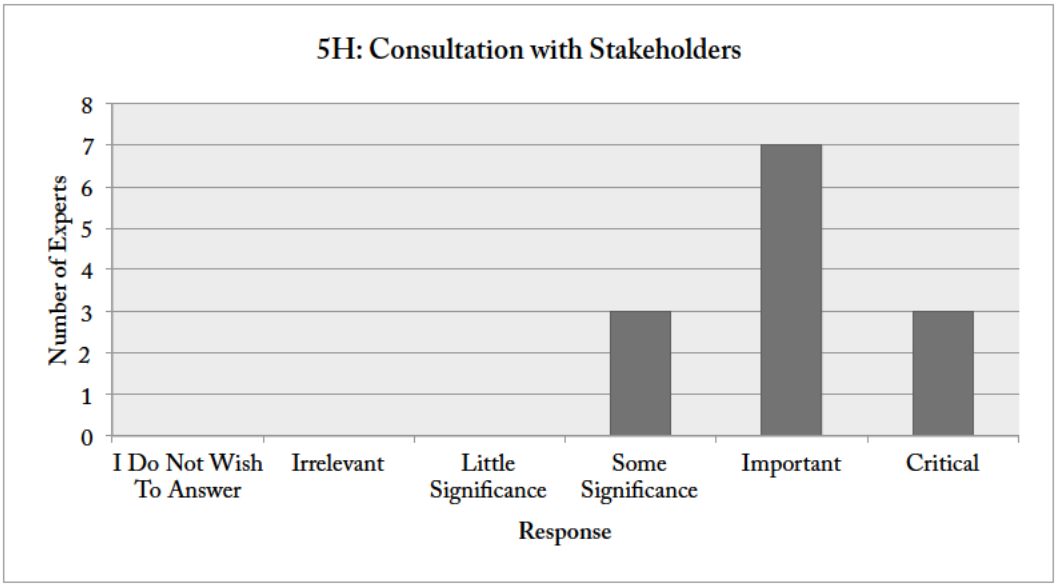

Figure 18: Response to Question 5 H

A consensus was formed that consultation with stakeholders was important. All experts responded to this question and a median value of four was recorded.

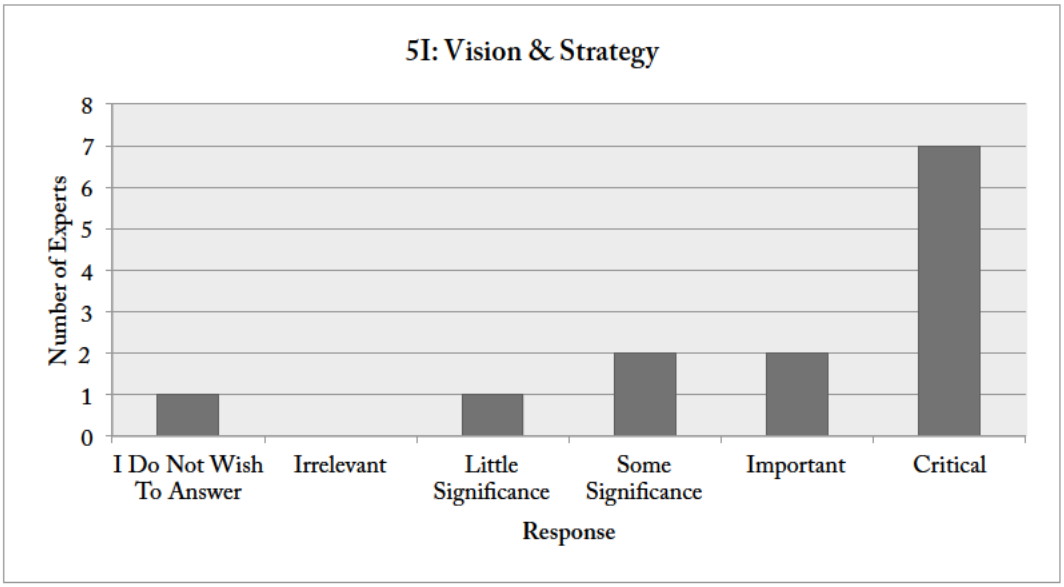

Figure 19: Response to Question 5 I

While the majority of experts agreed that an awareness of the NBN's vision and strategy is critical, it does not meet the requirements for consensus. However a consensus is formed when the result is generalized as important (with the required nine experts agreeing). The median value of five was recorded and one expert chose not to answer the question.

4.4.2.2 *Question 6*

Please write any further comments you wish to make about the factors relating to the provision of the NBN on regional SMEs in the space provided.

Of the population of thirteen experts, three chose to complete this optional question. The following values were reported.

Response No.	Response
1	Providing just a high speed network connection is not enough for regional SMEs to benefit from the NBN. Many years ago Telecom Australia did a broadband trial in Wollongong (called MACNET). The trial was a technical success but a communal failure because there was insufficient work done to educate the local population regarding the technology and its application. Similarly, for the NBN to be fully exploited by regional SMEs, local, state and federal governments will have to provide education and training for SMEs to appreciate what can be done via the NBN. Without this, it is likely the NBN will not provide regional SMEs with the improved efficiencies and business opportunities many proponents are currently claiming.
2	Price and ease of use will be key to take-up by SMEs
3	Ubiquity will be a challenge particularly for remote regional businesses. Alternative solutions should be sought for these businesses - eg Wireless Broadband Access.

Table 6: Responses to Question 6

4.4.3 Conditions Needed for Improving the NBN's Effect on Productivity

The next two questions focus on the conditions that need to be implemented to ensure that the NBN will have a positive impact on the growth and productivity of regional SMEs.

4.4.3.1 Question Seven

> *The following are suggested conditions that need to be in place to ensure that a High Speed Broadband Network such as the NBN will have a positive impact on the growth and productivity of SMEs in Regional Areas. Please rate them based on their significance.*

This question asked the experts to rate the significance of twelve conditions necessary for the success of the NBN, generalized from the response given in question three of the round one interviews (see 4.3.1.3). The results for each of these conditions are detailed below.

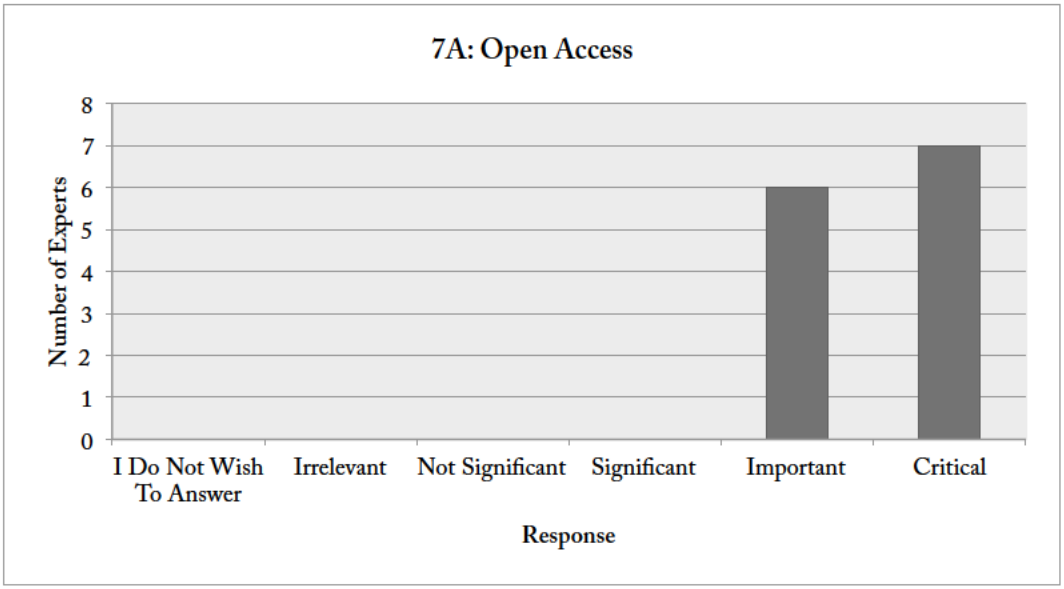

Figure 20: Response to Question 7 A

The consensus formed was that open access was a condition that was important to the success of the NBN. In addition the majority of experts stated that it was of critical importance. All thirteen experts answered this question and the median value recorded was 5.

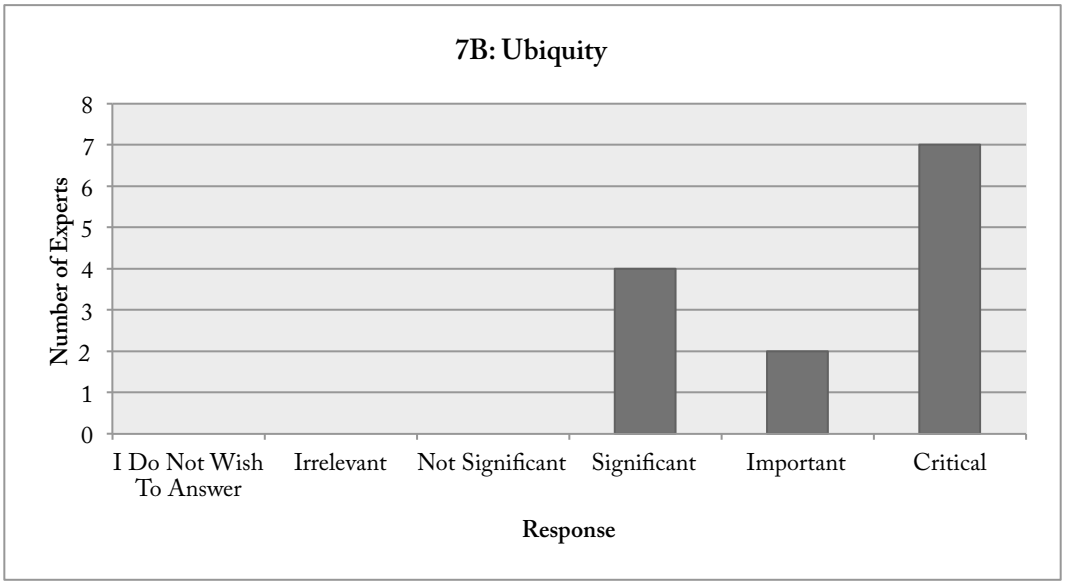

Figure 21: Response to Question 7 B

The expert consensus on the question of Ubiquity was that it was important. It should be noted that the majority of respondents indicated that they believe that ubiquity is critical. The median value recorded was five (Critical) and all thirteen experts answered this question.

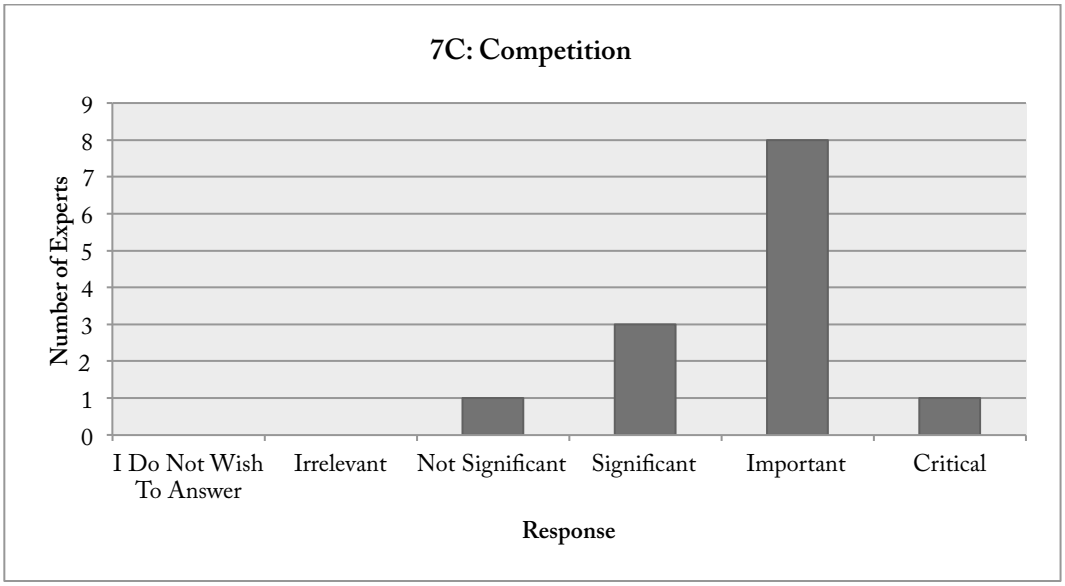

Figure 22: Response to Question 7 C

Reaction to question of competition was mixed, however a consensus was reached with experts suggesting that competition was important. All thirteen experts responded to this question and the median value was recorded as 4 (Important).

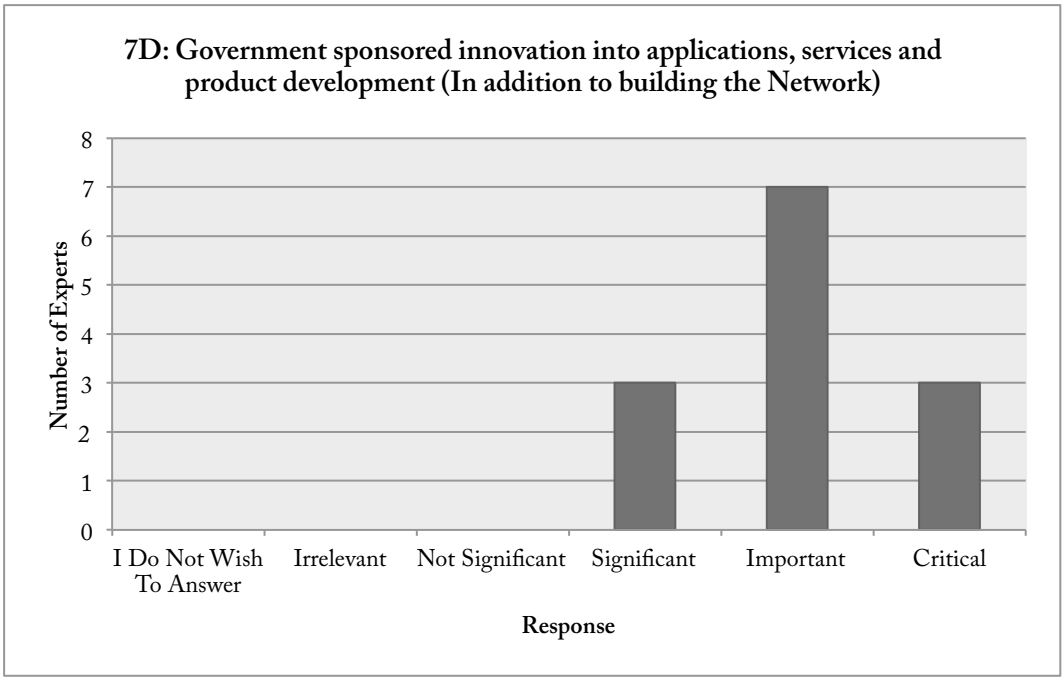

Figure 23: Response to Question 7 D

The expert consensus surrounding the issue of Government sponsored innovation was that it was Important. All thirteen experts participated in answering this question and a median value of four was collected.

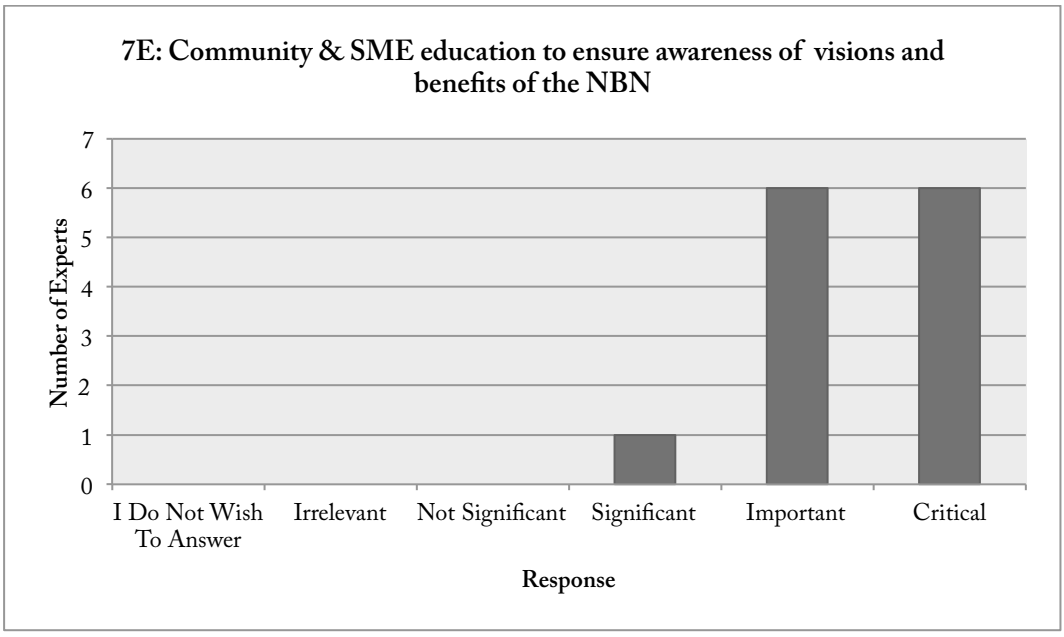

Figure 24: Response to Question 7 E

The expert consensus surrounding the issue of Community & SME education to ensure awareness of visions and benefits of the NBN was that it was important. However it should also be noted that a significant number of experts regarded it as critical. All experts responded to this question and the median value was 4.

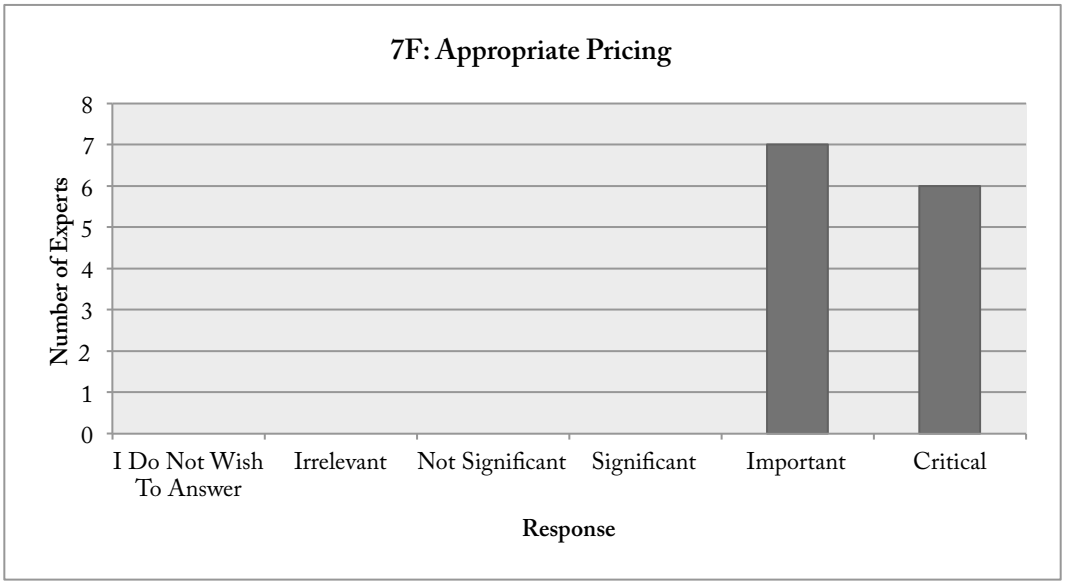

Figure 25: Response to Question 7 F

The consensus gathered from this response is that appropriate pricing is important. It should also be noted that a significant number of the respondents also believed that this was critical. All experts participated in responding to this question and the median value recorded was 4 (important).

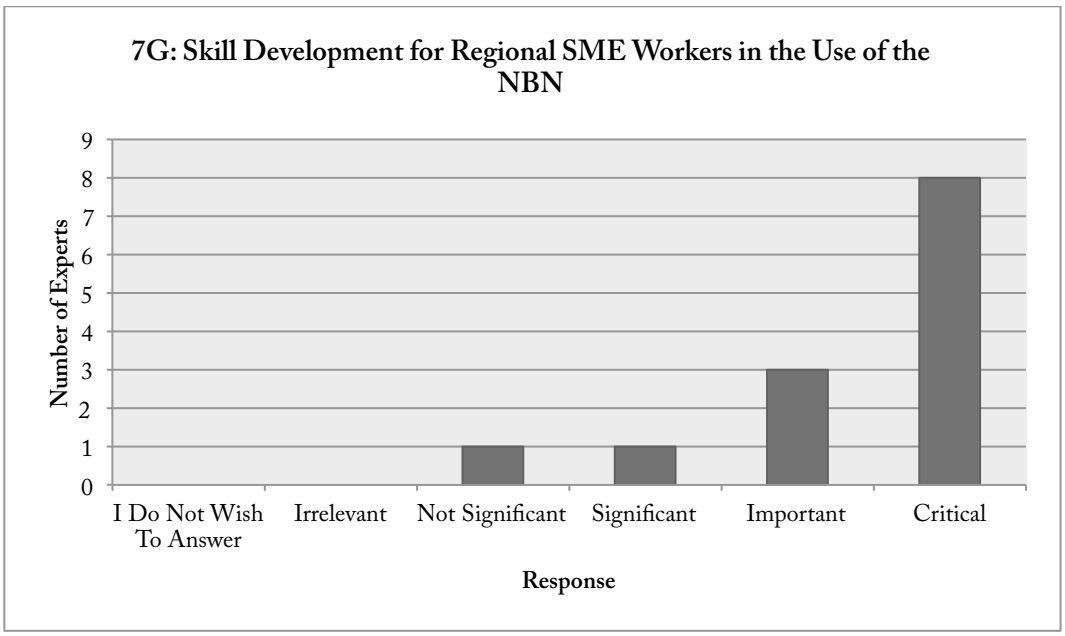

Figure 26: Response to Question 7 G

The consensus formed in response to this question is that Skill Development for Regional SME Workers in the use of the NBN is important, however the majority of experts have categorized it as critical. The median value for this condition is 5 and all thirteen experts participated.

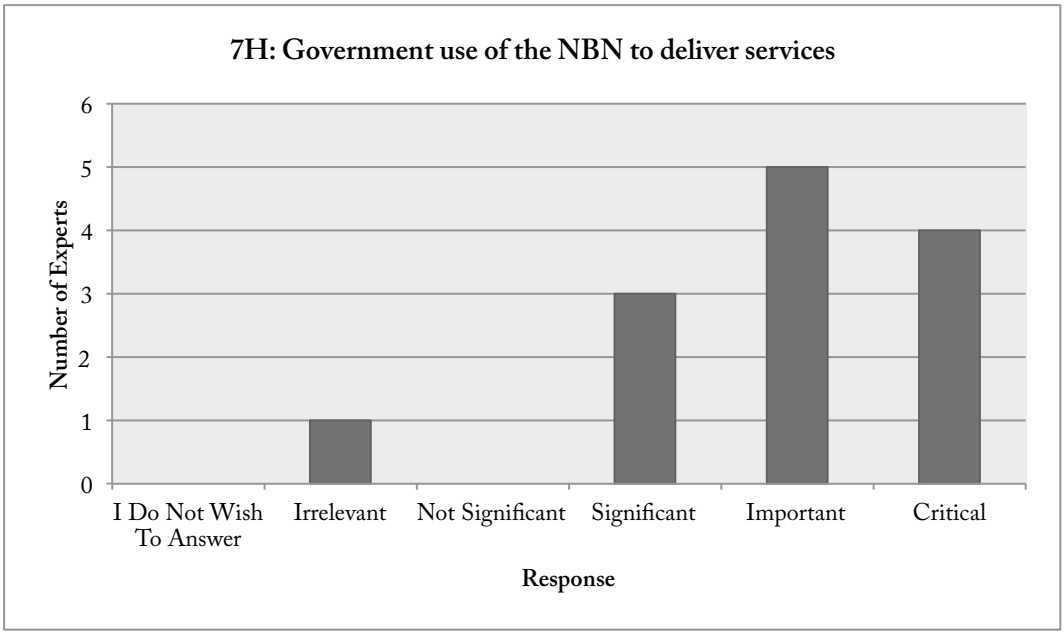

Figure 27: Response to Question 7 H

The experts developed the consensus that Government use of the NBN to deliver services was important to increasing the productivity of regional SMEs. All experts responded to this question and a median value of 4 was collected.

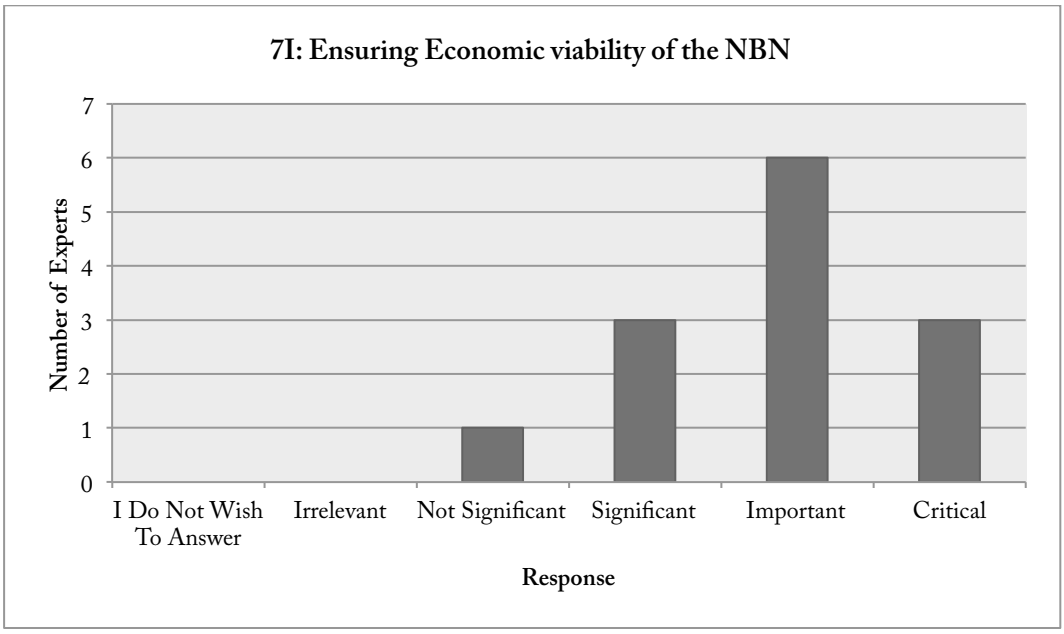

Figure 28: Response to Question 7 I

The consensus formed was that ensuring economic viability was a condition that was important to the success of the NBN. All thirteen experts answered this question and the median value recorded was 4.

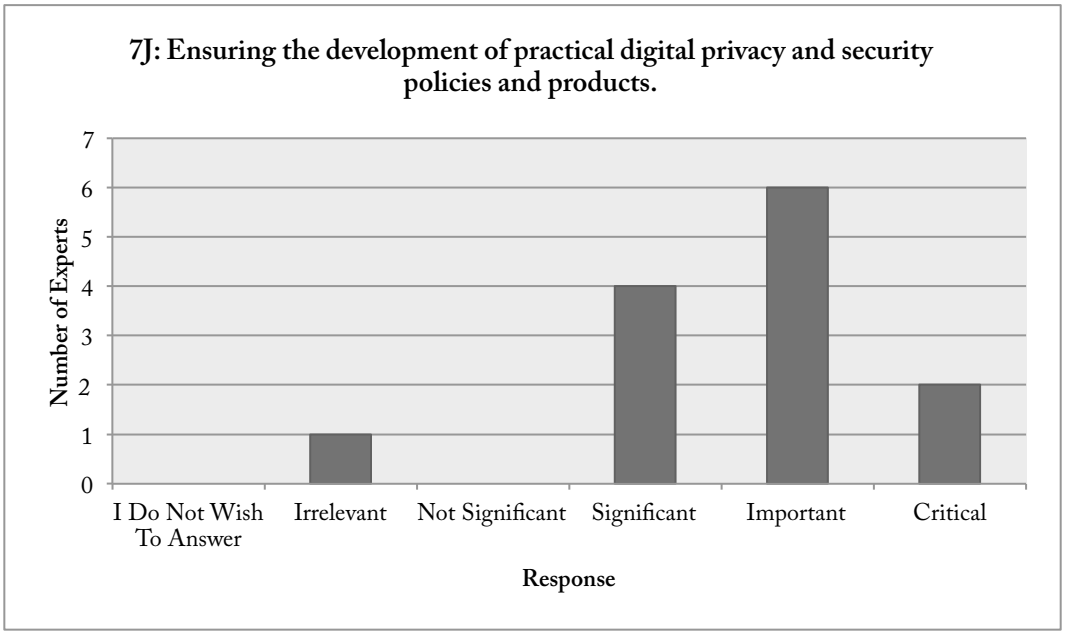

Figure 29: Response to Question 7 J

A consensus was formed that ensuring the development of practical digital privacy and security policies and products was significant. The median value recorded was 4 and all participants answered this question.

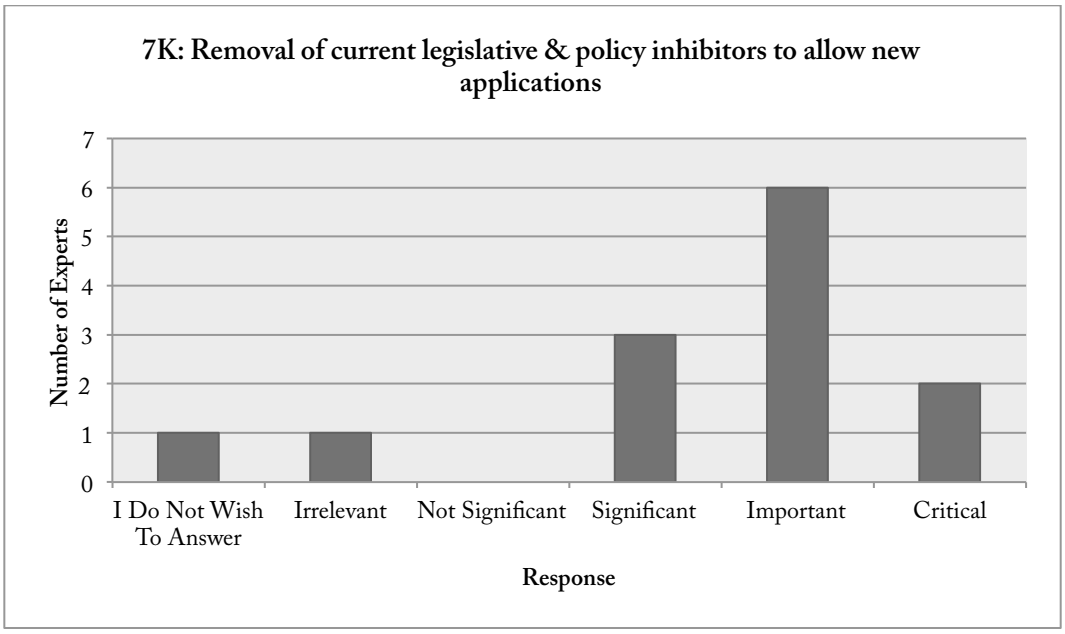

Figure 30: Response to Question 7 K

Only 12 responses were collected in answer to this question, with one expert electing not to answer the question. The experts came to a consensus that the removal of current legislation and policy inhibitors to allow new applications was a significant condition that needed to be met. The median value collected through this question was 4.

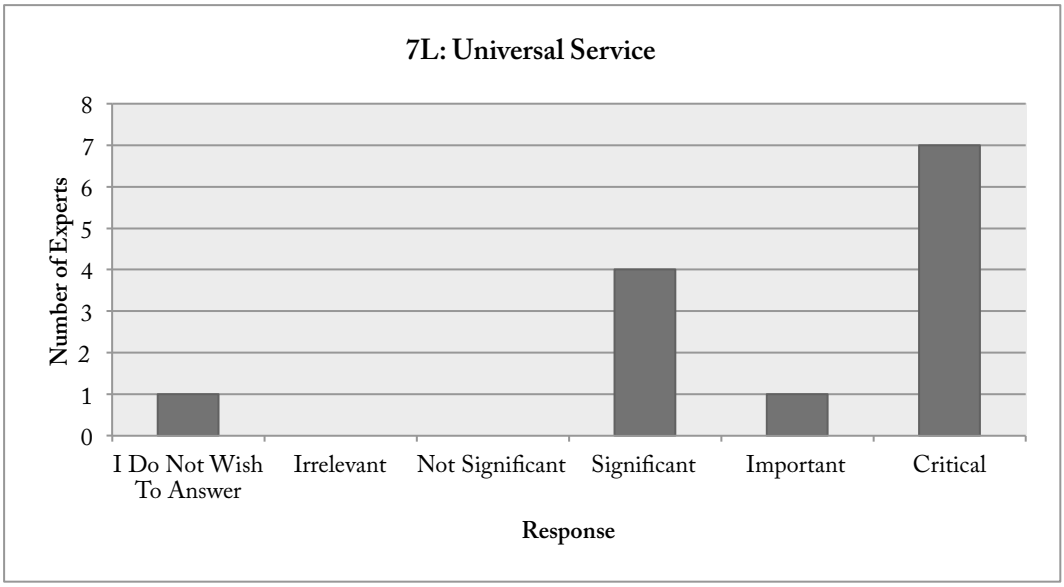

Figure 31: Response to Question 7 L

As can be seen from Figure 31, one expert did not wish to answer and has therefore been excluded from the consensus process in this question. The remaining experts have formed the consensus that universal service is a significant condition that needs to be in place to ensure the productivity and growth of regional SMEs. The median value of 5 reinforces the fact that the majority of experts suggested that this is in fact a critical factor.

4.4.3.2 Question Eight

> *Please write any further comments you wish to make about the conditions needed to complement the NBN to ensure its success for regional SMEs in the space provided.*

Of the population of thirteen experts, two chose to complete this optional question. The following values were reported.

Response No.	Response
1	Some same as above[1] it will be the real entrepeurs who will spurt ahead, laggers might need more advice, training and hand holding.
2	A key challenge will be to deliver a solution that is affordable by regional SMEs, yet allows the government to maintain a world class broadband network - the maintenance ~~of~~ [and] upgrade of the network is equally as important as the roll-out. If the government is not careful in managing the operational expenditure of the network, then Australian tax payers [will be] at risk of paying for the network on an ongoing basis, which will be a disaster.

Table 7: Responses to Question 8

[1] See Question 6 Response 1 – Section 4.4.2.2

4.4.4 The Productivity Paradox

The next eight questions focus on the productivity paradox and how it is likely to effect the possible productivity benefits delivered by the national broadband network to small to medium enterprises in regional areas. In addition to the questions below respondents were given a definition of the productivity paradox, which is included in Appendix D .

4.4.4.1 Question Nine

Will we have a situation with the NBN where we will spend the money on the NBN and be unable to see the benefits reflected in the productivity statistics?

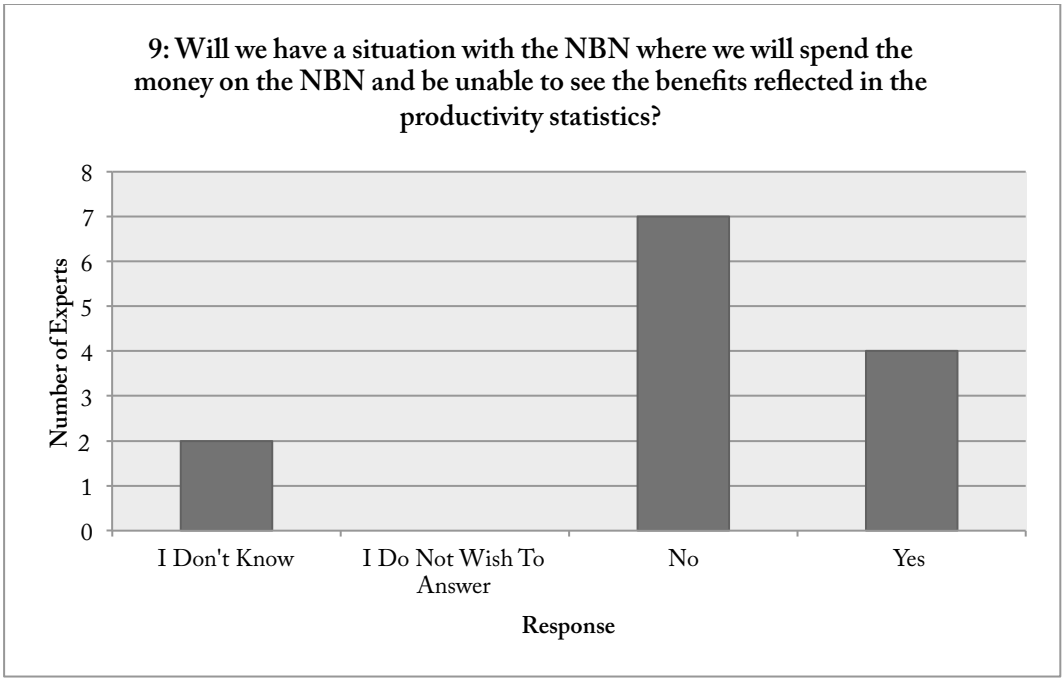

Figure 32: Response to Question 9

Unfortunately this question was not able to form a consensus amongst the experts. The majority (approximately 53%) of experts indicated that this was not likely to occur. All 13 experts contributed to this question and the median value was 1 (no).

4.4.4.2 Question Ten

> *At least one expert disagreed with the idea of the productivity paradox, suggesting that productivity would not have continued its historical growth levels if it had not been for the underlying telecommunications technology. Do you agree or disagree with this argument?*

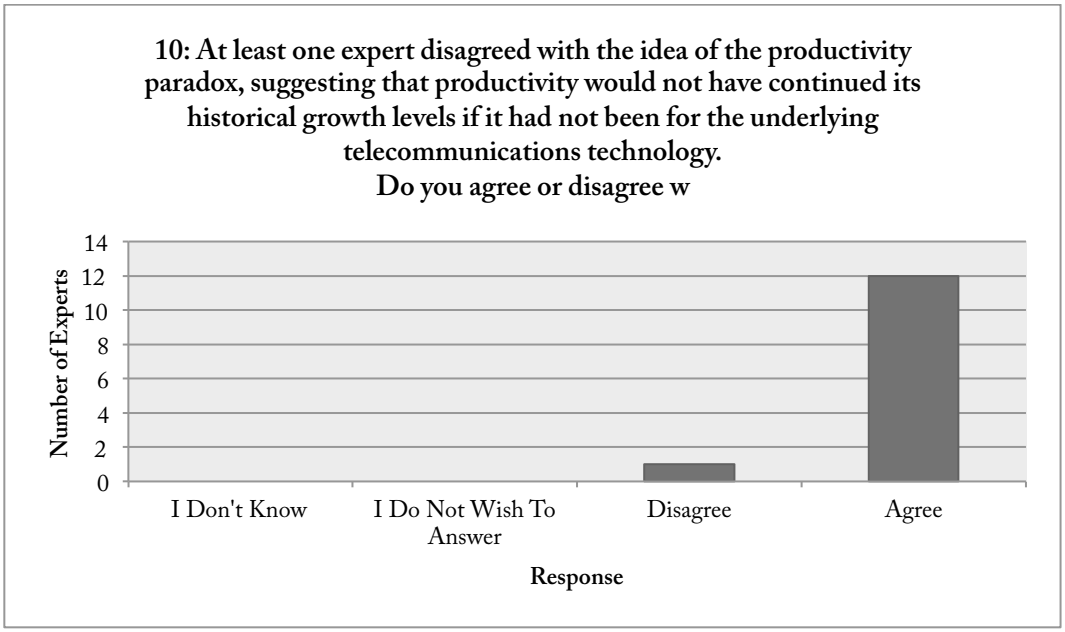

Figure 33: Response to Question 10

Approximately 92% of experts agreed that productivity would not have continued its historical growth levels if it had not been for the underlying technology. This is a clear consensus. All 13 participants answered this question and the median value of 2 (agree) was recorded.

4.4.4.3 Question Eleven

> *During the interviews, the following reasons were given for why we may see discrepancies between productivity statistics and the take up of the NBN by SMEs. Please rate the significance of these effects.*

This question asked the experts to rate the significance of nine effects, generalized from the responses given in questions four and five of the round one interviews (see 4.3.2.1 and 4.3.2.2). The results for each of these factors is detailed below.

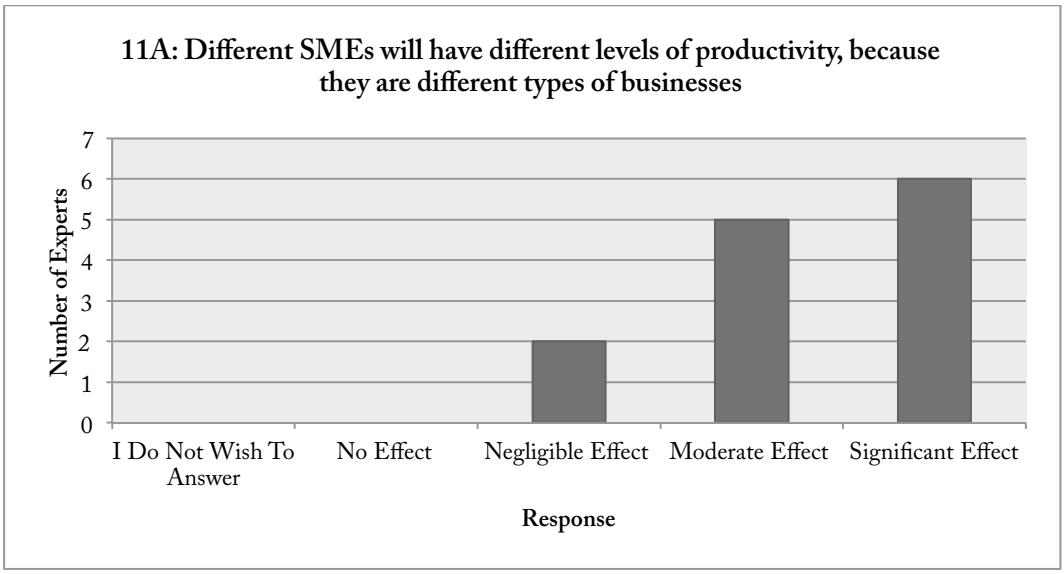

Figure 34: Response to Question 11 A

The experts considered that different SMEs would have different levels of productivity because they are different types of business and further this would have a moderate to significant effect on how we can measure the productivity of the NBN. All thirteen of experts answered this question and the median value was 3.

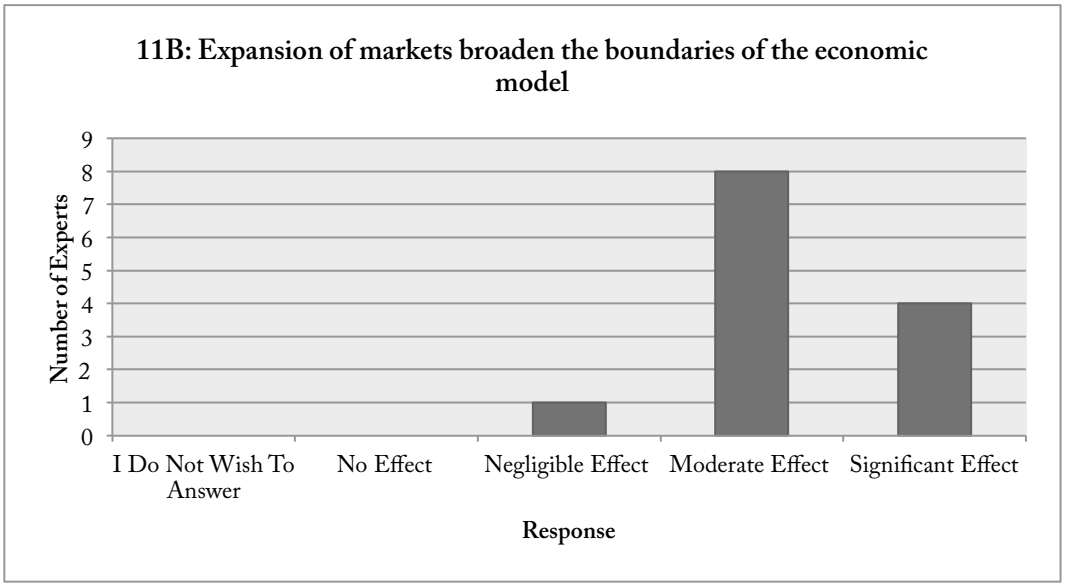

Figure 35: Response to Question 11 B

The experts came to the consensus is an expansion that the markets will broaden the boundaries of the economic model and this will have a moderate to significant effect on the measurement of productivity in regional small to medium enterprise. All thirteen experts contributed to this response and the median value was 3 (moderate effect).

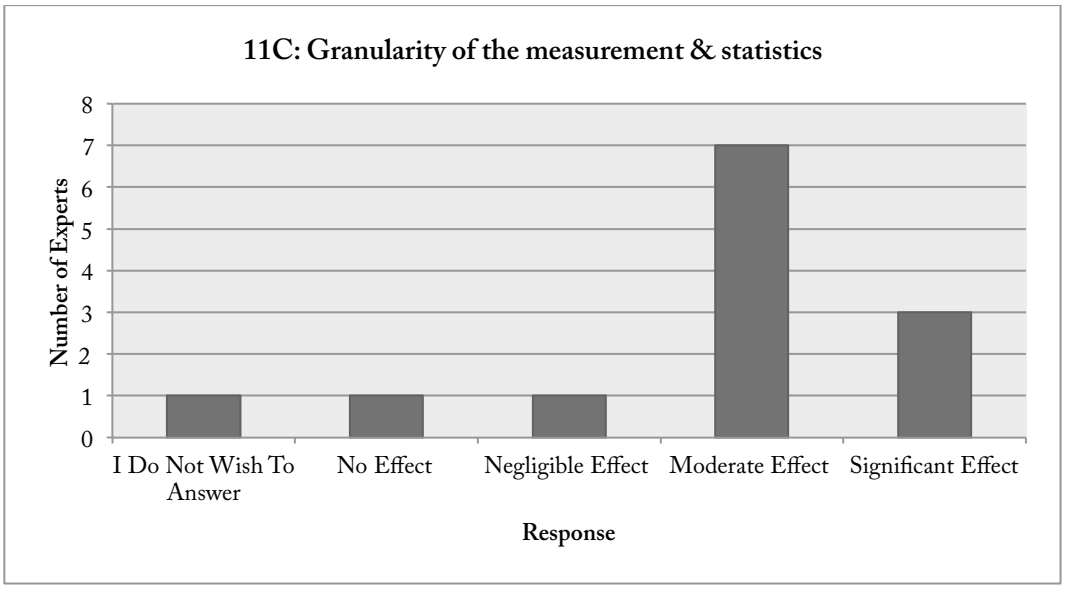

Figure 36: Response to Question 11 C

A consensus was formed that the regularity of the measurement and statistics would have a moderate to significant effect on the measurement of productivity in regional small to medium enterprise. Twelve of the thirteen experts chose to answer this question and the median value of 3 (moderate effect) was recorded.

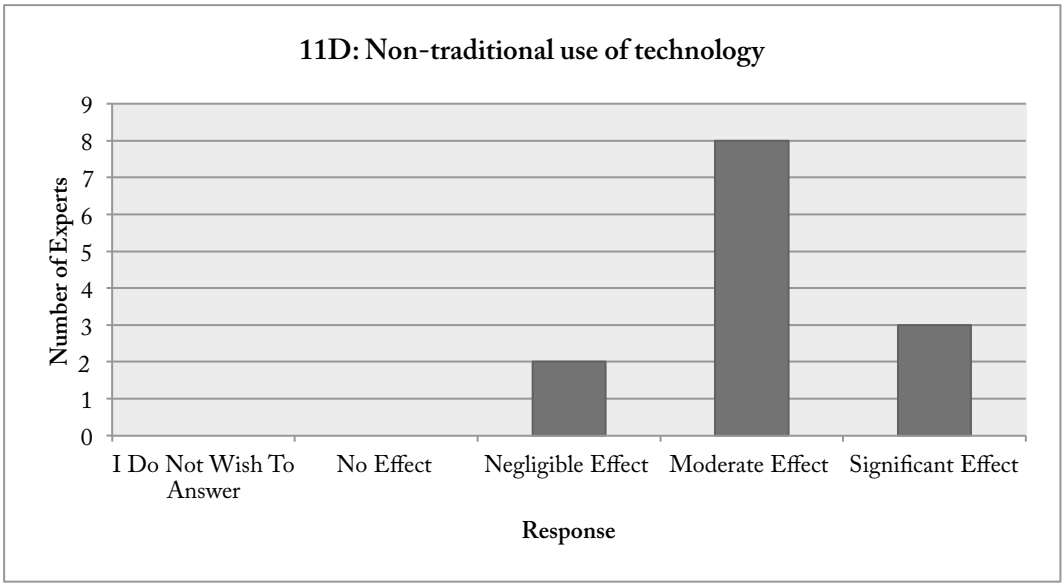

Figure 37: Response to Question 11 D

The consensus was formed amongst the experts, that the non-traditional use of technology would have a moderate to significant effect on our ability to measure the productivity of small to medium enterprise in regional areas. It should be noted that the majority of experts suggested that this would have a moderate effect. All 13 experts completed this question and the median value of 3 (moderate effect) was recorded.

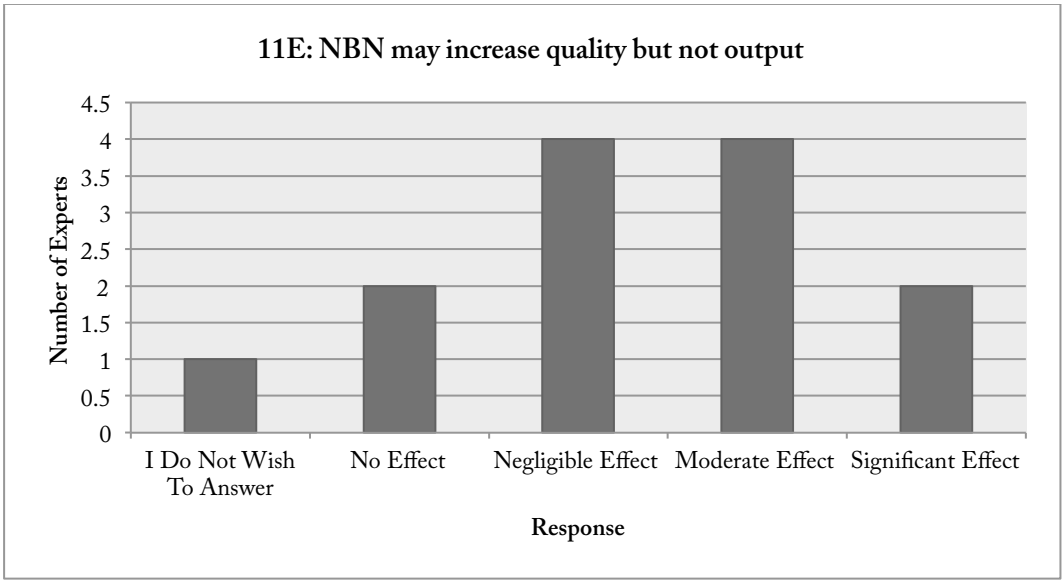

Figure 38: Response to Question 11 E

No consensus could be formed in this case. Twelve of the thirteen experts chose to answer this question and the median value of 2 was recorded with a standard deviation of 1.18.

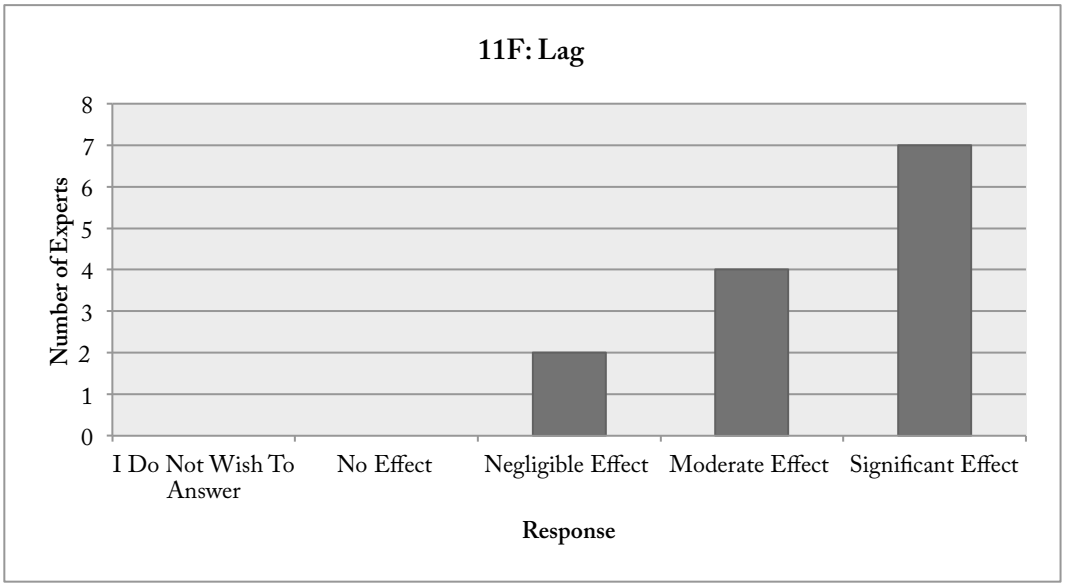

Figure 39: Response to Question 11 F

Experts reached a consensus that lag would have a moderate to significant effect upon the measurement of productivity in regional SMEs. All thirteen experts answered this question and a median value of 4 (significant effects) reinforces what the majority of experts said that this would be a significant effect.

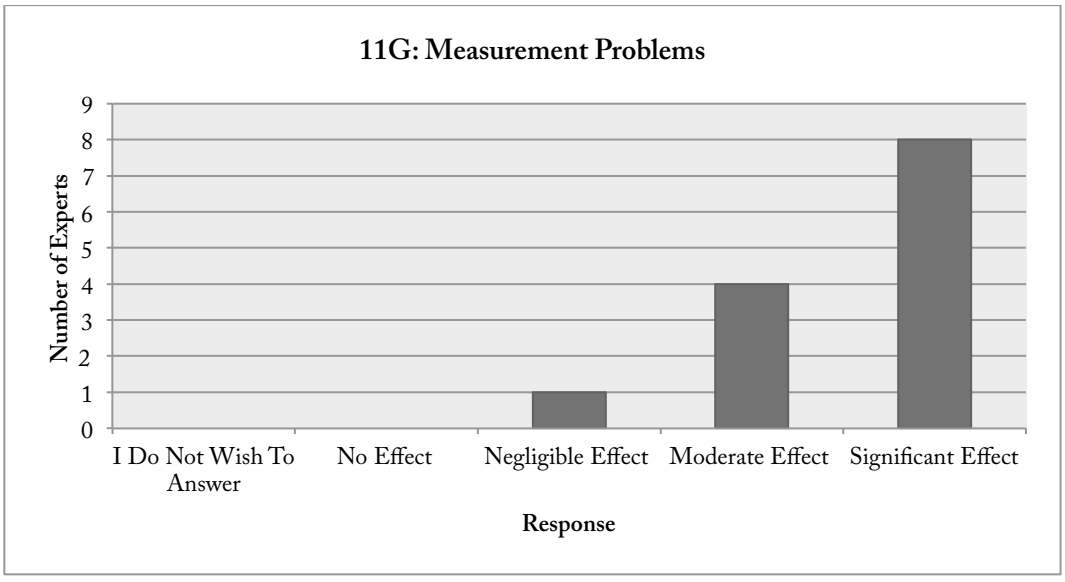

Figure 40: Response to Question 11 G

The experts reached the consensus that measurement problems would have a moderate to significant effect on the measurement of regional SMEs productivity. It should be noted that the majority of experts suggested that measurement problems would have a significant effect. All thirteen experts participated and a median value of 4 was recorded.

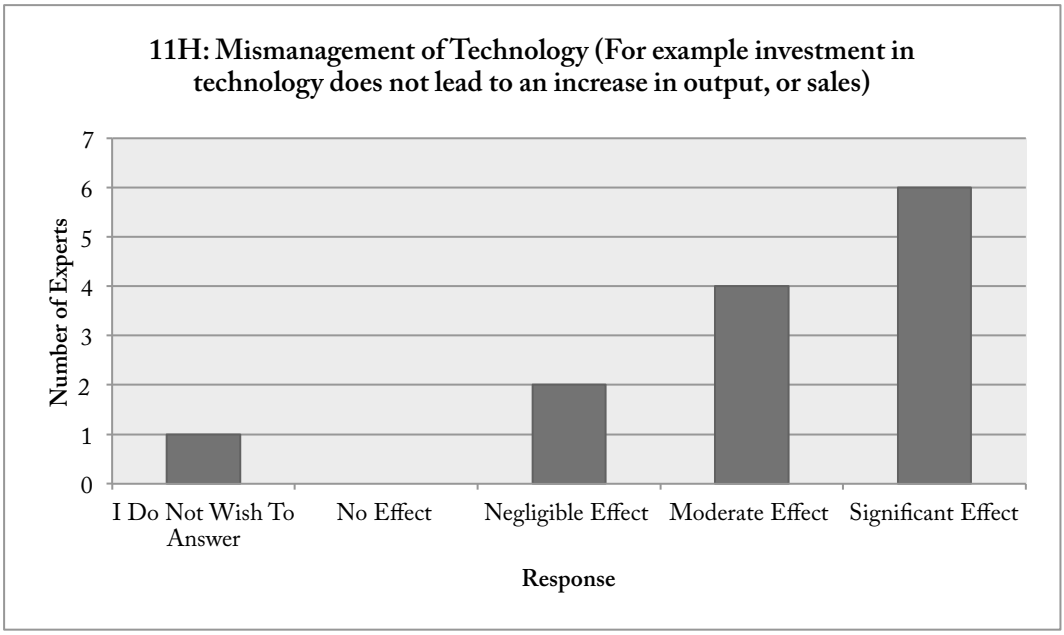

Figure 41: Response to Question 11 H

The experts agreed that the mismanagement of technology would have a moderate to significant effect on the measurement of productivity in regional SMEs. The majority of experts believe that this effect would be significant. Twelve of the thirteen experts in these study answered this question and the median value was 3 (moderate effect).

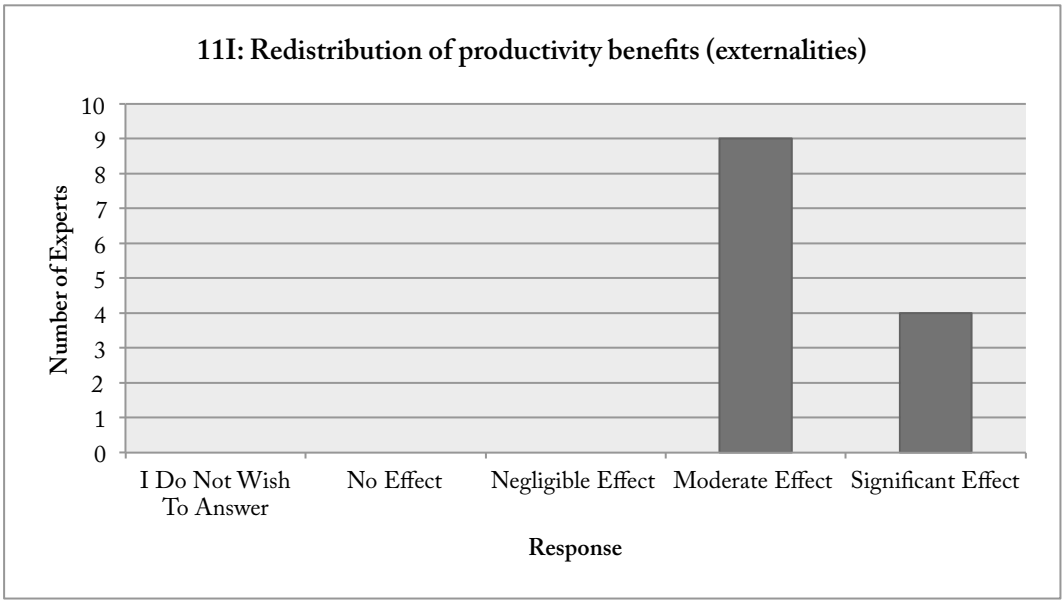

Figure 42: Response to Question 11 I

Question 11 I delivered the strongest consensus in question 11. Nine experts agreed that the redistribution of productivity effects would have a moderate effect on the measurement of the productivity of regional SMEs. In addition to this four experts believed that the effect would be significant. The full quota of experts responded to this question and a median value of 3 was recorded.

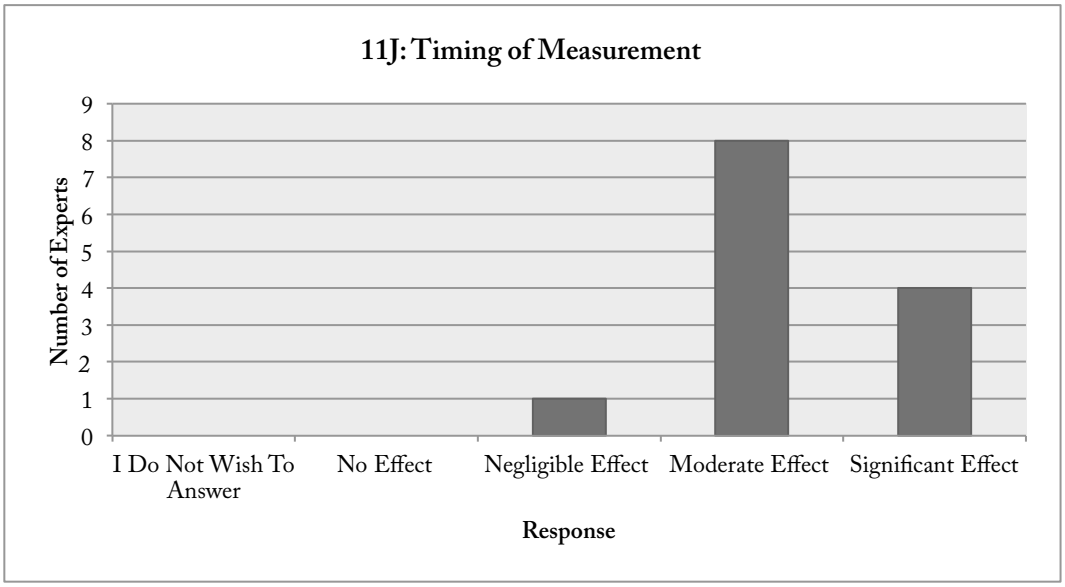

Figure 43: Response to Question 11 J

The experts formed a consensus that the timing of measurement would have a moderate to significant effect on the measurement of productivity in regional SMEs. The majority of experts suggested that this would be a moderate effect, which is reflected in the median value of 3 (moderate effects), which was recorded. The full number of experts contributed to this question.

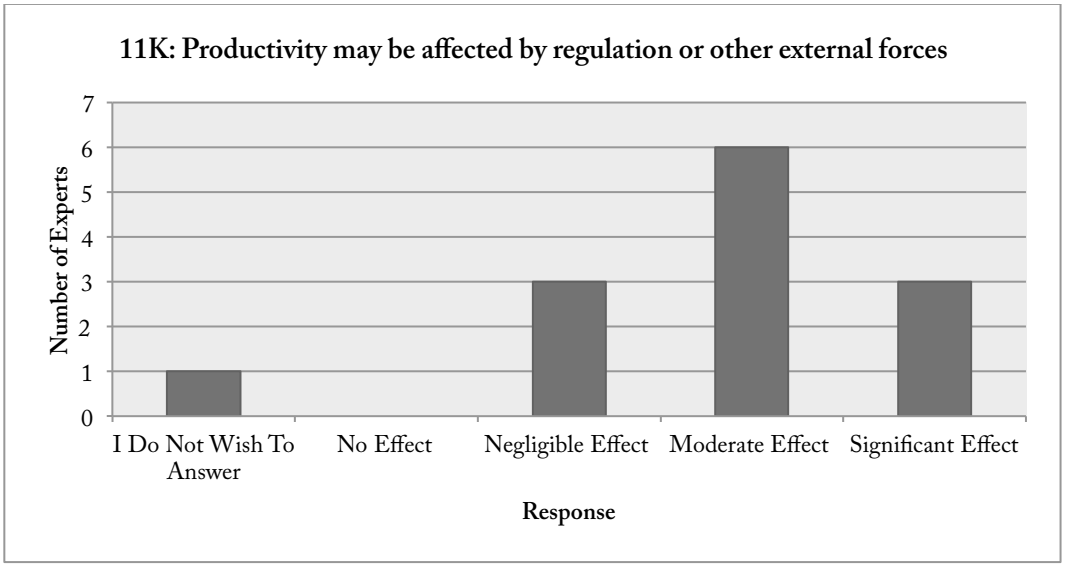

Figure 44: Response to Question 11 K

In response to question 11 K, the experts formed the consensus that productivity may be moderately to significantly effected by regulation or other external forces (see 4.3.2). This consensus was skewed towards moderate effects, which is confirmed by the median value of 3 (moderate effect). Twelve of the thirteen experts chose to answer this question.

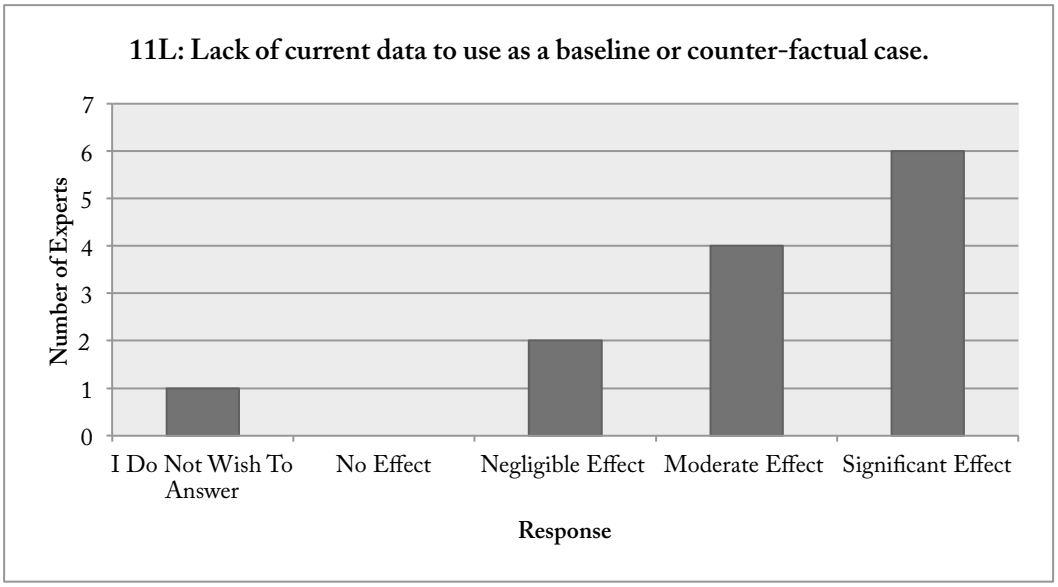

Figure 45: Response to Question 11 L

The experts formed a consensus in this question, that is a lack of current data to use as a baseline or counterfactual case would have a moderate to significant effect on the measurement of productivity in regional SMEs. This consensus was slightly skewed towards significant effect. Twelve experts participated in this question and the median value of 3 (moderate effect) was recorded.

4.4.4.4 Question Twelve

How should we be measuring the productivity effects of the NBN on SMEs?

This question is designed to determine the way we should be measuring the NBNs effect on the productivity of regional SMEs.

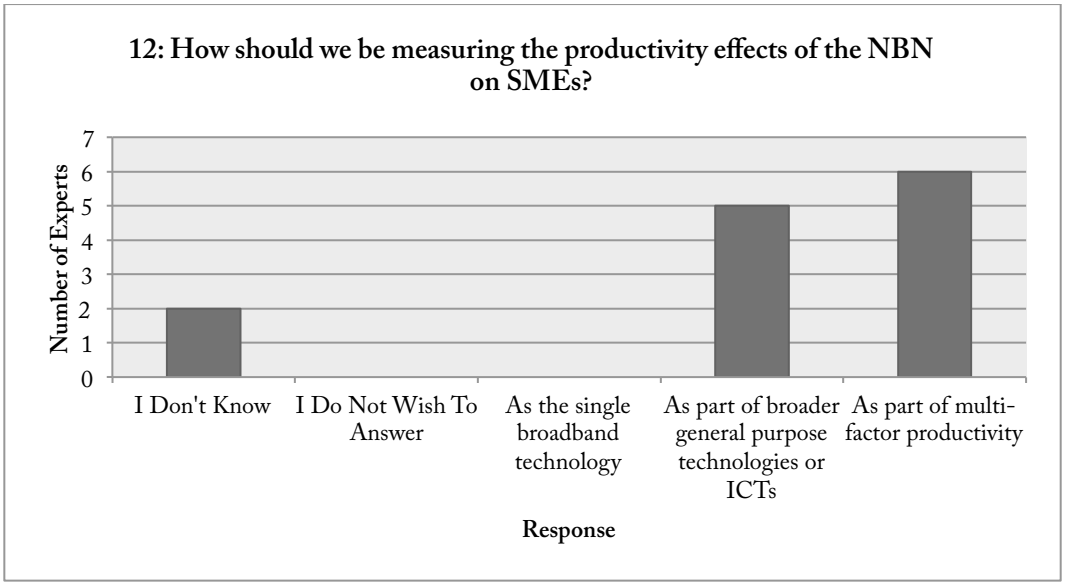

Figure 46: Response to Question 12

The experts were divided on how to best measure the effects of the NBN on the productivity of regional SMEs, and as such no consensus was reached. This may be explained somewhat by one comment in question 16 which suggested that there should have been a way in which to select multiple options in this question. Two experts chose not to answer this question, and a median value of 2 (As part of broader general…) was recorded.

4.4.4.5 Question Thirteen

At what level should we be measuring the productivity effects of the NBN on SMEs?

This question was designed to examine the best unit of analysis to use when looking at broadband related productivity.

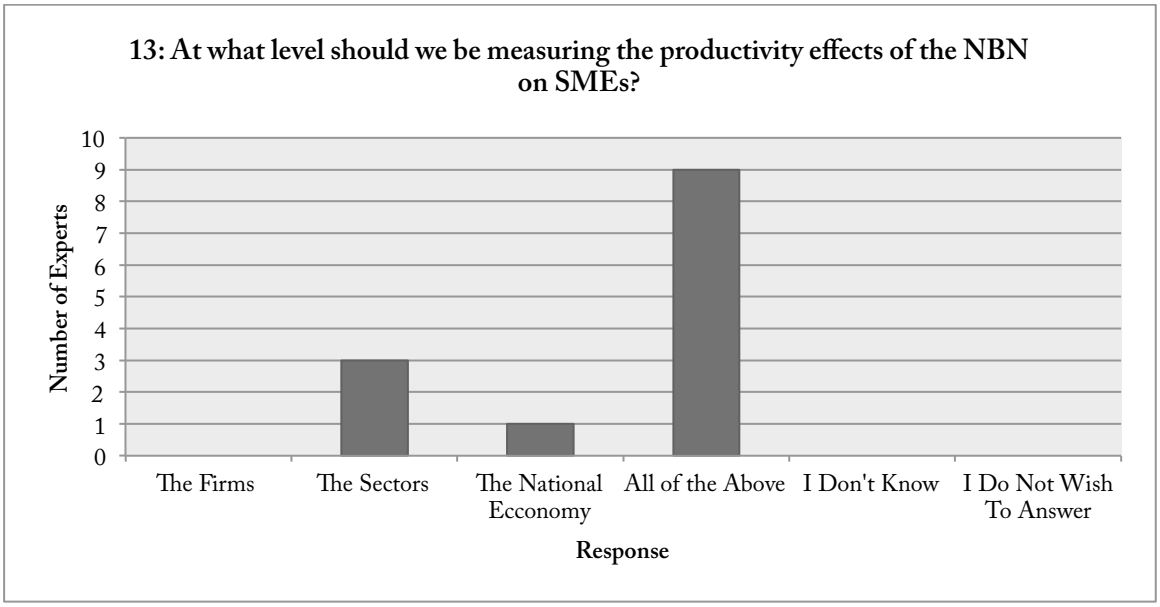

Figure 47: Response to Question 13

A clear consensus is visible in response to this question. The experts' consensus is that the effect of NBN on productivity on regional SMEs should be measured at the firm, the sector and the national economy levels. This consensus was formed from a full number of experts (thirteen) and the median value was 4 (All of the Above).

4.4.4.6 Question Fourteen

In your opinion, given that the NBN is an "enabling technology", should we be looking at the productivity benefits of the NBN or the applications that it enables?

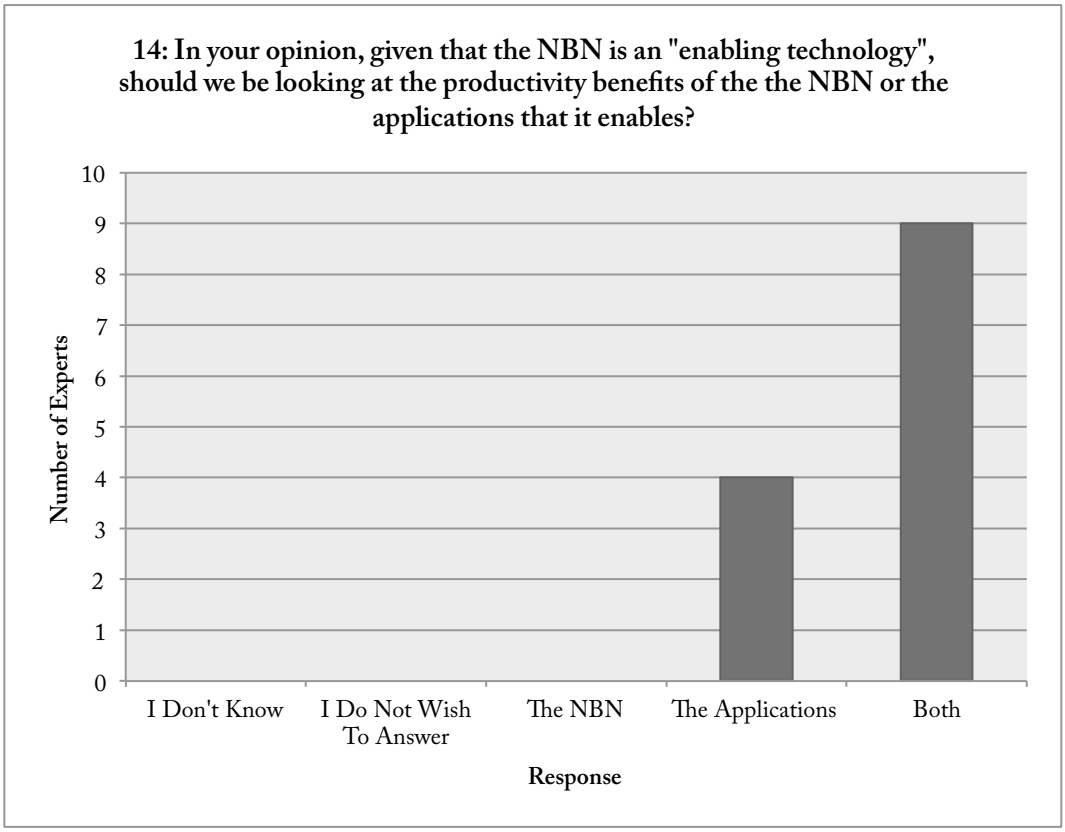

Figure 48: Response for Question 14

There was a clear consensus that the experts felt that we should it be measuring the productivity at both the NBN and application levels. All thirteen experts participated in this question and a median value of 3 (both) was recorded.

4.4.4.7 Question Fifteen

Do you believe that failure to invest in High Speed Broadband Infrastructure, will lead to Australian Regional SMEs becoming competitively disadvantaged in the global market leading to stagnation in productivity and growth?

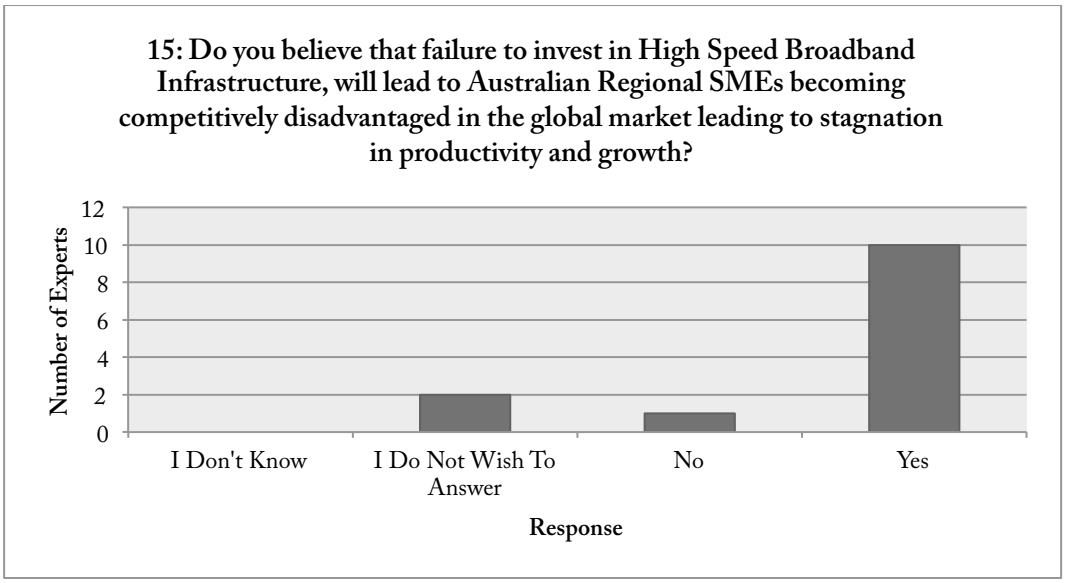

Figure 49: Response to Question 15

A strong consensus was formed amongst the experts that a failure to invest in high-speed broadband infrastructure would lead to Australian regional SMEs becoming competitively disadvantaged in a global market, which would lead to stagnation in productivity growth. Two of the thirteen experts decided not to answer this question while one indicated that they did not think that this would occur. A median value of 2(yes) was recorded.

4.4.4.8 Question Sixteen

> *Please write any further comments you wish to make about the effect of the Productivity Paradox on the NBN and regional SMEs in the space provided.*

Of the population of thirteen experts, three chose to complete this optional question. The following values were reported.

Response No.	Response
1	A ubiquitous NBN is a technology that can be so enmeshed in the rest of the society and economy that its effects will be extremely difficult to measure. For example, the NBN could be used to reduce the need for hospital beds for outpatient monitoring. How do we include this savings in an NBN "productivity model"? How does one measure the benefits of psychological well being secured by forming "virtual communities" between people previously isolated due to lack of bandwidth to regional townships? The problem is that the cost of the NBN is easy to identify and measure. Its benefits are far more complex and difficult to measure. Hence, using "productivity statistics" to measure the value of the NBN fails to capture the full picture. The problem is that it may not be possible to measure many of the NBN's benefits to community.
2	With a utility it is always difficult to meaure the effect. What is the effect of the use of water, electricity, roads, etc. Do we measure that in relation to productivity or do we simply know that without it productivity will be significantly less. For most businesses the question will be rather accademic they intuitivey[sic] know that it increases the productivity. It is at the political level and perhaps at a government level where these issues are more important.
3	Q12 should have an option to choose all options for measurement

Table 8: Responses to Question 16

4.4.5 The Use of the NBN in SMEs

The following four questions examine the reasons why regional SMEs may need a faster broadband connection as well as factors that may limit the use of these technologies.

4.4.5.1 Question Seventeen

> *The following applications were given as examples why SMEs need faster broadband connection. Please rate the potential of each of these applications to increase Regional SMEs Productivity.*

This question asked the experts to rate the examples given as reasons for faster broadband connection speeds. These examples were generalized from the response given in questions seven of the round one interviews (see 4.3.3.1). The results for each of these factors are detailed below.

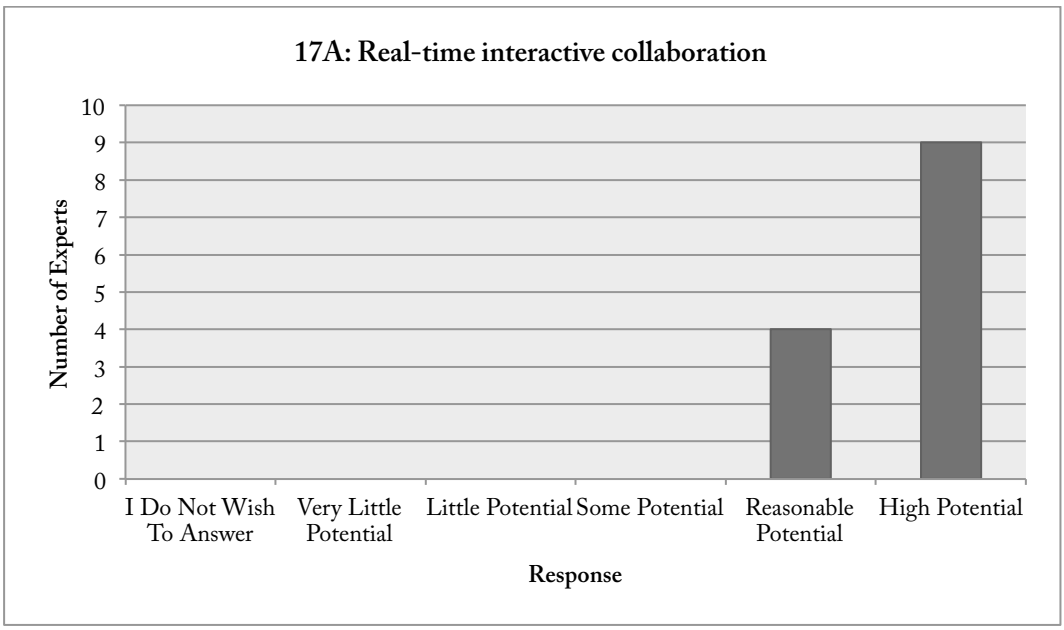

Figure 50: Response to Question 17 A

The response to questions 17 A was a very strong consensus amongst the experts that real-time collaborative technologies had a higher potential of improving the productivity of regional SMEs. All experts participated in answering this question and a median value of 5 (high potential) was reported.

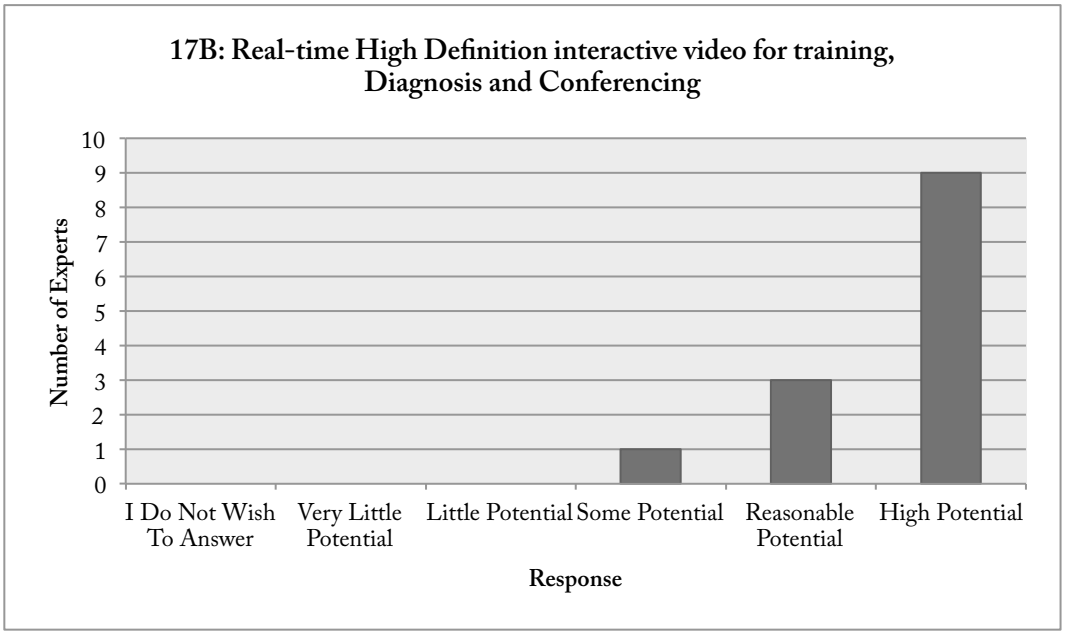

Figure 51: Response to Question 17 B

The response to questions 17 B was also a strong consensus that real-time high-definition interactive videos for training, diagnosis and conferencing had a high potential for increasing the productivity of Regional SMEs. All thirteen experts participated in answering this question and median value of 5 was reported.

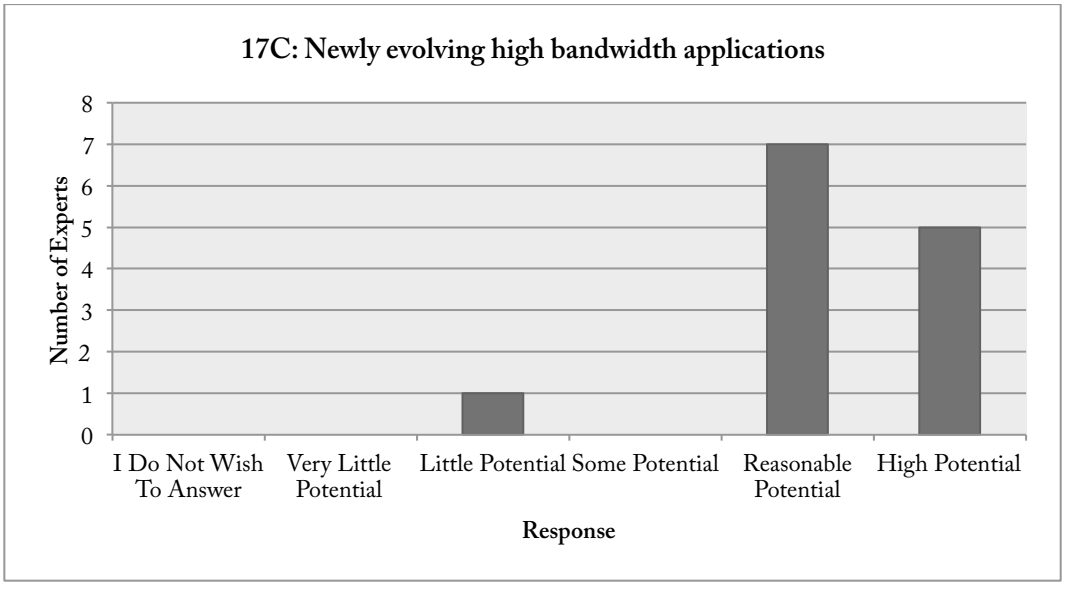

Figure 52: Response to Question 17 C

Despite the difficulty of judging all potential of an unknown future technology the experts came to the consensus that there was a reasonable to high potential that a newly evolving high bandwidth applications would enable increases in productivity from regional SMEs. All thirteen experts participated in answering this question and a median

value of 4 was reported which highlights the skew in this consensus towards it having only a reasonable potential.

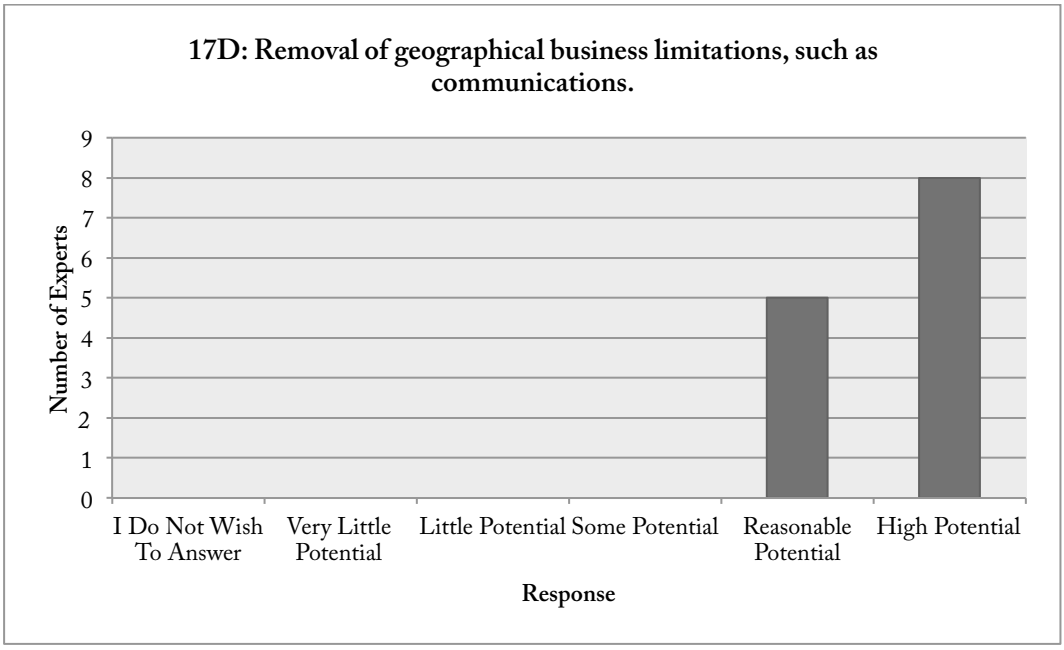

Figure 53: Response to Question 17 D

The expert consensus that was formed in answer to this question is that the removal of geographical and business limitations such as communications will have a reasonable to high potential to increase productivity of regional SMEs. The majority of experts however suggested that these had a high potential. All thirteen experts participated in answering this question and the median result was 5 (high potential).

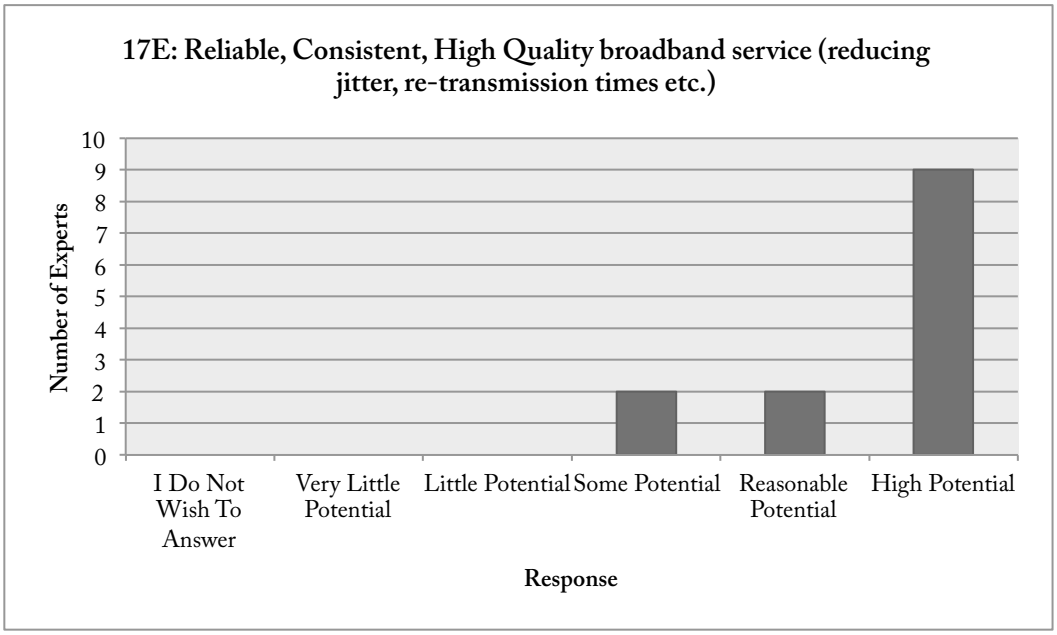

Figure 54: Response to Question 17 E

A strong expert consensus was reached in this question. That is that, because the NBN is reliable, consistent and high quality broadband service, it has a high potential to improve the productivity of regional SMEs. All thirteen experts contributed to the answering this question and the median value was recorded as 5.

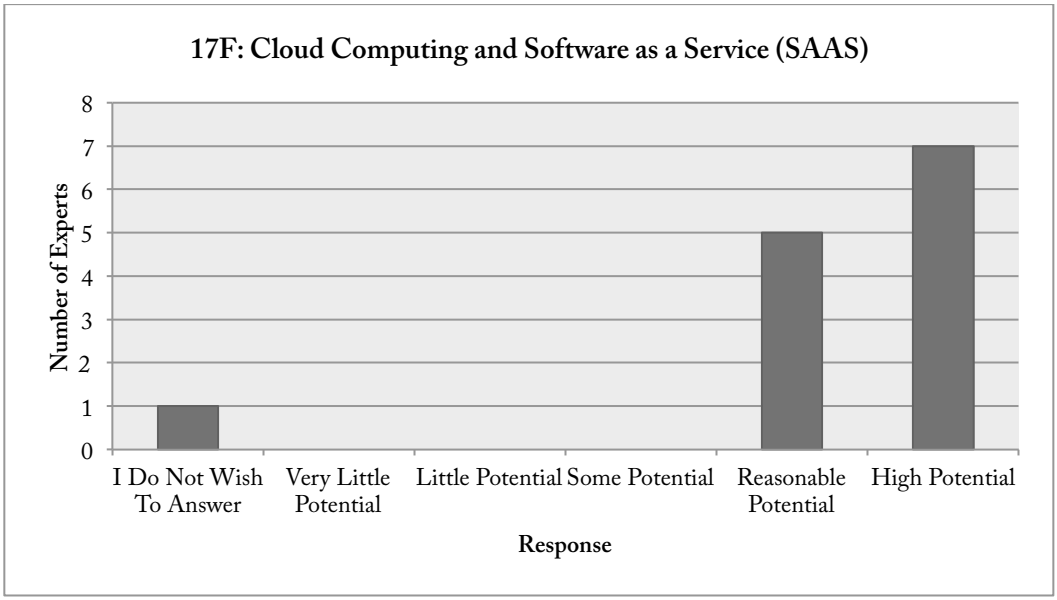

Figure 55: Response to Question 17 F

A consensus was formed amongst twelve of the experts in this case, as one chose not to participate. The consensus formed was that cloud computing and SaaS has a reasonable potential of increasing the productivity of SMEs in regional areas. Slightly more experts suggested that this would be a high potential and a median value of 5 was recorded.

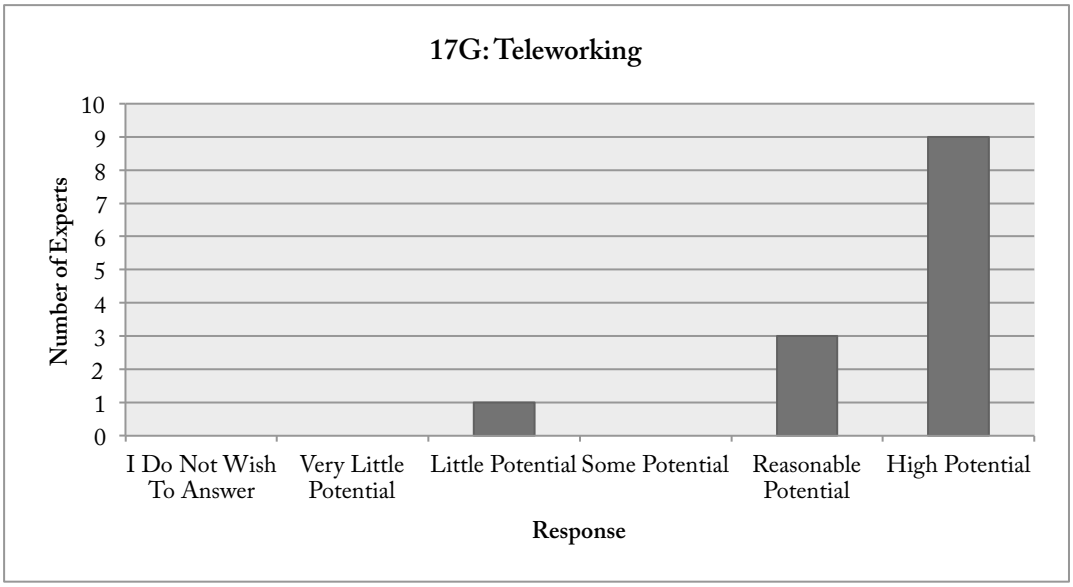

Figure 56: Response to Question 17 G

A clear consensus was formed in response to questions 17 G, that teleworking had a high potential of increasing the productivity of regional SMEs. All thirteen experts responded to this question and a median value of 5 was recorded.

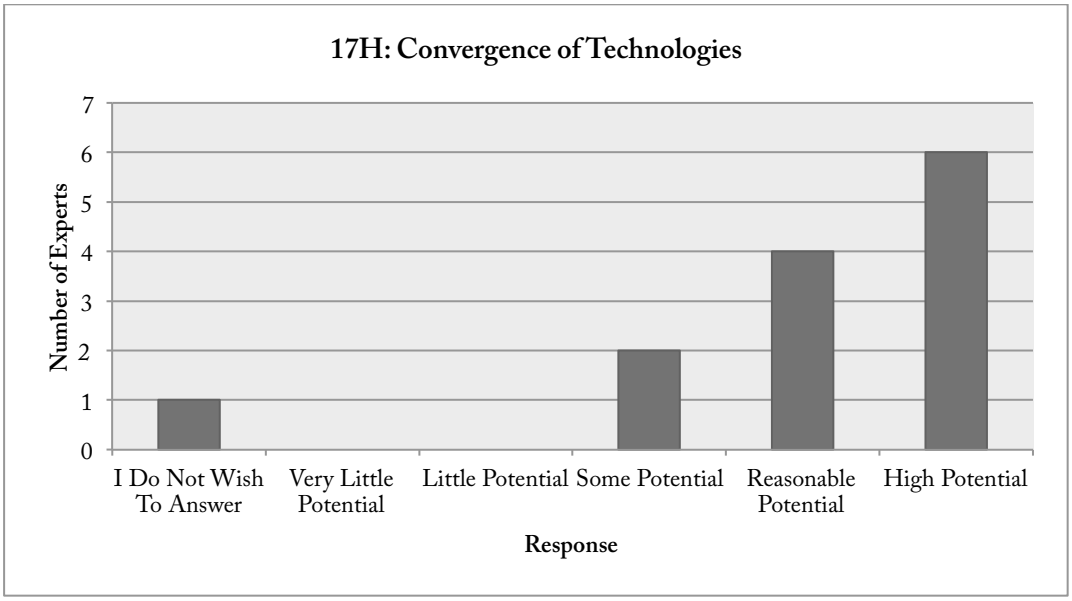

Figure 57: Response to Question 17 H

A consensus was formed amongst the experts in response to question 17 H that convergence of technologies had a reasonable to high potential of increasing productivity from regional SMEs. Only twelve of the thirteen experts chose to answer this question and a median value of 4 was collected.

4.4.5.2 Question Eighteen

> *This question also brought up several factors that could have the potential to limit Regional SME's use of this technology. Please rate the potential each of these factors has to limit the Regional SME's use of this technology.*

This question asked the experts to rate the factors that could potentially limit the Regional SMEs use of faster broadband connection speeds. These examples were generalized from the responses given in multiple round questions (see 4.3). The results for each of these factors detailed below.

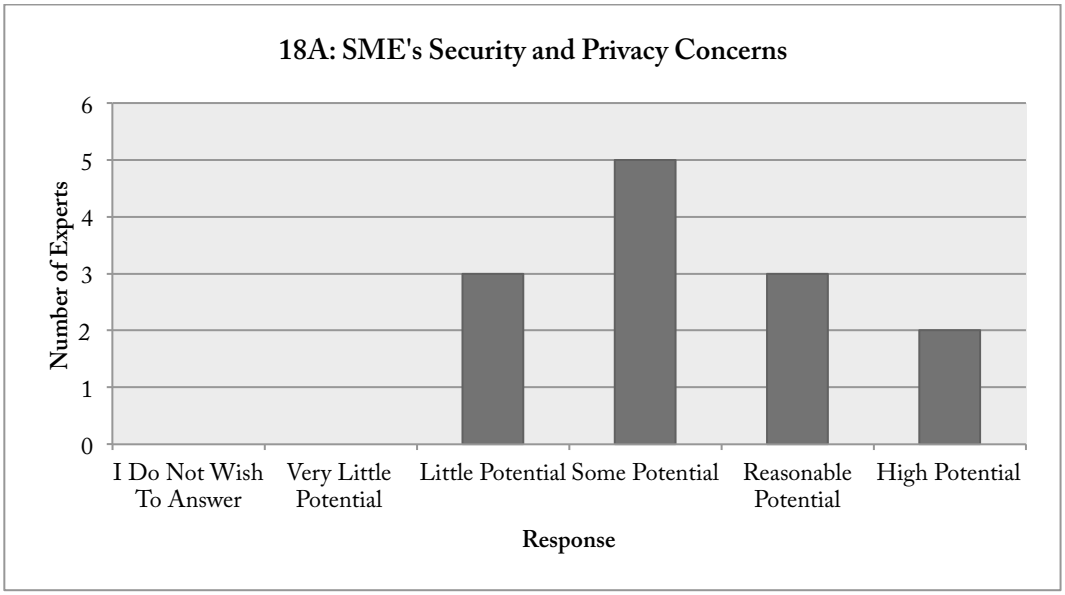

Figure 58: Response to Question 18 A

A very loose consensus is formed in question 18 A, which suggests that SMEs security and privacy concerns could have at least some potential to limit regional SMEs use of high-speed broadband infrastructure. The median value of this question was reported as 3 (some potential) and all experts responded to this question.

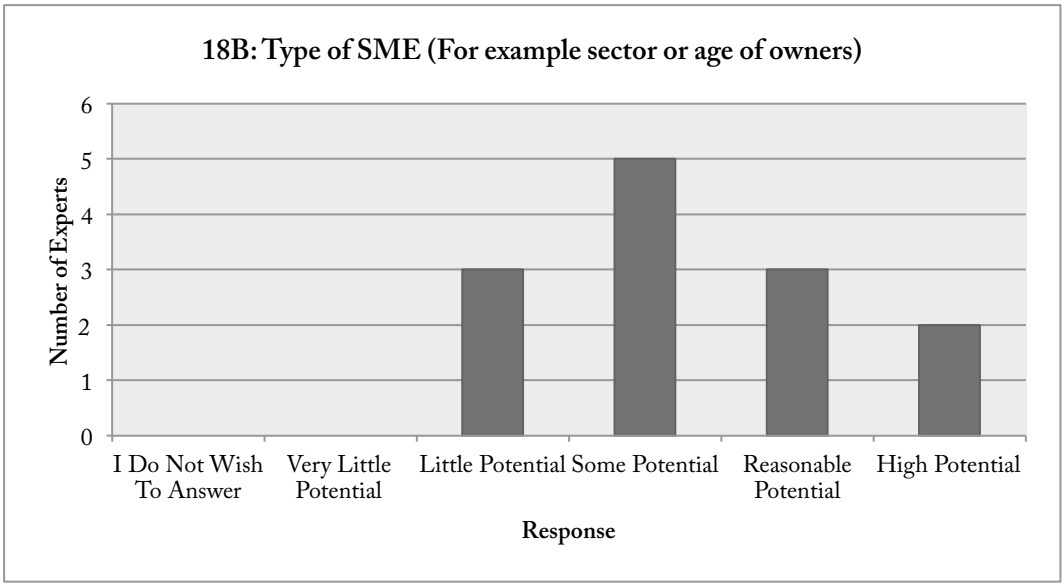

Figure 59: Response to Question 18 B

Question 18 B also shows a loose consensus between experts who suggest that the type of SME will have at least some potential to limit the use of high-speed broadband technologies to increase productivity and subsequent growth. All experts participated in answering this question and the median value reported was 4 (reasonable potential).

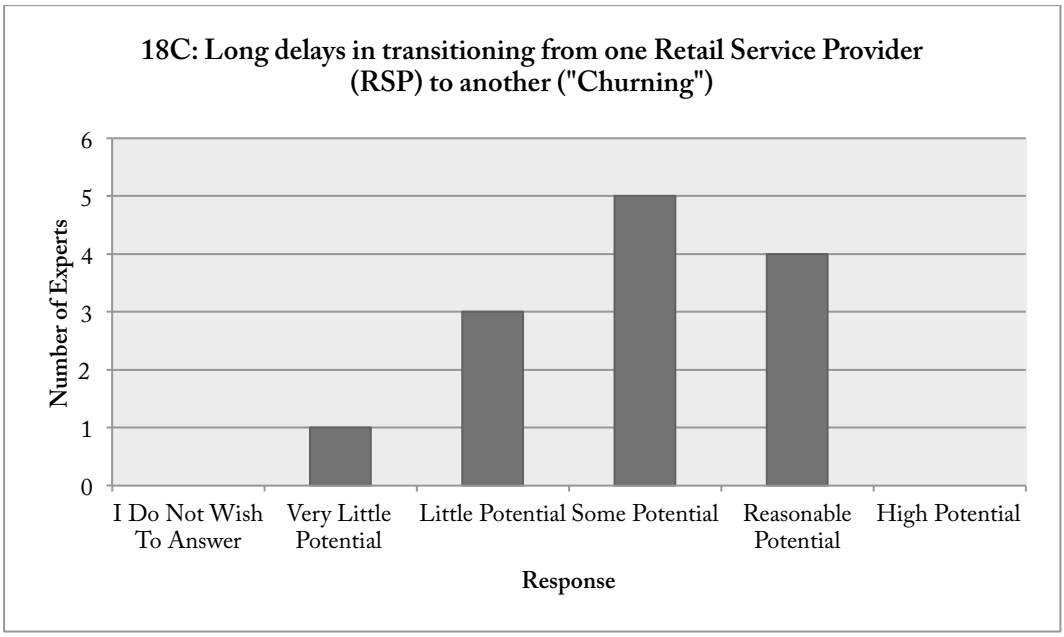

Figure 60: Response to Question 18 C

No consensus was formed in relation to question 18 C while the responses of some potential and reasonable potential can be combined to form a consensus, the same could be said for combining very little, little and some potential to form a consensus in their negative direction. Therefore on this question a consensus has not been reached. All thirteen experts answered the question and a median value of 3 was reported.

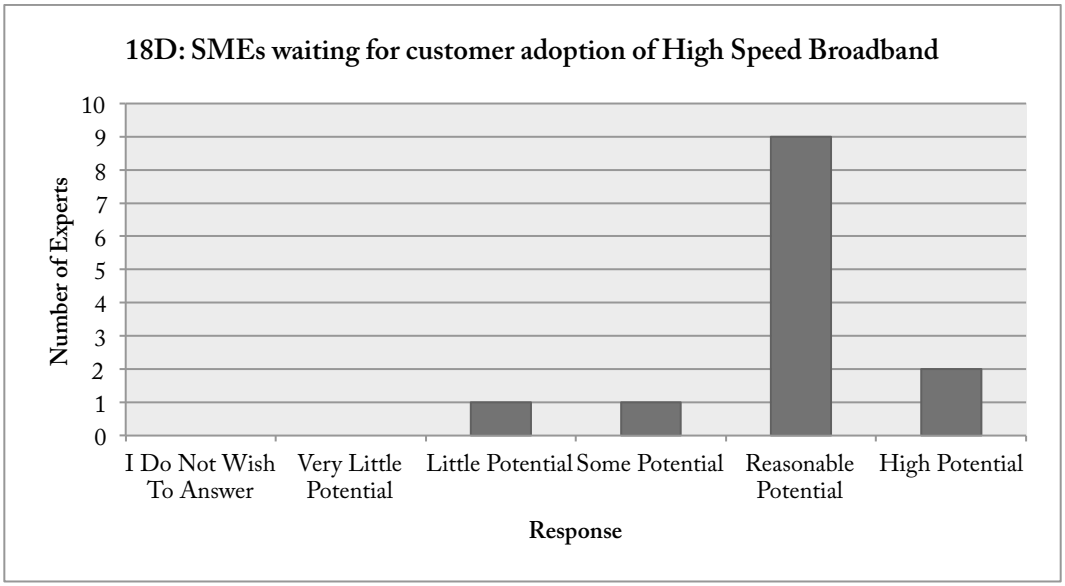

Figure 61: Response to Question 18 D

A clear consensus was formed in question 18 D. The experts agreed that there was a reasonable potential that SMEs would be limited in their use of high-speed broadband technologies to increase their productivity if they were waiting for customer adoption of high-speed broadband. All experts answered this question and a median value of 4(reasonable potential) was recorded.

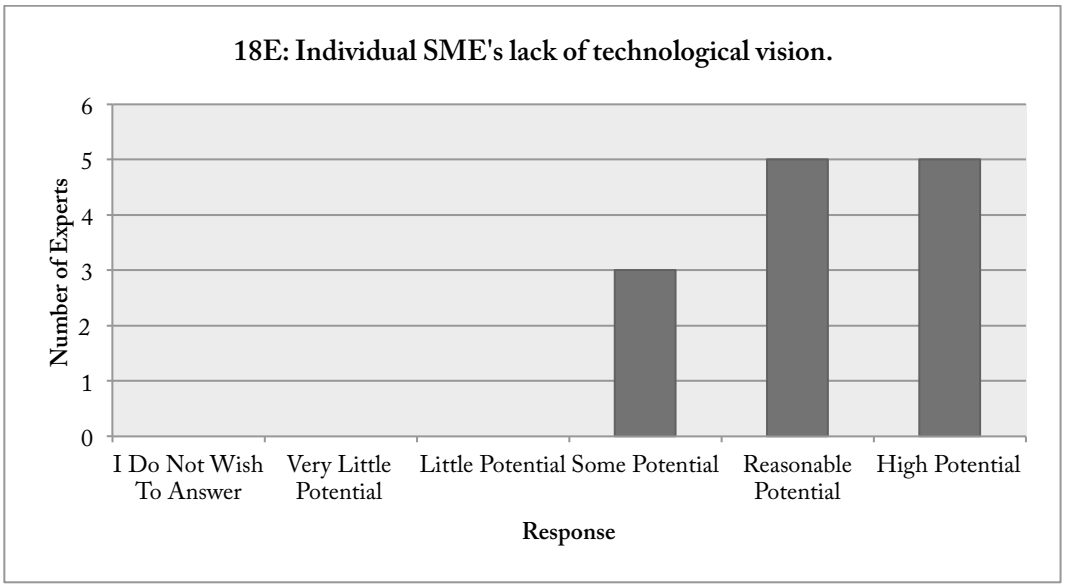

Figure 62: Response to Question 18 E

A consensus was formed by the experts that individual SMEs lack of technological vision had a reasonable to high potential to limit their effective use of high-speed broadband technologies to improve productivity. All experts answered this question and the median value reported was 4 (reasonable potential).

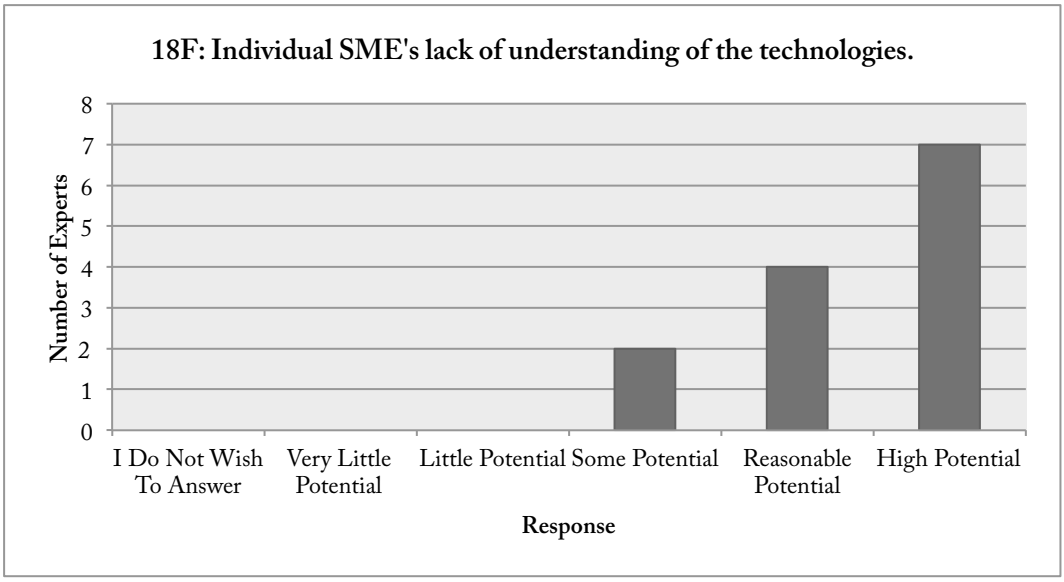

Figure 63: Response to Question 18 F

There is a consensus amongst the experts that there is a reasonable to high potential that an individual SME's lack of understanding of technologies could have a limiting effect on the use of the NBN to increase their productivity. It should be noted that the majority of responses indicate that this is a high potential. All thirteen experts answered this question and a median value of 5 (high potential) was recorded.

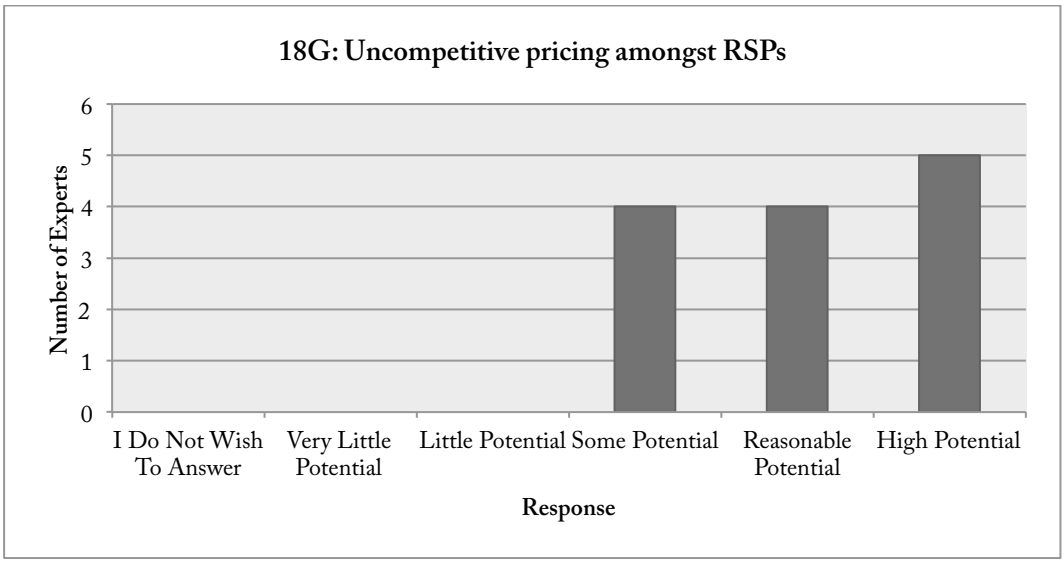

Figure 64: Response to Question 18 G

The expert consensus was formed that there was a reasonable to high potential that uncompetitive pricing amongst retail service providers could limit regional small to medium enterprises use of high-speed broadband technologies to increase productivity. All experts answered this question at a median value of 4 (reasonable potential) was recorded.

4.4.5.3 Question Nineteen

Do you believe that a failure to invest in High Speed Broadband infrastructure in regional areas will drive SME investment away from regional areas?

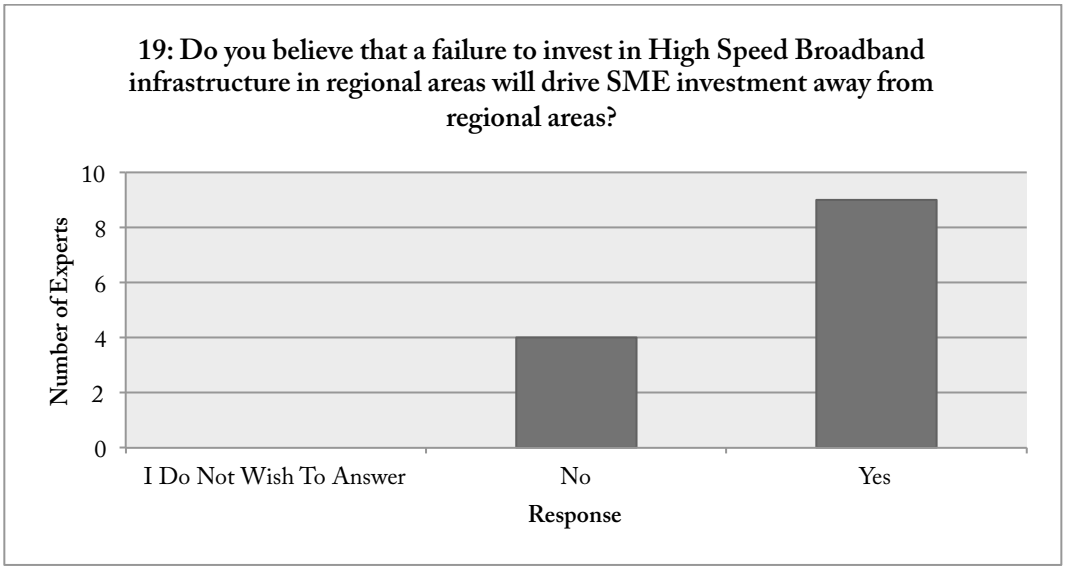

Figure 65: Response to Question 19

In question nineteen the consensus was formed that a failure to invest in high-speed broadband infrastructure in regional areas would drive SME investment away from regional areas. All thirteen experts chose to answer this question and a median value of 2 (yes) was recorded.

4.4.5.4 Question Twenty

Please write any further comments you wish to make about the effect of the reasons why Regional SMEs need better broadband connection in the space provided.

Of the thirteen experts, four chose to complete this optional question. The following values were reported.

Response No.	Response
1	The value of information in the modern economy plus the ongoing globalisation of industry means that ubiquitous access to up-to-date information is increasingly important. Therefore, failure to provide this access to up-to-date information will have a detrimental effect on any SME that relies on information and is connected into the national/global economy. Very localised SMEs may not see much benefit from the NBN, however all others will, provided they can apply the technology.
2	Already very few business would locate (if they have a choice) where there is little or no bb. In many regional areas they won't have a choice as soon that is available they will not locate where there is no access as that doesn't make business sense. They won't locate where there no roads or no electricity either. (all within reason of course)
3	It is very important that there is a plan to develop applications built around industries / industry verticals to demonstrate to regional SMEs the power that a better broadband connection will bring to the business. Using case studies will be a great way to illustrate this and give these businesses some real context, and understand how it can help them achieve their business goals (EG. More revenue, reduced costs, greater worker flexibility (work remotely), better time management, better collaboration.... etc.)
4	Please note that moving a business from a PSTN/ISDN based number range to an alternate voice provider (usually called complex number porting) can take weeks under current processes. The industry needs to overcome this issue which tends to be a roadblock for Businesses moving from Telstra to a new provider.

Table 9: Responses to Question 20

4.4.6 The Timing of the Projected Benefits

4.4.6.1 Question Twenty-One

Please select from the time frames provided, the time frame that you believe most closely matches the time frame in which we will be able to measure the effects of the NBN in each of the economic units[2].

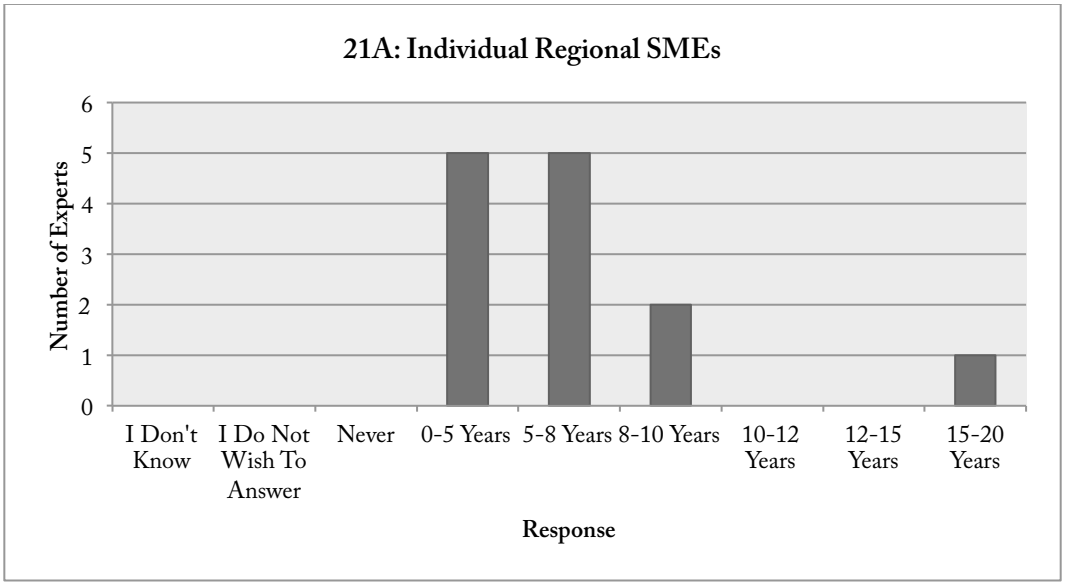

Figure 66: Response to Question 21 A

The results gathered in question 21 A did not reach a consensus. While it is possible to say that the majority of experts would expect to be able to measure the effects of the NBN on individual regional SMEs within eight years, the discrete nature of the responses mean that it is not possible to combine them to form a consensus. All thirteen experts answered this question and the median value was 3 (5 to 8 years).

[2] **Explanatory Note :**At least one expert suggested that productivity would not have continued its historical growth levels if it had not been for the underlying telecommunications technology. They further suggest that the NBN will continue to support the underlying productivity growth, and so a further increase in the productivity (attributable to the NBN) will never be seen.

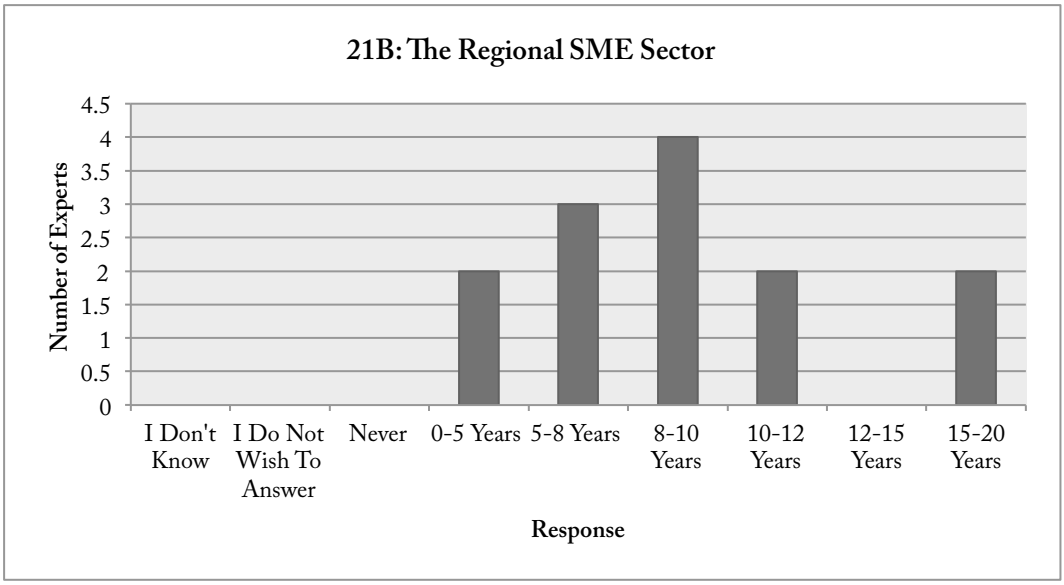

Figure 67: Response to Question 21 B

Question 21 B did not reach consensus and, for the same reasons as question 21 A, the values cannot be combined to create a consensus. However it is possible to say that the majority of experts would expect to be able to measure productivity in the regional SME sector with in 10 years. Total expert population of the survey answered this question and a median value of 4 (8 to 10 years) was recorded.

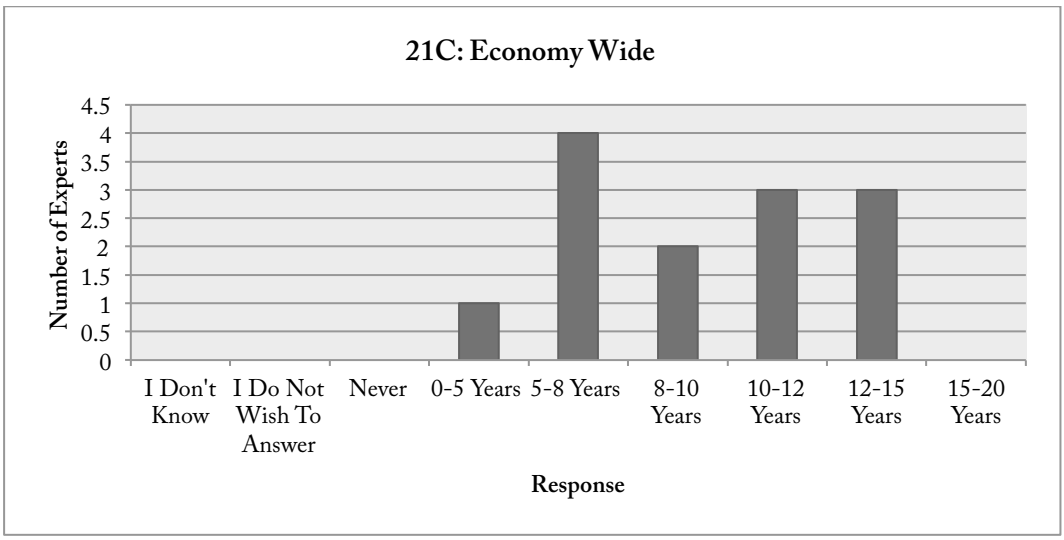

Figure 68: Response to Question 21 C

As with questions 21 A and 21 B, question 21 C could not reach consensus, and is subject to the same limitations of discrete values which make creating a consensus impossible. However, it is possible to say that, the majority of experts would expect to be able to measure economy wide productivity relating to the NBN within 10 to 15 years.

4.5 Conclusions

This chapter has presented the results from both the round one interview and the subsequent round two online surveys. The next chapter will discuss these results in the context of the literature and draw on them in the process of describing the findings of this study.

Chapter 5 : Discussion

5.1 Introduction

Chapter discusses the results collected during the data collection phase of this research, (see Chapter 4). This chapter examines rounds one and two as well as discussing the results within the broader context of the research.

5.2 Effects of the NBN on Productivity

Both rounds one and two of the research clearly show the NBN will have a *positive* effect on the productivity and subsequent growth of Australian regional small to medium enterprise. This is further emphasized by the consensus formed during the second round.

The findings suggest that there is a *high likelihood* that the NBN will increase SMEs productivity by: -

- Providing "instant access" to new and existing (high and low bandwidth) information.
- Better connecting regional SMEs to existing markets.

In addition our findings also find that it is *likely* that the NBN will increase regional SMEs productivity by (in order from most to least likely see …) : -

- Improving the reliability of communication, collaboration, e-commerce and other internet based activities.
- Enabling the building of information economies in regional areas.
- Providing essential infrastructure for the sustainable growth or survival of regional areas.
- Providing parity of access amongst regional & metropolitan businesses.
- Decreasing the relevance of geographical location.
- Connecting regional SMEs to new markets

It should be noted however that in all these cases the highest scoring response was without exception " highly likely".

The research also found that the "type of regional SME" was likely to effect the levels of productivity and subsequent growth that it achieved. This is significant as it suggests that external factors, not related to the NBN itself, will effect the impact that the NBN has on productivity. This is in contrast to the technologically determinist "build it and they will come" philosophy that is often used in arguments surrounding the NBN.

This was re-enforced by the comments made by the experts in the open response question at the end of this section of round two.

Response No.	Response
1	Regional SME's will ~~be the~~[sic] enjoy a steep change as a result of the NBN. The NBN alone will not achieve this ~~achieve~~[sic]. It will require innovation, ~~now~~ [new] business models and new applications for the benefits to be fully realised.
2	The impact of the NBN on SMEs will depend upon the industry in which the SME operates. For example, industries in which global "on the spot" pricing information is important will likely see a significant impact arising ~~form~~ [from] deployment of the NBN. However industries which are very localised (eg. local hairdresser) will see less or only marginal impact. This means that [the] regional SMEs that wish to leverage ~~from~~ the NBN may need to re-assess their business model and operations.
3	Obviously in the end it all depends on the SME itself. You can provide all the tools you want but if they are not used it won't have an effect.
4	The infrastructure is only the first step - work needs to be done on skills, policies, incentives and regulations to achieve the full benefits for SMEs
5	The success of the NBN in regional areas will only work if there is a clear demonstration around improving business process, transaction and operational activity within the particular business - to do this it is essential that end users are educated about this PLUS there is a need to provide access to specialists who can deliver business applications for the end user, within their particular industry. This is critical.

Table 10: Responses to the Open-Ended Question 4 (Round Two)

These responses list industry, skills, policies, incentives, regulations, processes, transactional and operation activities, education, business models and new applications as factors that will effect the NBN ability to facilitate an increase in productivity and growth in regional SMEs. It is clear that a simply technologically deterministic view of the National Broadband Network is not viable or complete.

The next section will examine further factors that were peer-reviewed during the second stage of the research, that further re-enforce the finding that a solely technologically determinist argument is not suited to an analysis of the NBN.

5.3 Contributing Factors on the NBN & Productivity

During the first round of this study, the experts were asked to name various factors that they believed would have an effect on increasing the productivity of Regional SMEs. The experts responded with a myriad of factors, which supports the hypothesis that the NBN cannot be described in simply technologically deterministic terms.

Our findings, based on the consensus of the experts, suggest that the following are important factors, which will be likely to impact on levels of productivity the NBN supports. While all these factors were rated as important by experts' consensus, they have been ranked (see 3.3.6) from most to least important.

- Speed/Bandwidth.
- Ubiquity.
- Pricing.
- Rollout Speed.
- Regional Focus.
- Competition.
- Consultation With Stakeholders.
- Vision/Strategy.
- Standardized Platform.

The findings suggest that while speed/bandwidth and ubiquity were rated as most important, neither was rated as critical. In addition of the nine factors, only three were technical factors, further reinforcing our findings about the inadequacy of a solely-technologically determinist view.

5.4 Conditions Needed for Improving the NBN's Effect on Productivity

While the previous two sections focused on the effects of the NBN and what factors would influence an increase in its productivity benefits the following section took a different angle. These questions were designed to develop an expert consensus around which conditions are necessary for the most productive outcome of the NBN. This was done so that the findings could be implemented during the building of the NBN so as to enhance the value of the NBN for Australian regional SMEs.

The expert suggested many conditions that should be put in place during the first round interviews, which were condensed to the following conditions for peer review. While all these conditions were rated as important by expert consensus, they have been ranked from most to least important using the same method as was previously explained in section 5.2.

- Open access.
- Appropriate pricing.
- Community & SME education to ensure awareness of visions and benefits of the NBN.
- Skill development for regional SME workers in the use of the NBN.
- Government sponsored innovation into applications, services and product development (In addition to building the network).
- Ubiquity.
- Government use of the NBN to deliver services.
- Ensuring economic viability of the NBN.
- Competition.

In addition a separate consensus was formed amongst the experts that the following three conditions, while not important, were significant: -

- Universal service
- Ensuring the development of practical digital privacy and security policies and products.
- Removal of current legislative & policy inhibitors to allow new applications

While it is obvious that conditions such as universal service, open access, ubiquity, ensuring the economic viability of the NBN and competition, have been previously addressed, it is essential that these previous discussions are acted upon to ensure that such fundamental conditions are both enshrined in the legislation, policies and ethos of the NBN. This may well prevent future governments (of any persuasion) deviating from these principles which our findings show are important in the productive utilization of the NBN.

In addition, the remaining conditions (along with their contributing ideas) should be debated and form part of the NBN policy. As our findings suggest that the these factors could potentially cause the success or failure of the NBN to increase productivity in regional SMEs. On expert pointed out in round two that:-

"Providing just a high speed network connection is not enough for regional SMEs to benefit from the NBN. Many years ago Telecom Australia did a broadband trial in Wollongong (called MACNET). The trial was a technical success but a communal failure because there was insufficient work done to educate the local population regarding the technology and its application. Similarly, for the NBN to be fully exploited by regional SMEs, local, state and federal governments will have to provide education and training for SMEs to appreciate what can be done via the NBN. Without this, it is likely the NBN will not provide regional SMEs with the improved efficiencies and business opportunities many proponents are currently claiming." (see 4.4.2.2)

This should serve as a warning to the current government to take the above findings seriously, or risk the potential failure of the NBN.

5.5 The Productivity Paradox

One of the main concepts defined within the literature surrounding productivity and technology, was that of the *"productivity paradox"* (see section 2.5). While this concept is generally applied to ICT (or GPTs), it had not yet been applied specifically to a broadband specific technology project such as the NBN. This research therefore set out to determine to what extent this concept could also be applied to the NBN and determine if the same concepts could explain possible measurement discrepancies in future productivity measurements.

During the first round, the majority of experts suggested that a *"productivity paradox"* could significantly effect our ability to measure the productivity and growth resulting from the NBN, especially on regional SMEs. However there was not a consensus as to which factors would cause this. In addition, there was an alternative hypothesis provided from the expert panel during the first round.

During the second round the experts were again asked about the whether they believed that we would see a *"productivity paradox"*. However, there were not sufficient numbers of experts committing either way to provide a consensus of opinion. Of the thirteen participants approximately 53% indicated that this was not likely to occur (This was the highest scorings of any response, see 4.4.4.1). This result was significantly different to the response in round one.

The second round also asked the experts to indicate their agreement with the alternative hypothesis that had been raised from within the expert panel. That is, that we do not see increases in productivity because telecommunications technologies have supported the historical growth levels in productivity, and without telecommunications technologies productivity levels would stagnate. There was a strong consensus formed that the argument was valid, with approximately 92% of all experts agreeing to the proposition. This response from amongst the experts may explain the lack of consensus surrounding the productivity paradox.

As part of the literature review, this study identified five factors surrounding the *"Productivity Paradox"* that may have contributed to the discrepancies between the actual productivity and the measured productivity. These were Lag, Mismeasurement, Mismanagement, Redistribution and Cyber-slacking.

While the experts could not form consensus surrounding the *"productivity paradox"* (which calls into question its relevance to the NBN) these factors should not be disregarded as they may still affect the measurement of productivity in some small way.

The issue of *"cyber-slacking"* was dealt with during the first round, with the experts reaching the consensus that this was largely a management issue. It was the opinion of the experts that this would not have a significant effect on productivity nor on its measurement. Experts suggested that this could be easily managed with internal business policies or in some cases technical solutions to block offending websites. Further, the experts also suggested that the increase of "*cyber-slacking*" activities such as internet banking, personal email and so forth are an important part of work-life balance, as people now also do work at home. Finally the suggestion was also made that increased speed may in fact reduce the time taken *"cyber-slacking"*, as employees would be able to complete online tasks more quickly.

The outstanding four factors from the research were then combined with the generalized factors contributed by the experts during the interview stage. Our findings show that the following effects would have a moderate to significant effect on our ability to measure productivity of the NBN on SME in regional areas (in order of significance): -

- Redistribution of productivity benefits (externalities)
- Measurement problems
- Timing of measurement
- Expansion of markets broaden the boundaries of the economic model
- Lag
- Different SMEs will have different levels of productivity, because they are different types of businesses
- Non-traditional use of technology
- Lack of current data to use as a baseline or counter-factual case.
- Mismanagement of technology (For example investment in technology does not lead to an increase in output, or sales)
- Granularity of the measurement & statistics
- Productivity may be affected by regulation or other external forces

However one factor failed to reach consensus amongst the experts which was:

- NBN may increase quality but not output

There was an equal distribution of experts who believed that this would either have no effect or a negligible impact and those who believed it would have a moderate or significant effect.

The findings reveal that while "*productivity paradox"* may not in fact be directly relevant to the NBN, these issues are still a significant issue that must be overcome when developing models to measure broadband specifically.

0 of this study established the validity of our broadband productivity "unit of analysis". This said that in order to understand the effect of broadband technologies on productivity, we must be able to measure broadband productivity separately. This was questioned by multiple members of the expert panel who believed that broadband alone would not effect productivity without the use of other technologies such as personal computers, email, printers and so on.

This study therefore decided to gain a consensus amongst the expert panel in an attempt to resolve this issue. The experts had to nominate whether the productivity effects of the NBN should be measured "As the single broadband technology", " As part of broader general purpose technologies or ICTs" or "As part of multi-factor productivity". However, the experts were unable to form a consensus on this topic. This may be explained by a comment that was recorded in the open answer question at the end of this section, which suggested that the experts should have been given the option to select multiple types of measurement.

The experts were also asked to nominate the economic unit in which to measure the productivity effects of the NBN on SMEs. The experts came to the consensus that this should be done at "The Firm", "The Sector" and "The National Economy" levels.

Further, as many of the experts commented, the NBN being an "enabling technology" this study attempted to form a consensus surrounding whether the productivity of the NBN or the Applications should be measured. The findings show that the experts formed the consensus that it should be measured at both the NBN and Application

levels. This adds an extra layer of complexity to the developing of a inclusive model for measuring broadband productivity in isolation from general ICTs.

Another major finding from this section was that failure to invest in a high-speed broadband infrastructure would lead to regional Australian SMEs becoming uncompetitive in a global marketplace, and that this would then lead to stagnation in productivity and growth. The experts formed a strong consensus to this logical extension of the argument that telecommunications technologies are responsible for underlying growth in productivity along historical trends. This would have to be taken into account when developing any counterfactual case for the NBN-related productivity model.

Finally, the following is a reiteration of the comments made as part of the open response section from round two.

Response No.	Response
1	A ubiquitous NBN is a technology that can be so enmeshed in the rest of the society and economy that its effects will be extremely difficult to measure. For example, the NBN could be used to reduce the need for hospital beds for outpatient monitoring. How do we include this savings in an NBN "productivity model"? How does one measure the benefits of psychological well being secured by forming "virtual communities" between people previously isolated due to lack of bandwidth to regional townships? The problem is that the cost of the NBN is easy to identify and measure. Its benefits are far more complex and difficult to measure. Hence, using "productivity statistics" to measure the value of the NBN fails to capture the full picture. The problem is that it may not be possible to measure many of the NBN's benefits to community.
2	With a utility it is always difficult to measure the effect. What is the effect of the use of water, electricity, roads, etc? Do we measure that in relation to productivity or do we simply know that without it productivity will be significantly less. For most businesses the question will be rather academic they intuitivey[sic] know that it increases the productivity. It is at the political level and perhaps at a government level where these issues are more important.
3	Q12 should have an option to choose all options for measurement

Table 11: Responses to Question 16 (Round 2)

As we can see from these responses the nature of measuring the productivity of the NBN and the broader benefits is an indepth and complex task, which should be considered before embarking on any economic modeling.

5.6 The Use of the NBN in SMEs

The questions contained in this section of the study were designed to examine the implications and veracity of the data collected in the 2009 ACMA report *"Convergence and Communications - Report 2: Take-up and use of communication by small and medium enterprises"*. This report suggested three main points that were of interest to this study :-

- 100% of businesses did not perceive *"speedier internet"* as a critical service within the next twelve months (May 2008 – May 2009).
- The majority of SME traffic was traditional, transactional internet activity (such as web-surfing, e-mail, internet banking and so forth)
- That the *"…overwhelmingly positive reported effect from adopting broadband internet provides evidence, together with increasing choice in communications, of the way in which the communications sector is meeting the needs of Australian SMEs (and, more broadly, the needs of the community)."* (Australian Media and Communications Authority, 2009)

During round one, two major ideas were expressed in relation to those points. Initially the figure of *"100%"* was not supported by the experts, many of whom have had discussions with multiple regional SMEs who have expressed a desire for access to higher bandwidth. A re-occurring assertion of the experts was that even ADSL line connectivity was still not available in some exchanges and some businesses were still using dial-up. In these cases SME operators obviously desire greater access to higher speeds within the next 12 months. While the ACMA report provides a profile of the characteristics of their sample in terms of size, annual turnover, industry and age of business, that does not extend to a breakdown of metropolitan versus non-metropolitan businesses surveyed. This could account for a discrepancy between the ACMA report and the experts' statements.

The second major idea expressed by the experts was that many regional SME operators were unaware of the benefits or applications of higher bandwidths that could increase their productivity and growth. This would explain their lack of interest in speedier internet connections.

During the study the experts were asked, given that the SMEs use of the internet was traditionally transactional, (and therefore their needs were currently being met by the telecommunications industry) why did SMEs need faster broadband connections? These factors were provided and during the second round the experts were asked to rate several general applications of the NBN, based on the potential they showed in increasing the productivity and subsequent growth of regional SMEs.

The following applications were seen as having a high potential to affect regional SME's productivity and have been ranked in order from highest to lowest potential: -

- Real-time interactive collaboration.
- Removal of geographical business limitations, such as communications.
- Real-time high definition interactive video for training, diagnosis and conferencing.
- Teleworking.
- Reliable, consistent, high quality broadband service (reducing jitter, re-transmission times etc.).

By contrast the following applications were seen as only having a reasonable to high potential of increasing the productivity of Australian regional SMEs.

- Cloud Computing and Software as a Service (SAAS).
- Newly evolving high bandwidth applications.
- Convergence of technologies.

These results reinforce the experts' assertions that the NBN will provide benefits that transcend simple increases in bandwidth. Rather, the advantages come from allowing consistent services that enable SMEs to separate their place of business from the their *"place of technology"*. For example this would be enabled through interactive, real-time collaboration, tele-working, removal of geographical boundaries, cloud computing and software as a service.

However, it should be clearly noted that there were several issues that were highlighted by the experts as having the possibility to limit the use of these applications by regional SMEs. The experts were presented with the list of these factors and asked to rate the potential of each of these issues. At the end of the second round the experts had formed the consensus that the following factors had a reasonable potential to limit productivity increases.

These factors have been ordered from highest to lowest potential.

- SMEs waiting for customer adoption of High Speed Broadband
- Individual SME's lack of understanding of the technologies.
- Individual SME's lack of technological vision.
- Uncompetitive pricing amongst RSPs

With the following factors only a very loose consensus was formed, with experts suggesting that there was some potential from these factors to limit the SMEs productivity.

These two factors are rated by potential from highest to lowest.

- SME's Security and Privacy Concerns
- Type of SME (For example sector or age of owners)

However, there was no consensus formed that the slow transition from one service provider would have even some potential to limit regional SME's use of this technology.

The findings of this study also show that there is an expert consensus that a failure to invest in high-speed broadband infrastructure (such as the NBN) will drive SME investment away from regional area. This is because businesses now need to exist within the information economy.

The open-ended responses at the end of this section, especially responses numbered one and two, also provided valuable information regarding relating to this point.

Response No.	Response
1	The value of information in the modern economy plus the ongoing globalization of industry means that ubiquitous access to up-to-date information is increasingly important. Therefore, failure to provide this access to up-to-date information will have a detrimental effect on any SME that relies on information and is connected into the national/global economy. Very localized SMEs may not see much benefit from the NBN, however all others will, provided they can apply the technology.
2	Already very few business would locate (if they have a choice) where there is little or no bb [broadband]. In many regional areas they won't have a choice as soon that is available they will not locate where there is no access as that doesn't make business sense. They won't locate where there[sic] no roads or no electricity either. (all within reason of course)

Response No.	Response
3	It is very important that there is a plan to develop applications built around industries / industry verticals to demonstrate to regional SMEs the power that a better broadband connection will bring to the business. Using case studies will be a great way to illustrate this and give these businesses some real context, and understand how it can help them achieve their business goals (EG. More revenue, reduced costs, greater worker flexibility (work remotely), better time management, better collaboration.... etc.)
4	Please note that moving a business from a PSTN/ISDN based number range to an alternate voice provider (usually called complex number porting) can take weeks under current processes. The industry needs to overcome this issue which tends to be a roadblock for Businesses moving from Telstra to a new provider.

Table 12: Responses to Question 18 (Round 2)

5.7 Timing of Projected Benefits

While this study attempted to provide a definitive timeframe in which we could expect to see measurable increases in productivity, a lack of expert consensus on this question has prevented this study from delivering a finding on this issue. However this does not prevent this study from sharing its observations.

The first observation is that the timing of the productivity increases is not uniform. Generally the experts grouped their predictions into one or two of three categories.

The first category was that of individual cases. The general consensus given during the first round interviews was that we would see individual cases of increased productivity almost immediately. This is because as it follows an adoption curve with some users quickly adopting the technology in an entrepreneurial way. One of the observations made by the expert panel was the early adopters would have a level of "first mover advantage" which would help to increase their productivity. However during the second round, consensus was unable to be formed with five experts suggesting that this would happen between zero to five years and another five suggesting five to eight. What can be said however, is that the majority of the experts would expect to see a measurable difference in productivity within individual regional SMEs in under eight years.

The second category was that of the regional SME sector. This "lumped in" all the SMEs in regional areas into a single sector, which could then be discussed in terms of time. Generally during first round of interviews experts said that this sector would take a much longer time than the individual SMEs, to see measurable increases in productivity. This would incorporate both the individual SMEs that moved quickly as well as the ones that moved slowly and possibly even lagged behind. This question, when put to the experts in the second round online survey, also did not reach consensus with the results being spread across the entire continuum of times. However, it could be said that the majority of the experts would expect to see a measurable gain in productivity within ten years.

The final category was an economy-wide effect. This was listed by a couple of experts too in the first round and generally involves long time periods of twenty or more years. In contrast to this however the second round interviews came back with a full range of responses ranging from between zero to five years and twelve to fifteen years.

This is entirely different to the first round. While consensus could not be reached, the majority of experts again would consider that they would see measurable, economy wide productivity increases as a result of the NBN within ten to fifteen years. This is interesting because experts suggested during the first round of the economy-wide changes would be based on introduction of the information economy in all areas of life (business, governments, education, health and so forth).

It is also possible that consensus failed to be reached as the question failed to determine from which point the measurement was taken for example after a business is connected, after the full network is rolled out, or even how many years from today.

5.8 Political Factors

Telecommunications is an area that has becomes intensely political. This is because the Australian Constitution officially recognizes that the power to legislate telecommunications is given to the federal government. In 1998, that power was used by the then Howard government to sell Telstra. In 2008, the Rudd government used these same powers to introduce their NBN policy. Both these have been political policy-based decisions which have caused intense debate and division amongst policymakers, industry groups and the public.

The NBN is an idea that is unfortunately linked to political policy, which does not share bipartisan agreement within the Australian Parliament. This causes a great deal of uncertainty in the lead up to and the weeks following, the 2010 Federal election.

Two questions were asked in this study to capture an expert consensus as to the merits of two of the political proposals that were of particular relevance to this study.

The first was the issue of the heads of agreement between NBN Co. and Telstra, which proposed a fixed price the decommissioning of Telstra's copper network, while they move their customers over to the new NBN infrastructure and negotiates for the NBN to the use of Telstra's ducts (Telstra 2010) This study asked the expert panel whether this agreement would have a "*… significant effect on the speed of NBN take-up, and will this have a significant impact on productivity*".

Our findings show that the consensus of the experts was that this agreement would have a significant effect on the speed of NBN take-up. Further, the experts said that this was a predominantly positive move that would save money and increase the value of the new network. However the comment was also made that this was not necessary for the successful implementation of the NBN. The expert suggested that the NBN Co. could quite easily roll out their network without any assistance from Telstra, had they refused to co-operate.

The second question asked was directly related to the Liberal-Nationals Coalition's alternative broadband policy, which was launched during the 2010 Federal Election. This plan proposed "*deliver[ing] a uniform national broadband network, under which 97 percent of premises are able to be served by high speed networks capable of delivering from 100 Mbps down to a minimum of 12 Mbps peak speed, using a combination of technologies including HFC, DSL and fixed wireless*" (Liberal Party of Australia 2010). The experts were asked to comment on whether this plan …*would have provided the same levels of productivity as the proposed NBN*"?

Our findings on this issue could not have been clearer, with the experts unanimously finding that it would not provide the same levels of productivity. They in fact would be significantly lower. Several experts suggested that this would in fact take Australia back five years, as it would be a return to the "patch-work quilt" approach to non-interoperable networks and lack of competition which would further increase the digital divide between metropolitan, regional and remote communities. In addition the experts said that this plan makes use of dated and inferior technologies (when compared to fibre optics).

Based on the experts' consensus it would seem foolish to implement such a plan in light of the finding that reliable high speed broadband access is a significant factor in determining where businesses will invest.

5.9 General Discussion

5.9.1 Optimistic Bias

While a general optimism is visible through the results it should not be interpreted as a bias in the sample. The experts were generally optimistic. They identified key negative factors, which were combined, peer-reviewed as part of round two question eighteen (see section 4.4.5.2). In addition this study was designed so as to provide constructive findings that inform policy makers in the area of telecommunications of the effects that may impact the NBN's effectiveness in delivering productivity and growth benefits to regional SMEs. This is best done through helpful, evidence-based suggestion, rather than ideology-riddled dogma.

5.9.2 Relevance of Method

While the method used for this study is neither novel nor usual, its use has been justified in this case. One of the key benefits of the Delphi model (as explained in Chapter 3) is it ability to allow the experts the opportunity to change their view. This allows experts who have been persuaded by the evidence presented in each round to change their position (Rowe and Wright 1999). This is vital, as the expert may be presented with a new and worthwhile idea, which alters their position thus changing the outcomes of subsequent rounds.

This was exemplified in the question of the *"productivity paradox"*. During the first round the majority of experts suggested that a *"productivity paradox"* would be expected to play a role in distorting the figures relating to broadband productivity when they were collected in the future. However there was a major dissenting opinion presented (see 4.3.2.1). During the second round there was a very different view. The majority of experts' changed their stance on the *"productivity paradox"* and in contrast supported the alternative hypothesis, which was drawn from the expert pool.

This suggests that the Delphi Method has in fact been highly effective in this study in providing the experts with the ability to select the most probable responses, without any damage to their credibility, as would have possibly been the case in a situation where the expert's identities were not confidential.

5.9.3 Criticism of Measurement

Amongst both the first and second rounds, some experts raised the concern that this research's focus on the productivity was "somewhat academic" with some experts suggesting the measurement of the productivity may in fact be irrelevant.

This can be seen in the open responses to round two. Question sixteen has two responses that illustrate two experts' concerns with the difficulty and level at which we are measuring the effects of the NBN.

Response No.	Response
1	A ubiquitous NBN is a technology that can be so enmeshed in the rest of the society and economy that its effects will be extremely difficult to measure. For example, the NBN could be used to reduce the need for hospital beds for outpatient monitoring. How do we include this savings in an NBN "productivity model"? How does one measure the benefits of psychological well being secured by forming "virtual communities" between people previously isolated due to lack of bandwidth to regional townships? The problem is that the cost of the NBN is easy to identify and measure. Its benefits are far more complex and difficult to measure. Hence, using "productivity statistics" to measure the value of the NBN fails to capture the full picture. The problem is that it may not be possible to measure many of the NBN's benefits to community.
2	With a utility it is always difficult to measure the effect. What is the effect of the use of water, electricity, roads, etc. Do we measure that in relation to productivity or do we simply know that without it productivity will be significantly less. For most businesses the question will be rather academic they intuitively know that it increases the productivity. It is at the political level and perhaps at a government level where these issues are more important.

Table 13: Response 1 and 2 from Question 16 (Round 2)

Response number one suggests that the NBN will be so "enmeshed" in society and technology that will be extremely difficult to measure its effects. Further they suggest that productivity statistics will fail to capture the full value of the NBN. This was a recurring theme amongst the experts in the initial round. Further, the second expert suggests is that the NBN is a utility and as such has "inherent" productivity benefits. They say that the productivity benefits of utilities such as water and electricity were never quantified, but we intuitively understand that without them we would be less productive.

While these comments are valid and important the objective of this research was never to identify the benefits of the NBN, but simply to attempt to determine the effect the NBN would have on productivity and subsequent growth of regional SMEs. As explained in Chapter 1 this is an important question, as it tests a prominent underlying assumption, which is used to justify the building of the NBN i.e. that the NBN will increase our the nation's productivity.

It should also be noted that since the announcement of the NBN policy, the justification has remained the same. On October 21st 2010, Hon. Anthony Albanese, acting as the Minister (representing the Minister for Broadband, Communications and the Digital Economy) answered the following question during parliamentary question time "What problems have been identified with Australia's current broadband technology? Are these problems widely identified, and how does the building of the National Broadband Network provide a solution to these problems?" The Minister responded, "…We know that innovation in information and communication technology is the single biggest driver of productivity in our economy. Some 78 per cent of gains in services productivity are a direct result of ICT and 85 per cent of improvements in productivity in manufacturing are a direct result of ICT…".

Therefore, the answer to the question *"Will be in NBN effect the productivity of regional small to medium enterprises?"* remains a valid question.

5.10 Conclusion

This chapter provided an in-depth explanation of the results of this study. An examination of the results clearly showed that simple, technologically determinist views of the NBN are not appropriate to describe the complex nature of the effects that the NBN will have on productivity. These social and technical factors, effects and conditions are essential to our understanding of the NBN as a whole. Policymakers should take note to incorporate these social and technical factors into the policy and practice of the NBN.

In addition, the findings suggest that the *"productivity paradox"* was not likely to be applicable to the NBN. The factors identified by the experts need to be taken into consideration when evaluating any productivity statistics that are released about the NBN.

This chapter also examined the possibility of an optimistic bias, the effectiveness of the method used for the research and the relevance of measuring productivity and what this means for NBN debate.

The next chapter will conclude this study providing a summary of the main findings from this section, the significance of these findings, limitations of the research and will explore the future direction of research in this area.

Chapter 6 : Conclusions

6.1 Introduction

Australia is currently embarking on a unique infrastructure project that may change the nature of "*Last Mile*" access to Australian telecommunications forever. The Australian geographical context is unique and encourages greater reliance on telecommunications infrastructure. Australia is both isolated from the rest of the world, isolated from itself, with small concentrated pockets of population surrounded by much larger areas of sparse population. This distribution of population coupled with the harsh natural landscape has caused a digital divide to grow between metropolitan and non-metropolitan areas of Australia and the National Broadband Network's goal to close this gap is ambitious.

Much of the argument for building this "super fast" broadband network has been based on the premise that increased internet bandwidth will increase Australia's productivity and growth. There is however very little evidence which links increases in bandwidth to increases in productivity and growth.

As over ninety percent of Australian businesses are classified as small to medium enterprise (SME), many of which are located in the regional areas, much of this increase in productivity and growth would take place in these businesses. This study has attempted to answer the question, Will access to "last mile" fibre increase productivity and growth, especially in regional SMEs?

6.2 Significant Findings

While the findings of this research and the original results can be found in Chapter 5 and Chapter 4 respectively, this section will present the most significant findings of this study.

6.2.1 The effect of the NBN on productivity and growth.

This is possibly the most significant finding of this research. The study found that *yes* the NBN would indeed have a positive effect on productivity and subsequent growth of Australian regional small to medium enterprise. This is significant for two main reasons.

Firstly, it provides a definitive answer to the thesis question, which was *"will having access to 'last mile' fibre increase productivity and growth, especially in regional SMEs?"*. The answer is of course *yes it will*. There was a strong expert consensus around this point, which was established within the first round.

Secondly, this finding provides new evidence that broadband connectivity can lead to increases in productivity. While other studies have linked these two factors, much of the evidence for an increase in productivity as a result of broadband have either been based on extrapolating data or is being based around productivity calculations which include broadband connections as part of general purpose technologies or ITCs.

Finally, this finding does not just provide a "yes/no" answer but also provides detailed set of qualitative data, which backs up the assertions made by the experts. This qualitative data has in turn been subjected to peer-review by the expert panel to gain a consensus about the relative importance of each factor, effect and condition.

6.2.2 The relative importance of technical factors.

The second major finding of this research relates to the relative importance of various factors identified and ranked by the experts. While our findings show that two technical factors were rated as the *most important* they only made up one third of the total number of factors ranked as *important* in this study. The remainder were a mixture of political, economic, regulatory and social factors.

This is significant as it is highlights the inadequacy of the technologically deterministic, "build it and they will come" approach that is being taken by many participants in the public debate surrounding the NBN. The findings of this research show that the relationship between productivity and the NBN is much more complicated than technical factors can adequately portray. This reinforces the case of using a framework such as actor network theory (as suggested in Chapter 1) to discuss the factors surrounding the NBN. In actor network theory (see section 2.3.3), a network (such as the NBN) is made up of multiple actors (such as social, economic, regulatory, political and technical factors) which work cooperatively to achieve the goal of the network, in this case creating the most productive NBN.

6.2.3 The list of conditions.

The third significant finding from this research was the list of important conditions that the experts developed through a process of consensus. These conditions, listed below, are highly significant as they provide participants in the public debate and especially policymakers with a "checklist" for success. The experts came to the consensus that these nine conditions should be fulfilled in order to bring about an NBN that has a positive effect on the productivity and growth of regional SMEs. These conditions should be embraced by policymakers and enshrined in the NBNs legislation, policy and ethos.

These nine significant factors are:-

- Open access.
- Appropriate pricing.
- Community & SME education to ensure awareness of visions and benefits of the NBN.
- Skill development for regional SME workers in the use of the NBN.
- Government sponsored innovation into applications, services and product development (In addition to building the network).
- Ubiquity.
- Government use of the NBN to deliver services.
- Ensuring economic viability of the NBN.
- Competition.

6.2.4 The underlying productivity argument.

The fourth significant finding of this research was that the experts did not believe that the "productivity paradox" would have a significant effect on our measurements of productivity relating to the NBN. They instead formed a consensus surrounding an alternative hypothesis, which was suggested from within the expert panel.

This suggested we would not see increases in productivity as a result of implementing the NBN because telecommunications technologies have supported the historic growth levels in productivity and without telecommunications technologies these productivity levels would stagnate. The consensus surrounding this argument was very strong with approximately 92% of all experts agreeing to the proposition.

This finding is highly significant as it suggests that we may never be see a definable increase in productivity that can be directly attributed to the NBN. It is therefore necessary for policymakers to be aware of this and set realistic expectations about the measurable differences in productivity. Without this there is a risk of political recrimination based on a lack of information.

6.2.5 Measurement of productivity

Further significant factors that were reported from this study were the issues with measurement. This research tried to determine three essential points about how we should measure the expected increases in regional SMEs productivity as a result of the NBN.

The first point we tried to ascertain was which measurement technique should we use to capture this expected increase in productivity. The experts were unable to provide a consensus on whether to use "multifactor productivity", or measure the productivity gain "as part of a GPTs or ICTs" or as a "single broadband technology".

The second key point to ascertain was at which economic level should the measurements be taken. At the "firm level", at the "sector level", or "economy wide". The consensus formed amongst the experts was that it should be measured at all three levels.

The final key point ascertained was whether the productivity measured should be that of the application running over the NBN or NBN itself. The experts concurred that both should be measured.

The findings are particularly significant as they show the level of complexity in trying to measure the productivity effects of a "enabling technology" such as the NBN. In order to complete productivity calculations of this kind it would therefore be necessary to collect firm, sector and economy wide data on the productivity of the enabling technology (and the NBN) and the individual applications that run over it. While this would be possible in a small number of cases the amount data required for these calculations would seem to make them prohibitive.

6.2.6 The failure to invest…

The sixth factor of significance from this research relates to the failure to invest in a high speed broadband technologies. A consensus among the experts found that a failure to invest in a high-speed broadband technologies in regional areas would lead to regional small to medium businesses becoming uncompetitive in regional, national and global markets. The NBN is, like a road to a port, an essential piece of regional infrastructure that allows the region to expand into new markets. Lack of investment in this service for regional areas will lead to a lack of investment in regional SMEs. One expert suggested that this would have the potential to cause the collapse of that region's economy, leading to higher unemployment and greater reliance on government services.

6.2.7 The major uses of NBN enabled technology

The final significant findings from this study were that of the major uses of NBN enabled technology. These uses are not only significant because they prove that there is a practical application for the NBN's high speeds but the findings also suggest that speed is only *one* of the benefits. As can be seen below some of the major advantages come from the ability to access a reliable, consistent and high quality broadband connection (which ADSL and wireless solutions do not always provide). In addition the NBN allows users freedom from their geographical location.

Finally these findings are significant because they provide a good direction and vision for both education and awareness campaigns relating to how the NBN can be used. One of the re-occurring themes throughout the research was the recommendation that case studies be established to provide education and awareness of the benefits of the NBN. This list is a possible starting point in the development of such case studies.

The following applications were seen as having a high potential to effect regional SMEs productivity and have been ranked in order from highest to lowest potential: -

- Real-time interactive collaboration.
- Removal of geographical business limitations, such as communications.
- Real-time High Definition interactive video for training, diagnosis and conferencing.
- Teleworking.
- Reliable, consistent, high quality broadband service (reducing jitter, re-transmission times etc.).

6.3 Limitations

6.3.1 Scope

The most obvious limitation of this research is that it is restricted to Australian regional SMEs. While it could be said that Australian regional small to medium enterprise represents a microcosm of the Australian business, care should be taken when applying any of the specific findings to other types of businesses.

6.3.2 Time Constraints & Consensus

When this study was first proposed and embarked upon it was expected that the 2010 federal election would occur at the end of October. However as a result of internal party politics, the former Prime Minister Kevin Rudd, was replaced by Prime Minister Julia Gillard. This change in leadership led to the calling of an early election. This election and the subsequent negotiating and time taken to form government caused great difficulty in this research.

The partisan nature of the NBN within Australian politics led to it becoming a wedge issue between both parties throughout the 2010 election campaign. This resulted in two competing broadband policies during the campaign with the Liberal-National Coalition suggesting that the NBN would be a "white elephant", current broadband access was adequate, and that this could be supplemented with wireless technologies for a much lower price than NBN. At the same time, the Labor Party was extolling the virtues of the NBN and asserting that the Liberal National coalition's plan was neither equivalent nor viable alternative.

This political posturing surrounding the NBN and its future caused reluctance amongst some experts in committing to this research until the election result was known. However the hung parliament resulted in key independents taking 17 days to decide which party to support in forming Government. These political uncertainties lead to an extra 17-day delay in the research.

As a result of this delay there was not time to run the third round of Delphi method, which may have successfully resolved the questions where a consensus was not formed. As such, results that did not reach consensus are of limited value.

6.4 Directions for Future Research

While there are multiple directions in which this research could be taken in the future, several facets of this research could be investigated in greater depth.

The first is an indepth research into the most appropriate method for measuring broadband productivity. Due to the time limitations of this research it was impossible to run the third round of the Delphi method to attempt to gain a consensus as to the best method with which to gauge the productivity effects of a particular broadband technology. In addition, experts raised concerns that the measurement should be done as part of multifactor productivity or in relation to general purpose or information communications technologies. Investigation in this area could also lead to the development of a comprehensive model for measuring broadband related productivity at whichever level was most appropriate.

The second facet of this research that could be explored in greater depth is the definition of "regional" in terms of the Australian telecommunications landscape. The definition of regional used to this study was based on the Australian Bureau of Statistics *ARIA+* classification. While this may be an appropriate measurement for many government projects, its basis in census collection districts (CCDs) makes defining a continuous "region" difficult and counterintuitive. In addition the *ARIA+* classification is based on access to multiple essential services including health, police, education and garbage collection, but does not include telecommunications. This makes it a somewhat inappropriate classification when talking about telecommunications generally.

As is being suggested by multiple experts, many of the benefits of the NBN will not be measurable in terms of productivity or standard economic terms. This makes the process of cost benefit analysis a difficult, if not impossible, task. Further research could be done to develop a framework to measure the tangible and intangible benefits of the NBN.

Finally while this study examined the effect of the NBN on the productivity growth of regional SMEs, a comparative study into the effects on metropolitan and rural SMEs could provide valuable insights into the extent to which the NBN is able to close the digital divide between geographical areas.

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Chapter 7 : Appendices

Appendix A : Semi Structured Questions

General Questions

Question One

What effect do you think that a High Speed Broadband Network such as the National Broadband Network will have on the Productivity of Australian Regional SME'S?

Question Two

What factors, if any, relating to the provision of a High Speed Broadband Network such as the NBN do you believe will have a negative or positive impact on the growth and productivity of SME's in Regional Areas?

Question Three

What conditions need to be in place to ensure that a High Speed Broadband Network such as the NBN will have a positive impact on the growth and productivity of SME's in Regional Areas?

Productivity Paradox Questions

Introduction

The productivity paradox is the observation that, despite spending in the area of ICT, we do not see proportional increases in the productivity statistics.

Question Four

Do you believe that this is also applicable to High Speed Broadband Networks such as the National Broadband Network? Why?

Question Five

Introduction

For the purposes of this question:

Lag is an extended period of time in which productivity benefits are not perceivable.

Mismeasurement – refers to our inability to measure productivity accurately.

Mismanagement – refers to management issues that may effect productivity.

Redistribution – refers to when a system provides greater productivity benefits to other areas, rather than to the area originally intended.

Do you believe that Lag, Mismeasurement, Mismanagement or Productivity Redistribution will effect the productivity of Regional SME under a High Speed Broadband Network such as NBN? Why?

Question Six

Introduction

For the purposes of this question, cyber-slacking is the use a company's Internet for personal business (e.g. Facebook).

Do you believe that the efficiency of regional SME's is likely to be effected by cyber-slacking as a result of the increased speeds? Why?

Question Seven

Current research from the ACMA reports that the majority of SME Internet use is in general webpage traffic and email, which is predominantly transactional. Why will SME's need faster Internet?

Question Eight

How many years do you think it will take to see the NBN's effect on productivity in regional SME's?'

Question Nine

Do you think that the Telstra – NBN Co. Financial Heads of Agreement, will have a significant effect on the speed of the NBN take up, and will this have a significant impact on productivity?

Question Ten

Do you believe that the Liberal – National Coalition's plan released during the 2010 Federal Election would have provided the same levels of productivity as a High Speed Broadband Network such as NBN.

Question Eleven

Do you have any further observations that you would like to make?

Appendix B : Online Survey Questions

1. The following effects of the NBN on Regional SMEs were generalised from data collected during interviews . Please rank the likelihood of each of these effects on the productivity of Regional SME's.

The NBN will :- *

	Highly Likely	Likely	Possible	Unlikely	Highly Unlikely	I Do Not Wish Answer
Better connect regional SMEs to EXISTING markets *	○	○	○	○	○	○
Provide parity of access amongst regional & metropolitan business. *	○	○	○	○	○	○
Improve the reliability of communication, collaboration, e-commerce and other internet based activities. *	○	○	○	○	○	○
Enable the building of information economies in regional areas *	○	○	○	○	○	○
Provide "instant access" to new and existing (High and Low Bandwidth) information *	○	○	○	○	○	○
Provide essential infrastructure for the sustainable growth or survival of regional areas. *	○	○	○	○	○	○
Connect regional SMEs to NEW markets *	○	○	○	○	○	○
Decrease the relevance of geographical location *	○	○	○	○	○	○

2. Do you believe that the effect of the NBN on the productivity of a regional SME will depend on the type of regional SME? *

○ Yes ○ No ○ I Do Not Wish To Answer

3. Do you believe that the NBN will bring regional SMEs into competition with metropolitan and global companies, and will that have a positive, negative or neutral effect on their productivity? *

○ Yes, it will have a positive effect ○ Yes, it will have a negative effect ○ Yes, it will have a neutral effect

○ I do not believe it will have an effect ○ I Do Not Wish To Answer

4. Please write any further comments you wish to make about the effect of the NBN on regional SMEs in the space provided.

5. The following factors, relating to the provision of a High Speed Broadband Network such as the NBN were suggested as having a positive or negative impact on the growth and productivity of SMEs in Regional Areas.

Please rate the significance of these factors (Please Note: Each of these factors is described in further detail at the bottom of the page). *

	Critical	Important	Some Significance	Little Significance	Irrelevant	I Do Not Wish To Ans
Pricing *	○	○	○	○	○	○
Standard Platform *	○	○	○	○	○	○
Ubiquity *	○	○	○	○	○	○
Consultation with Stakeholders *	○	○	○	○	○	○
Rollout Speed *	○	○	○	○	○	○
Competition *	○	○	○	○	○	○
Regional Focus *	○	○	○	○	○	○
Speed/Bandwidth *	○	○	○	○	○	○
Vision & Strategy *	○	○	○	○	○	○

6. Please write any further comments you wish to make about the factors relating to the provision of the NBN on regional SMEs in the space provided.

7. The following are suggested conditions that need to be in place to ensure that a High Speed Broadband Network such as a the NBN will have a positive impact on the growth and productivity of SMEs in Regional Areas.

Please rate them based on their significance . *

	Critical	Important	Significant	Not Significant	Irrelevant	I Do Not Wish To Answer
Competition *	○	○	○	○	○	○
Ensuring the development of practical digital privacy and security policies and products. *	○	○	○	○	○	○
Removal of current legislative & policy inhibitors to allow new applications *	○	○	○	○	○	○
Government sponsored innovation into applications, services and product development (In addition to building the Network) *	○	○	○	○	○	○
Skill Development for Regional SME Workers in the Use of the NBN *	○	○	○	○	○	○
Community & SME education to ensure awareness of visions and benefits of the NBN *	○	○	○	○	○	○
Government use of the NBN to deliver services *	○	○	○	○	○	○
Ensuring Economic viability of the NBN *	○	○	○	○	○	○
Universal Service *	○	○	○	○	○	○
Ubiquity *	○	○	○	○	○	○
Open Access *	○	○	○	○	○	○
Appropriate Pricing *	○	○	○	○	○	○

8. Please write any further comments you wish to make about the conditions needed to complement the NBN to ensure its success for regional SMEs in the space provided.

9. Will we have a situation with the NBN where we will spend the money on the NBN and be unable to see the benefits reflected in the productivity statistics? *

○ Yes ○ No ○ I don't Know ○ I Do Not Wish To Answer

10. At least one expert disagreed with the idea of the productivity paradox, suggesting that productivity would not have continued its historical growth levels if it had not been for the underlying telecommunications technology. Do you agree or disagree with this argument? *

○ Agree ○ Disagree ○ I Do Not Know ○ I Do Not Wish To Answer

11. During the interviews, the following reasons were given for why we may see discrepancies between productivity statistics and the take up of the NBN by SMEs. Please rate the significance of these effects. *

	Significant Effect	Moderate Effect	Negligible Effect	No Effect	I Do Not W Answe
Different SMEs will have different levels of productivity, because they are different types of businesses *	○	○	○	○	○
Expansion of markets broaden the boundaries of the economic model *	○	○	○	○	○
Timing of Measurement *	○	○	○	○	○
Productivity may be affected by regulation or other external forces *	○	○	○	○	○
Mismanagement of Technology (For example investment in technology does not lead to an increase in output, or sales) *	○	○	○	○	○
Measurement Problems *	○	○	○	○	○
Redistribution of productivity benefits (externalities) *	○	○	○	○	○
NBN may increase quality but not output *	○	○	○	○	○
Granularity of the measurement & statistics *	○	○	○	○	○
Non-traditional use of technology *	○	○	○	○	○
Lag *	○	○	○	○	○
Lack of current data to use as a baseline or counter-factual case. *	○	○	○	○	○

12. How should we be measuring the productivity effects of the NBN on SMEs? *

○ As the single broadband technology ○ As part of broader general purpose technologies or ICTs ○ As part of multi-factor productivity

○ I don't know ○ I Do Not Wish To Answer

13. At what level should we be measuring the productivity effects of the NBN on SMEs? *

- The Firms
- The Sectors
- The National Economy
- All of the above
- I don't know
- I Do Not Wish To Answer

14. In your opinion, given that the NBN is an "enabling technology", should we be looking at the productivity benefits of the the NBN or the applications that it enables? *

The NBN | The Applications | Both | I Don't Know | I Do Not Wish To Answer

15. Do you believe that failure to invest in High Speed Broadband Infrastructure, will lead to Australian Regional SMEs becoming competitively disadvantaged in the global market leading to a stagnation in productivity and growth? *

Yes | No | I Don't Know | I Do Not Wish To Answer

16. Please write any further comments you wish to make about the effect of the Productivity Paradox on the NBN and regional SMEs in the space provided.

17. The following applications were given as examples why SMEs need faster broadband connection. Please rate the potential of each of these applications to increase Regional SMEs Productivity *

	High Potential	Reasonable Potential	Some Potential	Little Potential	Very Small Potential	I Do Not W Answ
Real-time interactive collaboration *						
Real-time High Definition interactive video for training, Diagnosis and Conferencing *						
Newly evolving high bandwidth applications *						
Removal of geographical business limitations, such as communications. *						
Reliable, Consistent, High Quality broadband service (reducing jitter, re-transmission times etc.) *						
Cloud Computing and Software as a Service (SAAS) *						
Teleworking *						
Convergence of Technologies *						

18. This question also brought up several factors that could have the potential to limit Regional SME's use of the this technology.
Please rate the potential each of these factors has to limit the Regional SME's use of this technology *

	High Potential	Reasonable Potential	Some Potential	Little Potential	Very Small Potential	I Do Not W Answ
SME's Security and Privacy Concerns *						
Individual SME's lack of understanding of the technologies. *						
Individual SME's lack of technological vision. *						
Type of SME (For example sector or age of owners) *						
Long delays in transitioning from one Retail Service Provider (RSP) to another ("Churning") *						
SMEs waiting for customer adoption of High Speed Broadband *						
Uncompetitive pricing amongst RSPs *						

19. Do you believe that a failure to invest in High Speed Broadband infrastructure in regional areas will drive SME investment away from regional areas? *

Yes | No | I Do Not Wish To Answer

20. Please write any further comments you wish to make about the effect of the reasons why Regional SMEs need better broadband connection in the space provided.

21. Please select from the time frames provided, the time frame that you believe most closely matches the time frame in which we will be able to measure the effects of the NBN in each of the economic units. *

	Individual Regional SMEs	The Regional SME Sector	Economy Wide
Time Frame *			

Explanatory Note At least one expert suggested that productivity would not have continued its historical growth levels if it had not been for the underlying telecommunications technology. They further suggest that the NBN will continue to support the underlying productivity growth, and so a further increase in the productivity (attributable to the NBN) will never be seen.

Appendix C : Round Two Survey Reponses

Question / Response	N	Min	Max	Med.	Std. Dev
Question 1:					
1A: Connect regional SMEs to NEW markets	13	3	5	5	0.93
1B: Better connect regional SMEs to EXISTING markets	13	2	5	5	1.04
1C: Enable the building of information economies in regional areas	13	3	5	5	0.66
1D: Decrease the relevance of geographical location	13	1	5	5	1.38
1E: Provide "instant access" to new and existing (High and Low Bandwidth) information	13	3	5	5	0.65
1F: Improve the reliability of communication, collaboration, e-commerce and other internet-based activities.	13	4	5	5	0.51
1G: Provide parity of access amongst regional & metropolitan business.	13	1	5	4	1.19
1H: Provide essential infrastructure for the sustainable growth or survival of regional areas.	13	1	5	5	1.21
Question 2:					
2: Do you believe that the effect of the NBN on the productivity of a regional SME will depend on the type of regional SME?	13	1	2	2	0.28
Question 3:					
3: Do you believe that the NBN will bring regional SMEs into competition with metropolitan and global companies, and will that have a positive, negative or neutral effect on their productivity?	13	0	3	3	0.85
Question 4:					
4: Please write any further comments you wish to make about the effect of the NBN on regional SMEs in the space provided.	5	N/A	N/A	N/A	N/A
Question 5:					
5A: Competition	13	0	5	4	1.42
5B: Ubiquity	13	3	5	5	0.77
5C: Speed/Bandwidth	13	3	5	4	0.55
5D: Standard Platform	13	2	5	4	0.83
5E: Regional Focus	13	3	5	4	0.80
5F: Rollout Speed	13	3	5	4	0.49

5G: Pricing	13	3	5	4	0.75
5H: Consultation with Stakeholders	13	3	5	4	0.71
5J: Vision & Strategy	13	0	5	5	1.55
Question 6:					
6: Please write any further comments you wish to make about the factors relating to the provision of the NBN on regional SMEs in the space provided.	3	N/A	N/A	N/A	N/A
Question 7:					
7A: Open Access	13	4	5	5	0.52
7B: Ubiquity	13	3	5	5	0.93
7C: Competition	13	2	5	4	0.75
7D: Government sponsored innovation into applications, services and product development (In addition to building the Network	13	3	5	4	0.71
7E: Community & SME education to ensure awareness of visions and benefits of the NBN	13	3	5	4	0.65
7F: Appropriate Pricing	13	4	5	4	0.52
7G: Skill Development for Regional SME Workers in the Use of the NBN	13	2	5	5	0.96
7H: Government use of the NBN to deliver services	13	1	5	4	1.14
7I: Ensuring Economic viability of the NBN	13	2	5	4	0.90
7J: Ensuring the development of practical digital privacy and security policies and products.	13	1	5	4	1.04
7K: Removal of current legislative & policy inhibitors to allow new applications	13	0	5	4	1.45
7L: Universal Service	13	0	5	5	1.50
Question 8:					
8: Please write any further comments you wish to make about the conditions needed to complement the NBN to ensure its success for regional SMEs in the space provided.	2	N/A	N/A	N/A	N/A
Question 9:					
9: Will we have a situation with the NBN where we will spend the money on the NBN and be unable to see the benefits reflected in the productivity statistics?	13	-1	2	1	1.00
Question 10:					
10: At least one expert disagreed with the idea of the productivity paradox, suggesting that productivity would not have continued its historical growth levels if it had not been	13	1	2	2	0.28

for the underlying telecommunications technology. Do you agree or disagree with this argument?					
Question 11:					
11A: Different SMEs will have different levels of productivity, because they are different types of businesses	13	2	4	3	0.75
11B: Expansion of markets broaden the boundaries of the economic model	13	2	4	3	0.60
11C: Granularity of the measurement & statistics	13	0	4	3	1.17
11D: Non-traditional use of technology	13	2	4	3	0.64
11E: NBN may increase quality but not output	13	0	4	2	1.18
11F: Lag	13	2	4	4	0.77
11G: Measurement Problems	13	2	4	4	0.66
11H: Mismanagement of Technology (For example investment in technology does not lead to an increase in output, or sales)	13	0	4	3	1.19
11I: Redistribution of productivity benefits (externalities)	13	3	4	3	0.48
11J: Timing of Measurement	13	2	4	3	0.60
11K: Productivity may be affected by regulation or other external forces	13	0	4	3	1.09
11L: Lack of current data to use as a baseline or counter-factual case.	13	0	4	3	1.19
Question 12:					
12: How should we be measuring the productivity effects of the NBN on SMEs?	13	-1	3	2	1.41
Question 13:					
13: At what level should we be measuring the productivity effects of the NBN on SMEs?	13	2	4	4	0.88
Question 14:					
14: In your opinion, given that the NBN is an "enabling technology", should we be looking at the productivity benefits of the the NBN or the applications that it enables?	13	2	3	3	0.48
Question 15:					
15: Do you believe that failure to invest in High Speed Broadband Infrastructure, will lead to Australian Regional SMEs becoming competitively disadvantaged in the global market leading to a stagnation in productivity and growth?	13	0	2	2	0.77
Question 16:					
16: Please write any further comments you wish to make	3	N/A	N/A	N/A	N/A

about the effect of the Productivity Paradox on the NBN and regional SMEs in the space provided.					
Question 17:					
17A: Real-time interactive collaboration	13	4	5	5	0.48
17B: Real-time High Definition interactive video for training, Diagnosis and Conferencing	13	3	5	5	0.65
17C: Newly evolving high bandwidth applications	13	2	5	4	0.83
17D: Removal of geographical business limitations, such as communications.	13	4	5	5	0.51
17E: Reliable, Consistent, High Quality broadband service (reducing jitter, re-transmission times etc.)	13	3	5	5	0.78
17F: Cloud Computing and Software as a Service (SAAS)	13	0	5	5	1.36
17G: Teleworking	13	2	5	5	0.88
17H: Convergence of Technologies	13	0	5	4	1.41
Question 18:					
18A: SME's Security and Privacy Concerns	13	2	5	3	1.03
18B: Type of SME (For example sector or age of owners)	13	3	5	4	0.58
18C: Long delays in transitioning from one Retail Service Provider (RSP) to another ("Churning")	13	1	4	3	0.95
18D: SMEs waiting for customer adoption of High Speed Broadband	13	2	5	4	0.76
18E: Individual SME's lack of technological vision.	13	3	5	4	0.80
18F: Individual SME's lack of understanding of the technologies.	13	3	5	5	0.77
18G: Uncompetitive pricing amongst RSPs	13	3	5	4	0.86
Question 19:					
19: Do you believe that a failure to invest in High Speed Broadband infrastructure in regional areas will drive SME investment away from regional areas?	13	1	2	2	0.48
Question 20:					
20: Please write any further comments you wish to make about the effect of the reasons why Regional SMEs need better broadband connection in the space provided.	4	N/A	N/A	N/A	N/A
Question 21					
21A: Individual Regional SMEs	13	2	7	3	1.38
21B: The Regional SME Sector	13	2	7	4	1.61
21C: Economy Wide	13	2	6	4	1.36

Table 14: Round Two Survey Responses

Appendix D : Additional Survey Material

Question Five - Suggested Factors

Factors	Explanation
Competition	This refers to effective competition and competition policy surrounding the NBN and RSPs
Ubiquity	This refers to the provision of an effective High Speed Broadband Network to 100% of the Australian Population.
Speed/Bandwidth	This refers to the provision of between 12mbps and 100mbps speeds
Standard Platform	This refers to the provision of a standardized network that provides set speeds to set percentages of the population, without gradual service degradation based on distance. (Enables building of applications & services to standard specifications)
Regional Focus	This refers to specific focus on regional areas during the roll out of the NBN, such as building in regional areas first, equality of service, equity schemes to remove the digital divide etc.
Rollout Speed	This refers to the speed at which the roll out can be completed, speeding up adoption and increasing the value of the network.
Pricing	This refers to the development of a reasonable pricing model, which is competitive, standardized and affordable.
Consultation with Stakeholders	This refers to the appropriate consultation with various stakeholders in the network to: - Ensure compatibility with state planning laws. - Negotiate access to multi-tenant office blocks - Enable collaboration between Government, RSPs, SMEs etc.
Vision & Strategy	This refers to ensuring that the Public, SMEs, Parliament, Business etc. understand the vision and long term strategy of the NBN. It also refers to the education of these same parties as to the benefits and uses of the NBN.

Figure 69: Suggested Factors Stimulus

Questions Nine to Sixteen – Productivity Paradox Stimulus

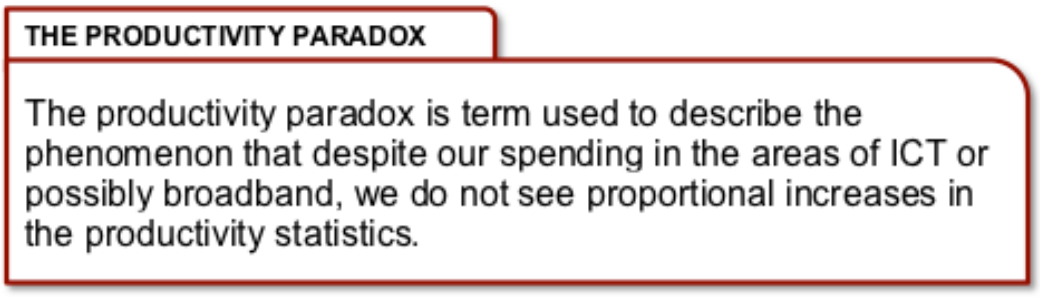

Figure 70: Productivity Paradox Stimulus