Deloitte Access Economics

Mobile nation

The economic and social impacts of mobile technology

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MOBILE NATION: The economic and social impacts of mobile technology

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Glossary

2G	Second Generation
3G	Third Generation
4G	Fourth Generation
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACO	Australian Chamber Orchestra
ACMA	Australian Communications and Media Authority
AMTA	Australian Mobile Telecommunications Association
Apps	Application software
BYOD	Bring your own device
DAE-GEM	Deloitte Access Economics' Computable General Equilibrium Model
ENG	Electronic news gathering
FTE	Full-time equivalent
GDP	Gross Domestic Product
GHz	Gigahertz
GPRS	General Packet Radio Service
GSM	Global System for Mobiles
HSDPA	High Speed Downlink Packet Access
IMT	Information, media and telecommunications industry
LTE	Long-Term Evolution
M2M	Machine-to-machine
Mbps	Megabits per second
MDM	Mobile device management
MFP	Multifactor productivity

MHz	Megahertz
MVNO	Mobile Virtual Network Operator
NBN	National Broadband Network
NFC	Near-field communication
PDA	Personal Digital Assistant
PSTN	Public Switched Telephone Network
RAV	Relationships Australia Victoria
TIO	Telecommunications Industry Ombudsman
VHA	Vodafone Hutchison Australia
WAP	Wireless Application Protocol
WiMax	Worldwide Interoperability for Microwave Access

Executive summary

Recent years have witnessed a dramatic transformation in the mobile industry. The mobile has become the dominant form of telecommunications technology; mobile broadband has dramatically increased; smartphones and tablets have driven a trend towards convergence; mobile has become critical in the digital strategies of business; and changing telecommunications and media has been one of the dominant influences on society in our time in history.

And yet, we may only be at the dawn of a new era in mobile technology. Growing investments in 4G networks, along with the rollout and transition to the NBN, promise to drive mobile even more deeply through our economy and society. M-commerce is in its infancy. The most innovative apps and location-based services have probably not been invented yet. It is against this background that the Australian Mobile Telecommunications Association (AMTA) commissioned Deloitte Access Economics to report on the economic, business and social impacts of the Australian mobile telecommunications industry.

Key points

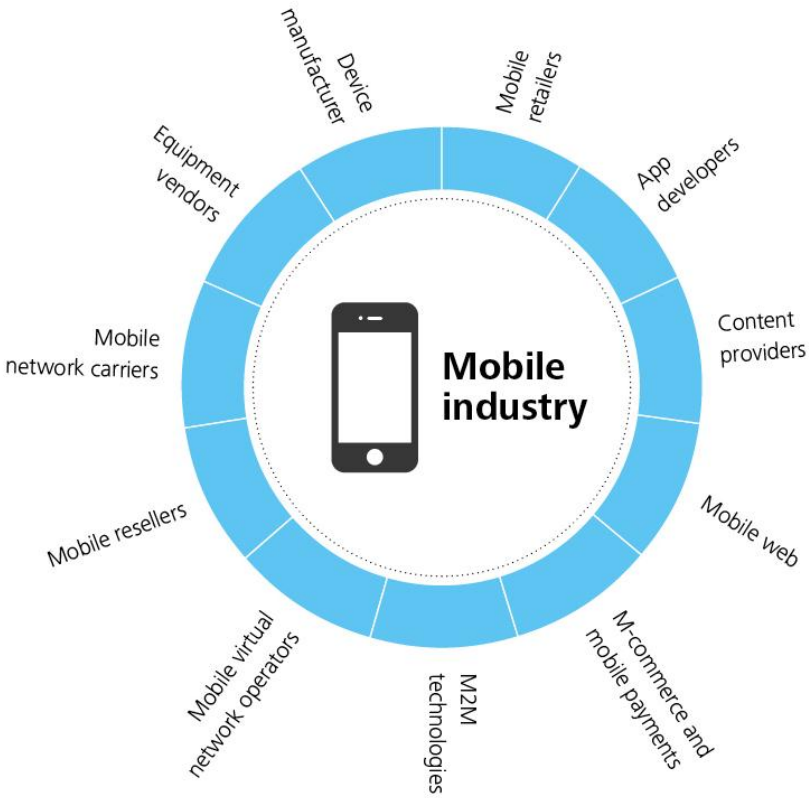
- The structure of the mobile industry is changing from a simple supply chain to an emerging ecosystem of mobile businesses that encompasses mobile web, apps, m-commerce and more.
- To maximise the benefits of mobility in the digital economy, spectrum policy must allow for the staged expansion of spectrum resources to mobile broadband.
- Convergence in devices will be complemented by increased integration between networks, with mobile and fixed networks, including the NBN being complementary and increasingly interdependent.
- Mobile telecommunications industry revenue was $22.0 billion in 2011-12, down 1.5% on the 2010-11 total, in contrast to the historic trend of high growth in industry revenue.
- The mobile industry is forecast to be stagnant in 2012-13. After a modest recovery, it will grow to $25.9 billion by 2016-17 (by 18%). The total economic contribution of the industry was $14.1 billion in 2011-12, supporting 56,970 FTE employees.

- The current wave of mobile technology is driving labour efficiency with 'productivity apps' and use of 'down time'; it is also increasing capital productivity: with estimated economic productivity benefits of $11.8 billion over the next decade.
- Mobile is moving from a device for individuals to a platform for all of business' ICT needs: email, software, cloud, big data, and m-commerce. Driven by customers and employees, it has significantly changed how marketing, HR and IT functions operate.
- Mobile technology is driving significant changes in society – influencing individual identity, relationships, work-life balance, communities and national media – with the full impacts not yet known.

The mobile industry: an emerging ecosystem

A key finding is that the industry is changing from what was once a relatively simple supply chain from hardware manufacturers to final customers to an emerging ecosystem of mobile technologies driving economic change and economic productivity growth.

Figure 1.1 Emerging structure of the mobile Industry



Source: DAE

Spectrum

The most critical issue for the mobile sector is policy and regulation with regard to spectrum allocation and licensing. Significant investments in spectrum and other infrastructure required to support the deployment of mobile networks have delivered significant economic productivity to Australia.

Demand for spectrum is increasing as significant investments in mobile networks have enabled the full capabilities of the new mobile devices to materialise.

To maximise the benefits of mobility in the digital economy, spectrum policy settings must be reviewed and allow for the staged expansion of spectrum resources to mobile broadband.

Convergence

Convergence of communications and media is where a user can access a range of multimedia services using varied devices and network connections.

The recent Australian Government 'Convergence Review' examined the policy and regulatory frameworks that apply to the converged media and communications landscape in Australia.

The Review focussed on media ownership laws, content standards, production and distribution of Australian local content, and spectrum allocation.

This is an important area where government action will be required to address existing and emerging problems in the current legal and regulatory framework.

Economic contribution

One measure of the size of the mobile telecommunications industry is output, which was $22.0 billion in 2011-12, down 1.5% on the 2010-11 total. Recent mixed results among carriers have come after a strong period of growth over the past decade.

Subscription numbers have largely driven the increases in revenue over the past five years, however, this has begun to slow as the market reaches saturation point with a mobile penetration rate of well over 100% (more than 30 million mobile services) according to the ACMA's 2011-12 Communications Report. In 2011-12, conditions also reflected other factors such as mobile repayment options, service to equipment ratios, mobile termination rates, changes to plans and user behaviour, market share changes, and generally slower growth in non-handset mobile growth.

For 2011-12, the total value added by the industry was $14.1 billion, with $7.6 billion direct contribution and $6.5 billion indirect activity in related sectors and across the economy. Total employment supported by the industry is 56,970 full-time equivalent employees, with 22,340 direct FTE employees.

Forecasts for growth

After years of strong growth, weaker conditions in the mobile telecommunications sector have seen forecasts for revenue revised down. After contraction in 2011-12 and stagnation (in real terms in 2012-13), the industry will experience a modest recovery in 2013-14.

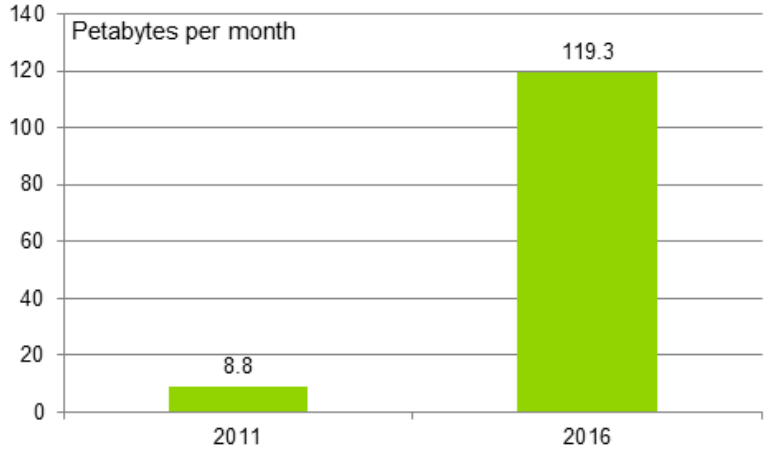
The medium term outlook for the industry is unusually uncertain. On the one hand, strong growth in demand for data and the increased capability of 4G networks will support growth. Some factors that have weighed on growth recently will have passed. On the other hand, recent weaker conditions could reflect structural change in the industry. Strong competition, especially from over-the-top (OTT) operators using mobile apps could change industry dynamics. How fast machine to machine technologies grow also contributes to uncertainty.

With this uncertainty in mind, industry revenue is expected to have grown to $25.9 billion by 2016-17 (2011-12 terms) – an 18% increase compared with 2011-12. Total value add is expected to grow to $16.6 billion (18%). By 2016-17, total employment by the industry (direct and indirect) will have grown by 8% to over 61,280 FTE jobs.

While there have been mixed revenue outcomes for the industry, the growth of Australians' use of mobile technology is much clearer: it is expected to grow strongly. This means carriers will invest more in infrastructure to support data usage growth but not receive as high revenue growth.

Australian mobile broadband traffic growth is expected to grow strongly over coming years. In 2011, an average of 8.8 petabytes per month were used, with this anticipated to grow to 119.3 petabytes per month by 2016 (Cisco, 2012) – a 14 fold increase.

Chart 1.2: Mobile broadband traffic growth, Australia



Source: Cisco (2012)

Productivity benefits

The productivity benefits of mobile devices have been assessed by considering the growth in the economy's multifactor productivity across all industries from ICT. Our central result is that the *current wave* of mobile technologies will result in a productivity benefit to the

Australian economy of $11.8 billion over the period to 2025. In the year 2011 alone, this contribution to the Australian economy is estimated to be $495 million. These productivity benefits are expected to grow over time – to $1.3 billion by 2016 and to $1.8 billion in 2025.

There are many ways mobile technologies contribute to productivity for an individual business – for labour or capital (including land).

Figure 1.2: Productivity gains from mobile devices

Enabling Productivity in the Australian Economy

Mobile's contribution to productivity growth is also important in the context of Australia's overall productivity performance. Productivity is important because it the long term, it represents technical progress that contributes to economic growth and improved living standards (ABS, 2011).

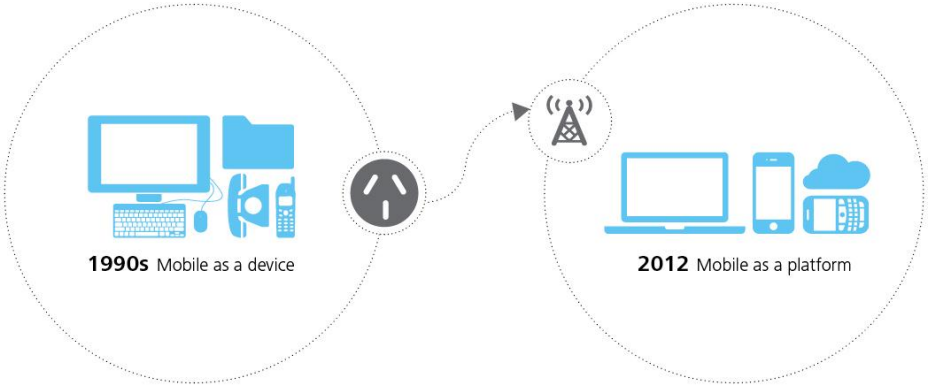
In the most recent productivity cycle (from 2003-04 to 2007-08), Australia's 'multifactor' productivity growth (MFP), which measures output per unit of labour or capital input, was 0.0% a year. That compares with 1.2% in 1998-99 to 2003-04 and a massive 2.5% in 1993-94 to 1998-98.

With the capacity to enable more productivity growth, technology developments in the mobile sector and their diffusion throughout the economy has the potential to reverse Australia's declining productivity performance.

Business impacts

Mobile telecommunications is becoming a deeply integrated part of an organisation's digital strategy. While mobile phones have been an important business tool for at least 15 years, they have previously stood separate from other digital technologies. Now, everything digital is also going mobile: computers, software, the internet, cloud and social media.

Figure 1.3: Going mobile



Source: DAE

A key feature of the latest wave in mobile innovation is that it is being driven by people – by consumers and by employees. This reverses the trend of previous decades when technological developments came from government research agencies and the IT departments of large businesses. With the simple motivation for more convenient and easy to use devices, individuals are dramatically changing how business operates.

Mobile is changing interactions with customers – it is a source of sales / revenue, and a marketing and engagement opportunity, with new behavioural and geo-locational targeting strategies. For some businesses it is a service delivery channel. Many businesses are expected to adopt point of sale technologies, such as virtual wallets, in coming years.

Mobile is also changing business operations. The trend towards bring your own device (BYOD) is an opportunity to build engagement with employees, and possibly achieve greater retention and loyalty. Increased communications and applications can mean better use of down time, and present administrative and organisational opportunities. Machine to machine technologies have the potential to transform capital use.

Cloud based services allow device and location independence; users are able to access systems using a web browser regardless of their location or what device they are using. As infrastructure is off-site and accessed via the Internet, users can connect from anywhere.

E.1: Industry views

Perspective	Who said it?
"Being able to communicate with workers who are not in the office and being able to send files and photos using smartphones increases productivity."	Malcolm Parker, Wyndham Vacation Resorts
"Productivity gains arise from the ability for employees to utilise downtime, as well as the use of integrated mobile technologies to digitise manual processes."	Denise Carson, UXC Ltd.
"In the days before digital, the tools of the trade for the Australian Chamber Orchestra (ACO) were cellos and music stands. Now, mobile devices are equally important – allowing musicians to share new musical ideas and amend the notes for concerts while on the go."	Ken McSwain, Systems and Technology Manager, Australian Chamber Orchestra
"We believe that the proliferation of mobile devices and the need to service those devices will be one of the key areas driving demand for the NBN."	NBN Co.
"Voice calls make up only a quarter of the time people spend on their mobile devices. This means that customer expectations for network performance, including lower latency and high-speed download and upload performance, have increased dramatically. Infrastructure providers are now working on how mobile network architectures as well as end-user service pricing structures can be better managed to cope with surging demands."	Ericsson
"Data-hungry devices and user service expectations have created a looming crisis of user satisfaction. Part of the solution may be to use small cells, bringing wireless access points closer to users to address network coverage, congestion and energy efficiency."	Alcatel Lucent

Social impacts

Mobile technologies are changing the way we experience and engage with everyday life. Beyond the transformative impact of mobile phone calls; mobile technology now has mobile web, apps, smartphones and mobile broadband to influence every sphere of society.

For individuals, mobile devices are not just for communication. They offer rich digital experiences on the go. Photos, music, games, location-based services, maps, the internet and the millions of features offered by apps can all fit in your pocket.

There are mixed effects of mobile phones on work-life balance. The shift to data-enabled devices makes it even easier for employees to work from home without being tied to the office desk. Previous research has found mobile phones a positive for work life balance. Of course, some consider that increased mobility facilitates more work at home and can make people feel "always on" and affect the quality of leisure time.

On a national level, mobile devices are changing the nature of the media: with the ease of capturing and distributing user-generated content allowing every individual to become a broadcaster. Crowd-sourced 'on the spot' reporting has been used for everything from traffic updates to monitoring bushfires.

E.1: Industry views

Perspective	Who said it?
"You have this sense of continuous connection; it's like being in a strand of a web which is continuously vibrating. Part of this feeling of being in a 'cyber tribe' is illusory, but some of it is real; it is important to note that some of this tribalism is purely cyber…The big emotional benefit of this revolution is paradoxical. If you're contacting people using a mobile device, you are further away from them; the richness of interpersonal encounters is largely lost if you rely on a mobile connection…We're treating the exchange of data as if it is the same thing as communication. In doing so, we lose something quite precious in the richness of our encounters."	Hugh Mackay, Social Researcher
"You used to hear people say 'I'm not a doctor or a nuclear scientist. Why do I need to be contactable all the time?' Now the same people find mobile phones compelling and useful; they feel like they couldn't do without them."	Yvonne Adele, formerly Ms Megabyte

1 Introduction

The mobile telephone has become the dominant form of telecommunications technology in Australia over recent years, with more than twice as many mobile handset subscriptions in Australia than subscriptions to any other telecommunications service. The use of mobile telecommunications has been a key enabler of productivity benefits for businesses.

Over recent years, the rapid development and diversification of mobile broadband has been the driving force of industry activity. It wasn't long ago that use of mobile data was largely limited to email on mobile handsets, today a wide range of applications and uses for mobile handsets are stimulating adoption and use of the technology. The use of mobile broadband across a wider range of devices – in particular laptops and tablets – has seen a rapid increase in the number of subscriptions as well as the volume of traffic.

The industry has undergone consolidation in recent years, with the four network carriers reduced to three with the merger of Vodafone and Hutchison into Vodafone Hutchison Australia (VHA). At the same time, the number of mobile resellers has declined, as has the market share of resellers, as these much smaller firms merge either with one another or with a major carrier.

The industry has progressed investment in 4G networks to meet the growth in demand for mobile broadband in a market that has experienced weaker revenue growth.

The "Digital Dividend" auction will see the release of new spectrum that will help meet strong growth in demand for mobile broadband.

According to industry, it is also important to progress planning to define the quantity and timing of the release of future spectrum resources for mobile broadband post the "Digital Dividend" and the need for a comprehensive policy review about how efficiently spectrum is allocated and managed.

It is against this background that the Australian Mobile Telecommunications Association (AMTA) commissioned Deloitte Access Economics to report on the economic significance and contribution of the Australian mobile telecommunications industry. As well as the economic value, the task involves review of the importance of the technology in business use as well as the social value of mobile telecommunications.

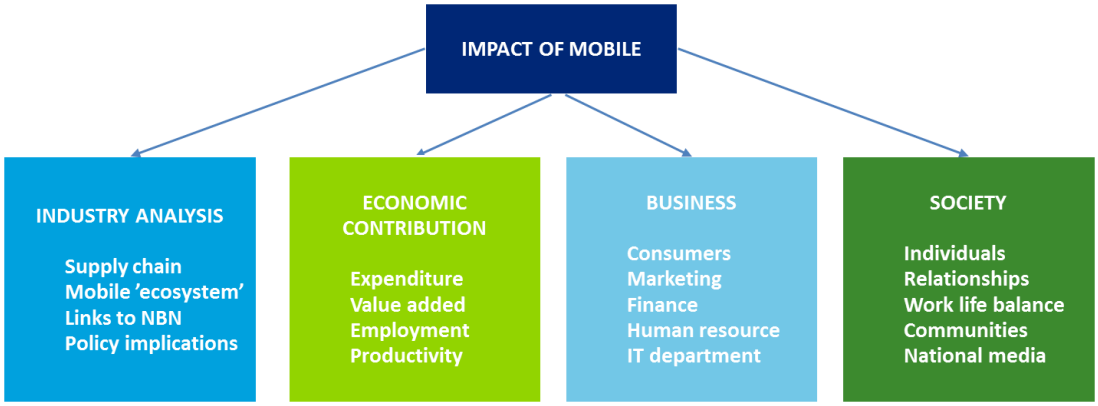
1.1 Project approach and objectives

This is the fifth in a series of reviews of the economic importance of the mobile telecommunications industry undertaken by Deloitte Access Economics and its predecessor. However, this study goes beyond a mere update of the previous iterations. The rapid growth in the uptake and use of mobile broadband and the diversification of its applications mean that the previous approach – with a strong voice focus – has become somewhat dated. As a result the methodology has been revised to better consider the role of mobile broadband.

This report analyses the mobile sector. For the contribution to the Australian economy, we focus on mobile telecommunications industry: activity generated by mobile network operators. This part of our analysis does not include treatment of Wi-Fi, a popular technology that links mobile devices with fixed telecommunications.

However, when we look more broadly at how mobile technologies are driving productivity growth and changing business, we are indirectly taking into account their convenient features and therefore their compatibility with Wi-Fi. We also discuss how mobiles are one of the main factors driving changes in Australian society. Figure 1.1 outlines Deloitte Access Economics' framework for the analysis.

Figure 1.1: Framework for the analysis



Source: DAE

1.2 Report structure

The report is organised as follows:

- Chapter 2 provides a snapshot of the Australian mobile telecommunications industry.
- Chapter 3 reviews the direct and indirect economic contributions of the industry, including the productivity gains that mobile telecommunications have enabled.
- Chapter 4 considers the business impacts of mobile telecommunications.
- Chapter 5 reviews the social impacts of the industry.
- The report finishes with some concluding remarks and observations.

2 Industry overview

2.1 The changing mobile industry

Recent years have witnessed a dramatic transformation in the mobile industry. In what was once a relatively simple supply chain from hardware manufacturers to final customers, there is now a developing ecosystem of mobile technologies changing the economy. This ecosystem involves active and not just passive infrastructure, which has the potential to transform other industries which utilise mobile technologies.

It will be some time before these trends are fully understood, but already, the changed structure of the sector is beginning to take shape.

Figure 2.1: Old structure of the Mobile Industry

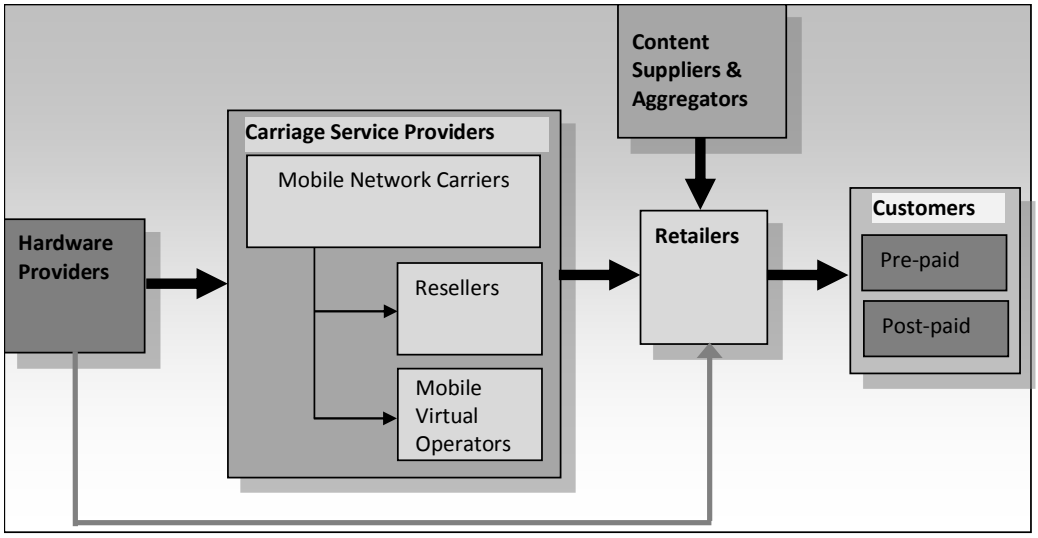
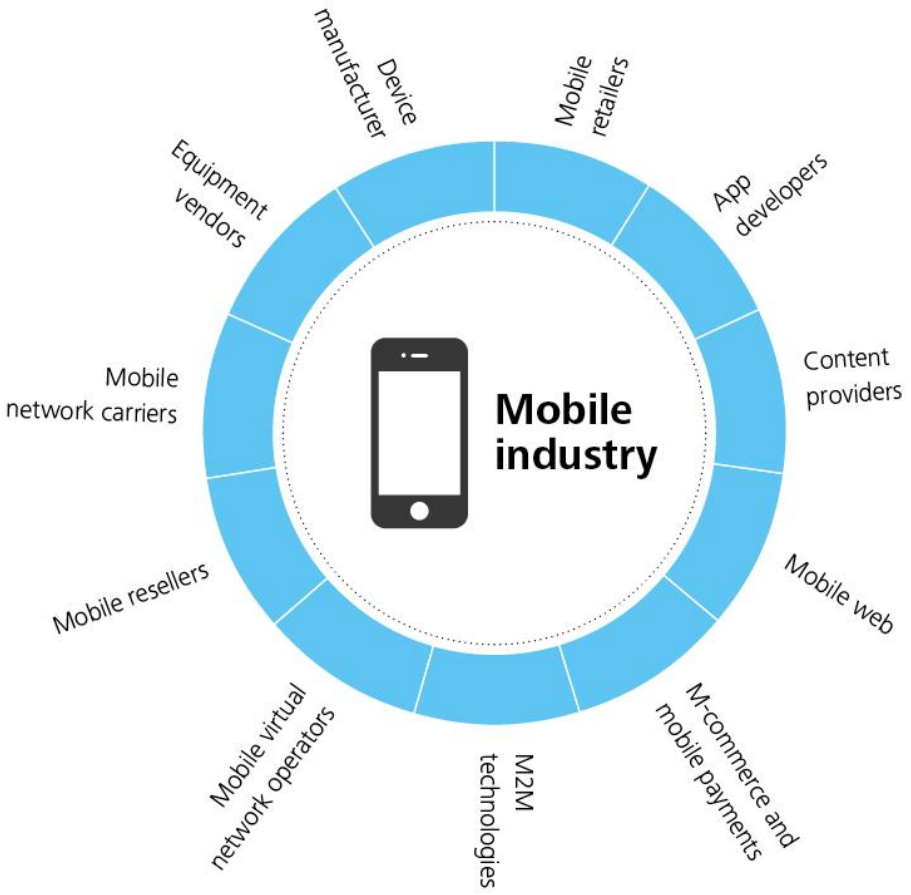


Figure 2.2: Emerging structure of the mobile Industry



Source: DAE

The mobile industry requires several entities to work together. Some firms operate across multiple sectors of the industry while others have only some activities related to mobile technologies.

Commercial/market terms

- **Devices manufacturers** are responsible for manufacturing and supplying handsets and associated equipment to end-users. A large proportion of this is undertaken overseas, with most handsets shipped to Australia ready to sell.
- **Equipment vendors** are responsible for building and maintaining the extensive telecommunications network (including base stations, switching equipment, antennas and towers).
- **Mobile retailers** offer mobile services to end users on behalf of carriage service providers. Most carriage service providers have their own retail shops where customers can purchase hardware, particularly handsets and USB dongles, and enter into contracts with the provider to access services. There are also 'non-branded' specialty telecommunications retailers and other retail outlets. There are also other retail outlets that offer hardware and services, such as supermarkets and Australia Post.

- **App developers** are a range of agencies, dedicated app developers and brands that produce mobile applications for sale, to facilitate customer or business interactions or to build brand for a company.
- **Content providers** deliver information and entertainment services, which are sourced and purchased from a variety of channels before being structured and bundled for distribution over mobile networks.
- **Mobile web** refers to the use of internet-connected applications, or browser-based access to the internet from a mobile device – such as a smartphone or tablet PC – connected to a telecommunications network.
- **M-commerce** refers to the conduct of commerce using a mobile device, such as a mobile phone, a tablet or other emerging mobile equipment. An associated and emerging concept is **mobile payment** or 'mobile wallet' which refers to payment services performed from or via a mobile device.
- **M2M** is machine-to-machine technologies, denoting technologies designed to facilitate communication between appliances using mobile technology. For example, M2M technology has been used to let the developers of products know when certain products need to be taken in for maintenance and for what. Another application is the monitoring of systems such as utility meters. M2M has the potential to benefit many industries, including health, transport and logistics, and education, driving productivity, labour savings and operational efficiency improvements in these sectors.

Legislative terms

- **Carriage service providers** provide telecommunications services to households and businesses using carrier network infrastructure. There are several levels of these.
    - **Mobile network carriers** are primarily engaged in operating and maintaining switching and transmission facilities that provide direct communication via airwaves.
    - **Mobile resellers** provide telecommunications services by use of a network owned by a third party (i.e. a mobile network carrier) but bill customers in their own names.
    - **Mobile virtual network operators (MVNOs)** are value adding entities that use an existing network to sell a service, usually one linked to other branded services. Unlike mobile resellers, MVNOs purchase *wholesale* mobile capacity from network carriers.
- **Content service providers** are defined under section 97 of the *Telecommunications Act* 1997 as a person who uses or proposes to use a listed carriage service (a carriage service between points inside and/or outside Australia) to supply a content service to the public.
- **Content service** is defined under section 15 of the *Telecommunications Act 1997* as:
    - a broadcasting service (as defined in the Broadcasting Services Act 1992 (for example, television and radio services))
    - an on-line service (including those for information and entertainment) and
    - a service specified in a written determination made by the Minister.
- **Carriers** are holders of carrier licences, that is, one granted under section 56 of the *Telecommunications Act* 1997.

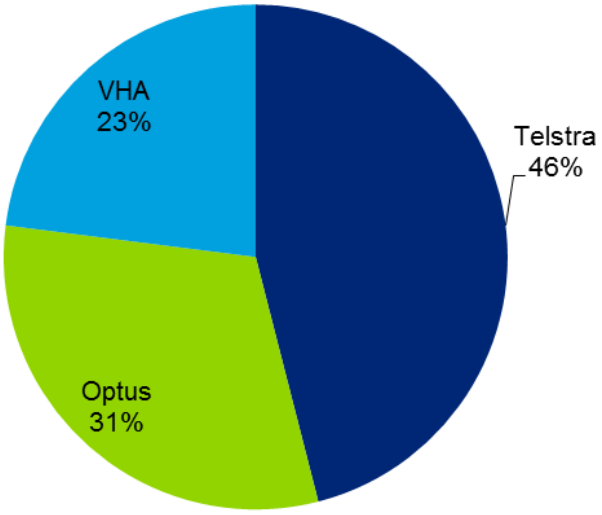
2.2 Market participants

There are three mobile network carriers in Australia.

- Telstra is the former government provider of telecommunications services in Australia. Now a fully privatised publicly listed company, it provides a wide range of telecommunications services and in 2011-12 accounted for 46% of carrier-owned mobile subscriptions in Australia.
- Optus was the first full service competitor to Telstra. In 2011-12, it accounted for 31% of carrier mobile subscriptions in 2011-12.
- The 2009 merger of Vodafone and Hutchison to form Vodafone Hutchison Australia (VHA) means that the market is now contested by three major participants that are much closer in size than previously. In 2011-12 the merged company accounted for 23% of carrier mobile subscriptions.

As well as the major carriers a number of smaller mobile resellers, without their own physical infrastructure network, provide retail services to consumers. The role of resellers has declined in recent years, with many of the larger providers merging with carriers. At the same time, the shift towards 3G and data usage seems to have favoured the carriers in terms of subscription activity.

Chart 2.1: Market share of subscriptions by carrier



Source: ACMA 2012

Table 2.1: Network coverage

Carrier	Population coverage (aggregate)	Frequencies and networks
Telstra	99%	1800MHz (4G LTE) 850MHz (NextG 3G) 2100Mhz (3G) 900 MHz and 1800 MHz (2G)
Optus	97%	2100MHz (national 3G) 900MHz (national 3G and 2G) 1800MHz (metro 2G and 4G selected markets)
VHA	94%	2100MHz (urban 3G) 900MHz (regional 3G) 850MHz (new 3G data network) 900MHz and 1800 MHz (2G)

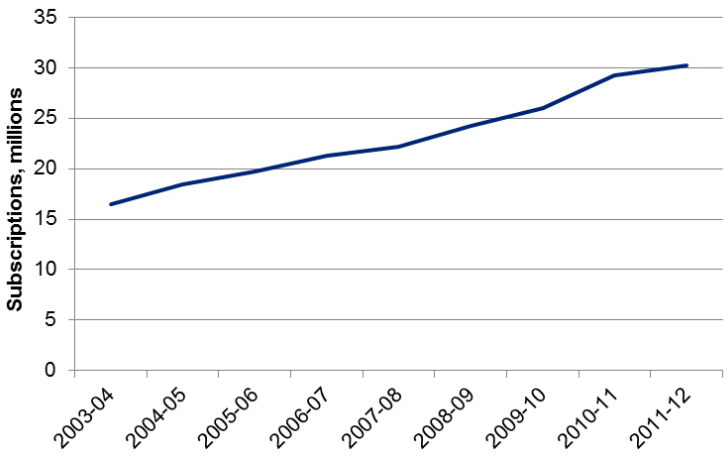
Source: ACMA 2011, IBISWorld 2012, industry figures

Coverage of 3G mobile networks now effectively matches that of older, 2G networks. More than 99% of Australia's population receives coverage from at least one of the three carriers, although there remain some coverage blackspots where reception is poor or network congestion issues exist. The highly urbanised nature of Australia's population also means that, while the majority of the population receives coverage, large unpopulated parts of the country mean that the land mass coverage is substantially lower.

2.3 Market size

At June 2012 total mobile subscriptions in Australia reached 30.2 million, well more than one per person. Of these, 24.3 million are mobile phone handset subscriptions (9% growth) and 5.9 million are mobile broadband (ACMA, 2012).

Chart 2.2: Total mobile subscriptions

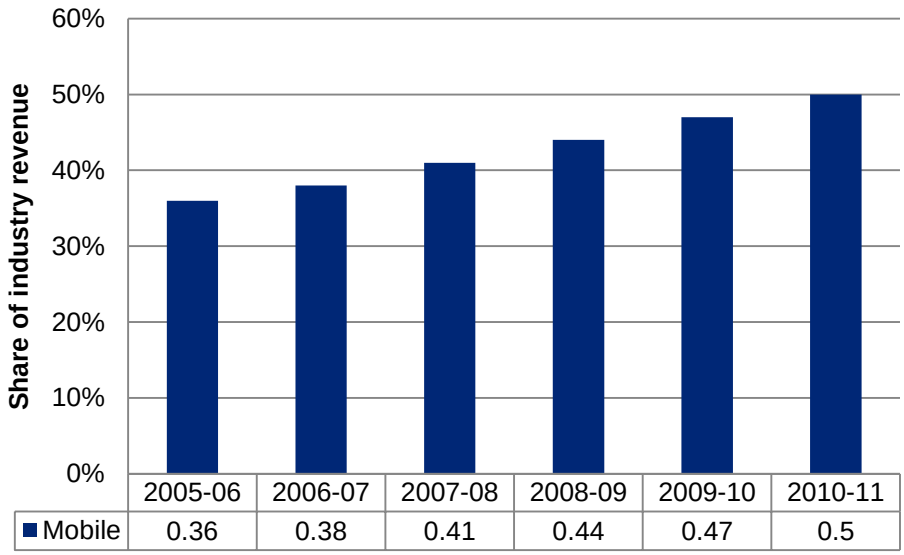


Source: ACMA 2010, ACMA 2012

There are now 16.2 million mobile handset internet subscribers – and in 2012 the ABS stopped collecting separate data on the proportion with dedicated data subscriptions (ABS 2012). Volumes are increasing as well, with 25.3 terabytes on mobile broadband in the quarter ending June 2012 and 6,610TB on mobile handsets (ABS, 2012).

Overall, mobile telecommunications is making up a greater share of industry revenue, compared with fixed telecommunications.

Chart 2.3: Mobile as a share of total telecommunications industry revenue



Source: ACMA 2011

2.4 Regulation

The main regulatory body is the Australian Communications and Media Authority (the ACMA). The specific responsibilities of the ACMA include regulating compliance with legislation, licence conditions and the like; reporting on matters relating to the communications industry, including its performance; and issuing telecommunications licences and allocating and licensing radiofrequency spectrum.

Under the *Telecommunications Act 1997 (Cth)*, the telecommunications industry has broad scope for self-regulation. The industry has developed a range of industry codes, primarily via the Communications Alliance industry group (CA). The ACMA registers telecommunications codes developed primarily by CA. The ACMA may act in response to a complaint of a breach of one of these codes as well as more formal regulation.

The Telecommunications Industry Ombudsman (TIO), which carriers and carriage services providers are obliged to join, may also be responsible for responding to breaches of these codes. The TIO is funded by members, and is a dispute resolution body for residential and small business customers and their service providers.

The Telecommunications Consumer Protection (TCP) Code was registered by the ACMA on 1 September 2012, replacing the 2007 Industry Code. It applies to all Carriage Service

Providers in Australia and is a code of conduct providing community safeguards related to areas such as sales, service and contracts, billing and complaint handling.

Convergence

Convergence of communications and media is where a user can access a range of multimedia services using varied devices and network connections. In a converged world there is less of a distinction between transmission channels – you can now watch television on your mobile or computer.

Developments in technology have led to significant changes in the communications and broadcasting landscape. Existing legislation has become dated in a converged world. This market change prompts a rethink and review of Australia's existing policy and regulatory framework to ensure opportunities and potential threats are appropriately managed in this environment.

The Australian Government's Convergence Review was completed on 30 March 2012, and examined the policy and regulatory frameworks that apply to the converged media and communications landscape in Australia. The Review focussed on media ownership laws, content standards, production and distribution of Australian local content, and spectrum allocation.

In November 2012, there was an initial Australian Government response, but a complete reform agenda could take several years. This is an important area where government action will be required to address existing and emerging problems in the current legal and regulatory framework.

Spectrum

The critical issue for the sector is policy and regulation with regard to spectrum allocation and licensing. Significant investment in spectrum and other infrastructure required to support the deployment of mobile networks have contributed to delivering mobile services that enable the economic productivity benefits derived through mobile as a platform.

Spectrum is regulated in accordance with the *Radiocommunications Act 1992*, with the ACMA the independent statutory authority responsible. Demand for spectrum is increasing due to substantial growth in the number and capabilities of mobile devices. Cisco estimates that between 2012 and 2016, Australia is forecast to experience a seven-fold increase in mobile traffic volume.

From a policy perspective, the Australian Government's focus has been on providing certainty to licence holders in retaining existing spectrum holdings and providing opportunities to acquire new capacity.

Spectrum licence reissue

The recent conclusion of the spectrum licence reissue process will see a broad range of spectrum used to deliver current and next generation mobile broadband services offered for reissue in the public interest to existing licensees, including, Telstra, Optus and Vodafone Hutchison Australia.

Key stakeholders have flagged the importance of a review of the legislative process that governs licence reissue to provide a greater certainty to licencees and a more efficient and streamlined process as part of a broader reform of spectrum allocation under the *Radiocommunications Act 1992*.

Digital Dividend Auction

The Digital Dividend auction will allocate spectrum in the 700MHz band – previously used to transmit analogue television services – and 2.5GHz band – used for outdoor broadcasts by free to air and subscription television broadcasters.

The auction will be managed by the Australian Communications and Media Authority.

Beyond the Digital Dividend

The Australian Government has started its consideration of how future demand for mobile broadband will be met with ACMA issuing its "Towards 2020 – Future spectrum requirements for mobile broadband" paper in 2011.

This paper estimates that an additional 300MHz of spectrum is required by 2020 to meet future demand for mobile broadband. This will need to be obtained through new allocations, improved efficiency of use and accessing under-utilised spectrum.

It is possible that the estimated 300MHz of spectrum will not be sufficient to meet future demand and that there would be merit in further industry engagement.

Increased constraints on mobile network infrastructure will reduce the capacity of the industry to meet the growing demand for mobile broadband from customers. To maximise the benefits of mobility in the digital economy, spectrum policy settings must be reviewed and allow for the staged expansion of spectrum resources to mobile broadband.

2.5 Mobile devices and the National Broadband Network

Alongside the growth of smartphones and the shift to 4G networks, the other big development in digital technologies is the enhancement of fixed networks: the National Broadband Network. Recent developments suggest that mobile and fixed technologies are complementary means of network access – that is, people are using both networks. In addition, the traditional boundaries between services are becoming blurred.

The NBN aims to increase broadband capabilities across the nation with a mixture of optical fibre, fixed wireless and satellite technologies. As currently designed, it will be a national wholesale-only, open-access data network; the biggest infrastructure project ever undertaken by the Australian Government. While it is a fixed service, the NBN will also benefit from mobile trends.

Convergence means that devices are no longer mobile phones using mobile networks. These devices, including smartphones and tablets, can now easily switch between 3G/4G mobile networks and Wi-Fi/fixed networks. Consumers can get the flexibility of mobile and

capacity of fixed without having to 'plug in' to a network or manually switch between networks. These devices are now being talked of as the 'first screen' for media consumers.

According to a 2011 Google survey, one in two people use smartphones while watching TV, while Ericsson research (2012) showed that 62% of people visited social networking sites while watching TV. Further, it is estimated that users are in range of a Wi-fi hot spot 70% of the time (ACG Research, 2012).

We note a projection by Cisco (2012) that by 2016, Wi-Fi fixed traffic will increase as a proportion of total fixed traffic from 65% to 70%.

Mobile devices can be used with both mobile and fixed networks – they are complementary means of access to data. The growth of mobile devices is likely to be a significant driver of demand on the NBN.

"We believe that the proliferation of mobile devices and the need to service those devices will be one of the key areas driving demand for the NBN." NBN Co

In addition, traditional distinctions between mobile and fixed infrastructure networks are becoming blurred:

- Mobile networks are more dependent on fibre backhaul to cope with surging demand for capacity (although the NBN is not proposing any mobile-specific infrastructure);
- Fixed networks are becoming more flexible at their termination points, including Wi-Fi in the home and the potential for this capacity to be offered publicly.

Wi-Fi offload and Fon

Wi-Fi offload moves mobile traffic from mobile to fixed line networks and improves performance. According to one study, 65% of a typical smartphone user's data traffic can be off-loaded to Wi-Fi (Lee et al, 2010).

In the United Kingdom, BT Fon is a network of 7 million Wi-Fi hotspot locations. When households agree to provide some of their fixed home broadband to other BT Fon members via Wi-FI they can also access the same from other people.

Wi-Fi offload and initiatives like BT Fon have the potential improve mobile services, mobile network performance and increase the uses of fixed networks.

2.6 Industry trends

2.6.1 Mobile data

The growth in the use of mobile data has been the key trend in the industry over recent years. Growing from close to zero just five years ago, mobile broadband accounted for 47% of all internet subscriptions at December 2011 (ABS 8153.0). A wide range of devices now utilise mobile broadband services, leading to rapid growth in uptake as well as use of these services.

According to Ericsson, a supplier of mobile telecommunications network infrastructure, voice calls make up only a quarter of the time people spend on their mobile devices. This means that customer expectations for network performance, including lower latency and high-speed download and upload performance, have increased dramatically.

Infrastructure providers are now working on how mobile networks and pricing structures can be better managed to cope with surging demands. See, for example, Ericsson ConsumerLab's Smart Mobile Broadband (Ericsson, 2012).

The ACMA (2011) nominates several factors driving the increasing uptake of mobile broadband.

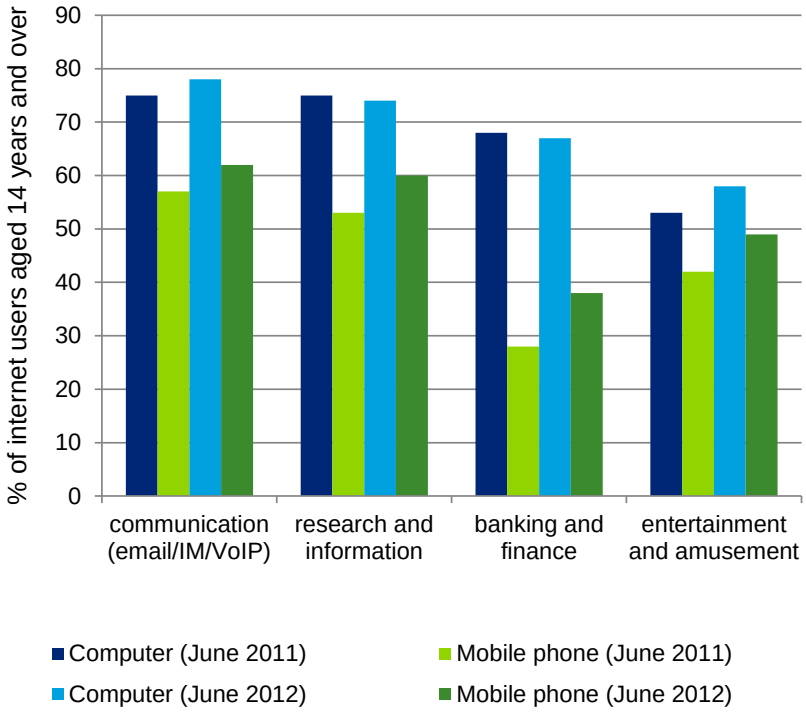
- Improvements in 3G technology, network coverage and capacity, in particular faster download and upload speeds.
- The increasing functionality of mobile phone handsets, including features such as touch screens and on screen keyboards that make them more readily amenable to higher volume use than older numeral keypads.
- Developments in tablet computer technology – devices such as the iPad and Samsung Galaxy tab have made highly capable portable computing far more portable since 2010, with an associated spike in usage.
- Providers competing on price and payment options to attract this growing segment of the market, with a large share of the growth in mobile revenue coming from the data space.
- A wider range of applications and services – from productivity enhancers like online mobile banking through to games and social applications, the range of data-based activities that can be undertaken on a mobile device have led to a substantial increase in the use of mobile broadband.

According to Alcatel Lucent, the combination of more data-hungry devices and higher user service expectations has created a 'perfect storm' for mobile broadband providers, and a looming crisis of user satisfaction. Businesses are already aware that part of the solution may be to use small cells, bringing wireless access points closer to users to address network coverage and congestion issues, while also improving energy efficiency.

While accounting for almost half of internet subscriptions, mobile technologies only account for 7% of total data downloaded (ABS 8153.0). This indicates that mobile broadband is still viewed by many as a complementary technology. So while many are taking advantage of the ability to use mobile broadband while on the move, fixed broadband services – which still provide higher average speeds – remain the main internet connection used.

Accessing the internet using mobile handsets has increased dramatically in recent years. In June 2009, just 9% of people used the internet via a handset; in June 2012, that figure was 32%. For many areas of internet use, mobile devices are 'catching' the computer in usage levels. For example, in June 2012, 38% of people were mobile banking compared with 67% online banking; this compares with 28% and 68% a year earlier.

Figure 2.3 Online activities undertaken by access device during June



Source: Roy Morgan Single Source, June 2012, cited in ACMA 2012

New network investments

Carriage service providers are investing in network mobile network infrastructure to cope with surging demand.

VHA has made a billion dollar investment in the 850MHz network, rolling out alongside existing 3G networks to improve network capacity and reliability. It is also preparing for 4G.

Since 2009 (FY10), Optus has invested more than $1.8 billion in its mobile network, doubling network capacity in metro areas with its 2100MHz and 900MHz networks operating together to strengthen in-building coverage. It will also continue its rollout of an LTE network in 2013.

Further, Optus is investing in femto cell technology, allowing users to have personalized and dedicated mobile coverage in the home. It is also likely to expand this to enterprise users (Optus, 2011).

Telstra has launched LTE 4G services in major CBDs, including some airports, with capable devices operating on a dual band so they switch between the 4G and Next G networks based upon availability. For FY2013, Telstra has announced it would invest a further $1.2 billion on its mobile network.

2.6.2 Mobile commerce

E-commerce has grown rapidly in Australia in recent years. This might reflect lower prices, reduced search costs and the greater range available online.

Mobile internet (i.e. via smartphones) appears to be playing an increasing role in e-commerce. Communications Day (Issue No. 3845, September 2010) reported that research commissioned by eBay and conducted by Pure Profile shows that around one in

four Australian mobile phone owners use their device to make an online purchase, including more than 80,000 on eBay alone in June 2010.

> *Around 43% spent between A$50 and A$250 a month shopping via their mobiles, with 17% spending over the A$250 mark monthly. In January 2010, less than 98,000 items were purchased on eBay via mobile, at a total value of under A$7 million; these numbers shot up to 220,000 and over A$13 million respectively for July 2010.*

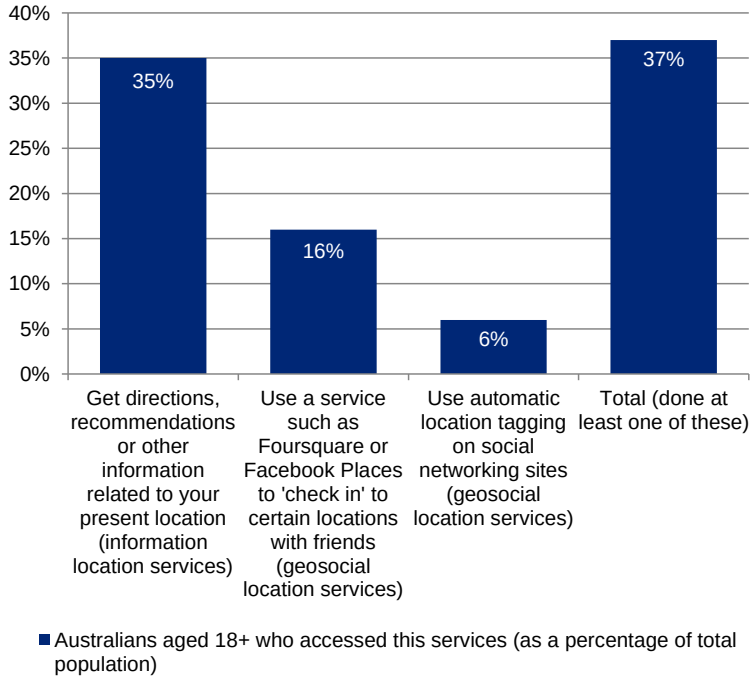
In addition to using the internet to make actual purchases, many Australian consumers use the internet for research. According to Sands and Ferraro (2010), up to 50% of Australians search online for information about products prior to purchasing them in-store. A wide range of online resources are utilised in this research process, including company websites, social networking sites, online reviews both formal and informal, and ratings and consumer information websites.

2.6.3 Location-based services

Location-based services are generally different to mobile commerce because they are more likely to relevant to an individual's location and often do not involve charges. Mostly, location-based services are based on using individual information for marketing or other business purposes.

According to ACMA (2012), 37% of Australian adults had access a location service on a mobile phone in the six months prior to May 2012. Some location-based services simply provide information, such as getting directions. Others have a service related to social media. Finally, others tag the user to their location and link it to something else.

Figure 2.4: Use of location services on mobile phones by Australians



Source: ACMA, 2012, Here, there and everywhere: Consumer behaviour and location services

2.6.4 M2M

Another key trend is machine to machine technology that allows different pieces of equipment to 'talk to each other' without human guidance. While still an emerging area of digital technology, M2M has the potential to increase productivity, avoid unnecessary investments and maintenance costs, and dramatically transform capital-intensive sectors of the economy like mining and utilities.

One example of M2M is Goanna Telemetry Systems, a system that uses a farmer's mobile phone as a central server to coordinate irrigation systems and monitor soil moisture, allowing these machines to be managed remotely. This has the benefit of improving productivity through access to real-time information to make informed decisions, and reducing travel time between farm sites to monitor irrigation systems (Goanna Telemetry, 2012).

There is also great potential of 'smart technologies' in capital intensive industries such as energy, water and transport. Access Economics (2009) was commissioned by IBM to investigate "The economic benefits of intelligent technologies" and found that adoption of these resulted in an increase in the net present value of GDP of between $35 billion and $80 billion over the first ten years, depending on the amount of spare capacity in the economy.

3 Economic contribution

The mobile telecommunications industry makes a substantial contribution to the overall Australian economy[1]. The analysis below estimates the direct and flow-on economic contribution the sector makes. This economic activity was measured in both:

1. Value added or the contribution to national Gross Domestic Product

2. Full-time equivalent workers.

In addition to the direct contribution to aggregate output through value added by the industry, mobile telecommunications also benefit other industries and economic sectors by raising the productivity of businesses. Deloitte Access Economics has used its DAE-GEM dynamic computable general equilibrium model to quantify the economy-wide impacts of rising productivity resulting from mobile innovations.

The key estimates in this chapter are:

Mobile telecommunications industry revenue was $22.0 billion in 2011-12.

Total value added by the industry was $14.1 billion, with $7.6 billion direct contribution and $6.5 billion indirect activity in related sectors and across the economy.

Total employment supported by the industry was 56,970 full-time equivalent employees, with 22,343 direct FTE employees.

The sector is expected to grow over the next five years – by 2016-17, industry revenue will be $25.9 billion, total value added will be $16.6 billion and total employment will be 61,284 FTE employees.

Productivity benefits from mobile technologies are estimated to boost GDP by $11.8 billion over the period to 2025 (in net present value terms) – rising from a $495 million productivity benefit in 2011 to $1.3 billion in 2016.

[1] Note this analysis takes account of mobile carriers and resellers. For example, the mobile handset industry is also an important contributor of value added and employment in Australia. However, data is presently unavailable to quantify the industry wide contribution.

3.1 Direct contribution

The direct contribution of the telecommunications industry can be summarised as follows:

> Value added – the contribution production in the sector makes to gross domestic project (GDP) – totalled $7.6 billion for the 2011-12 financial year. This is up 4.3% from $7.3 billion in 2010-11.
>
> Employment in the sector totalled 22,343 full-time equivalent (FTE) persons for 2011-12, an increase of 2.2% on the previous financial year.
>
> Earnings to employees grew by 3.3% in 2011-12.

Table 3.1 outlines the direct economic contribution of the sector for the last three financial years.

Table 3.1: Industry revenue and value-add, 2011-12 $m

	2009-10	2010-11	2011-12
Industry revenue	$21,381.0	$22,312.8	$21,972.3
Industry gross value added	$6,569.9	$7,293.3	$7,608.7
Gross operating surplus	*$4,694.9*	*$5,477.8*	*$5,732.4*
Earnings to employees	*$1,875.1*	*$1,815.5*	*$1,876.2*
Employment	21,800	21,868	22,343

Source: Deloitte Access Economics estimates using industry and IBISWorld data

3.1.2 Output (revenue) and industry value added

Output in the sector was valued at $22.0 billion for 2011-12, down 1.5% on the 2010-11 total. The historic trend of high growth in the industry has slowed in the last financial year.

Subscription numbers have largely driven the increases in revenue over the past five years, however, this has begun to slow as the market reaches saturation point with a mobile penetration rate of well over 100% (more than 30 million mobile services) according to the ACMA's 2011-12 Communications Report. In 2011-12, conditions also reflected other factors such as mobile repayment options, service to equipment ratios, mobile termination rates, changes to plans and user behaviour, market share changes, and generally slower growth in non-handset mobile growth.

The combined industry value added of mobile network carriers and resellers in 2011-12 was $7.6 billion. This represents a real increase of 4.3% for the financial year, with the increase attributable to capital more than making up for the decline in earnings to employees.

3.1.3 Contributions of labour and capital

Employee earnings are wages paid to those working in the mobile telecommunications industry. In 2011-12, the total wage bill for the mobile telecommunications industry was approximately $1.9 billion. This is an increase of 3.3% on the 2010-11 result.

Table 3.2: Earnings to employees (2011-12 $m)

	2009-10	2010-11	2011-12
Earnings to employees	**$1,875.1**	**$1,815.5**	**$1,876.2**
Carriers	*$1,725.1*	*$1,678.3*	*$1,744.8*
Resellers	*$150.0*	*$137.2*	*$131.4*

Source: Deloitte Access Economics estimates using IBISWorld data

Earnings in the mobile telecommunications industry attributable to capital were $5.7 billion for 2011-12. In this report, earnings to capital have been derived as the residual of industry gross product once earnings to employees have been accounted for. The total earnings to capital in the industry have been relatively stable in real terms over recent years, and also in terms of the share of total industry gross product, accounting for around three-quarters of the total. This highlights that mobile telecommunications is a capital-intensive industry.

3.1.4 Employment

Employment in the sector is estimated to be 22,340 FTE employees in 2011-12. This represents an increase of 2.2% in total number of employees for the year. Similar to trend, the vast majority of persons employed in the mobile telecommunications industry work for network carriers, with only 10.4% of total employees working for resellers. Table 3.3 provides a breakdown of the share of total employment by carriers and resellers. Staff numbers have been on the rise, following cuts in numbers prior to 2008-09.

Table 3.3: Employees (FTE), by carriers and resellers

	2009-10	2010-11	2011-12
Employment	21,800	21,868	22,343
Carriers	*19,316*	*19,463*	*20,004*
Resellers	*2,484*	*2,405*	*2,339*

Source: Deloitte Access Economics estimates using IBISWorld data. Numbers may not add up due to rounding

3.1.5 Payments to government

Like all major industries, the mobile telecommunications industry engages with the Australian Government regularly. The industry contributes to government revenues through one-off payments for spectrum allocations as well as through annual payments for apparatus licence fees and through other charges such as those relating to the National Relay Service, carrier licences, and numbering charges. Many of these payments are proportional to a carrier's eligible revenue, which is based on the carrier's gross sales revenue less a series of revenue and expense deductions.

Like businesses in other industries, those in the mobile telecommunications industry also pay corporate income taxes to the Australian Government and payroll taxes to State and Territory Governments.

The mobile telecommunications industry is required to make a number of industry-specific payments to government. Deloitte Access Economics estimates that, in 2011-12, the value of these payments was almost $300 million, although it is noted that the $145.08 million

received under the Universal Service Obligation is not retained by the Government but rather paid to Telstra to cover the cost of providing universal services in areas where it is not profitable to do so. The portion of this total attributable to each type of payment is detailed in Table 3.4.

In addition, the industry contributes to its effective operation through voluntary and compulsory payments to support various industry associations and self-regulatory schemes, including AMTA and the TIO.

In 2011-12, Annual Carrier Licence Charges included $22 million to the ACMA, $13 million to the ACCC, and $2 million to the Australian Communications Consumer Action Network (ACCAN).

Table 3.4: Industry payments to government, 2011-12

Payment type	Basis for calculating payment amount	Estimated 2011-12 payment ($m)
Radiocommunications licence fee		$56.30
Universal Service Obligation	Eligible telecommunications revenue	$145.08
National Relay Service	Eligible telecommunications revenue	$2.70
Licence fee for fixed service	Number of fixed point-to-point installations	$17.30
Numbering charge	Quantity of mobile telephone numbers	$40.10
Annual Carrier Licence Charge	Fixed sum plus eligible telecommunications revenue	$38.00
Total		**$299.48**

Source: Deloitte Access Economics estimates based on ACMA, 2012.

3.2 Indirect contribution

The indirect contribution of the mobile telecommunications industry reflects value added in other sectors of the economy generated by spending of the industry on inputs to production and services purchased from other sectors. This additional economic activity is a 'flow-on' or indirect contribution to the economy, resulting in revenue and employment in other sectors.

The indirect contribution of the mobile telecommunications industry would include, for example, activity caused by spending on physical devices and construction services for telecommunications infrastructure. More generally, it would also include the flow-on activity generated in all sectors – in manufacturing, transport, retail and across the economy. The indirect contribution is summarised in Table 3.5.

Table 3.5: Indirect contribution (2011-12 $m)

	2009-10	2010-11	2011-12
Indirect gross value added	$5,575.9	$6,189.8	$6,457.5
Earnings to capital	*$2,551.3*	*$3,261.3*	*$3,431.0*
Earnings to employees	*$3,024.6*	*$2,928.6*	*$3,026.5*
Employment (FTE)	33,787	33,892	34,629

Source: Deloitte Access Economics calculations using industry and IBISWorld data

In 2011-12, the indirect gross value added of the mobile telecommunications industry was $6.5 billion. Slightly more than half of this was attributable to capital, though the gap between earnings to capital and earnings to employees has been declining in recent years.

Through its demand for services, the industry was responsible for 34,629 FTE jobs in other sectors of the economy in 2011-12. The high number of jobs created through indirect effects shows that while mobile telecommunications itself is highly capital-intensive, it creates many more jobs in other sectors of the economy.

3.3 Total contribution

The total contribution of the mobile telecommunications industry is the sum of its direct and indirect contributions to the economy. In 2011-12, this contribution to GDP was $14.1 billion, of which $9.2 billion and $4.9 billion were attributable to capital and employees respectively.

The industry's total contribution to the economy supported 56,972 FTE jobs, as shown in Table 3.6.

Table 3.6: Total contribution, 2011-12 $m

	2009-10	2010-11	2011-12
Total value added ($ million)	12,145.9	13,483.2	14,066.1
Earnings to capital	*7,246.2*	*8,739.0*	*9,163.4*
Earnings to employees	*4,899.7*	*4,744.1*	*4,902.7*
Employment (FTE)	55,586	55,760	56,972

Source: Deloitte Access Economics calculations using industry and IBISWorld data

The charts below show the direct and indirect contribution shares of total value added and total employment by the industry. It can be seen that the indirect share of employment is larger than the direct, while its share of value added is lower than the direct contribution.

This can be interpreted as the mobile telecommunications industry creating a large number of jobs in other sectors. However, these jobs are generally in industries which have a lower value-add than the mobile industry itself.

Figure 3.1: Total value added contribution

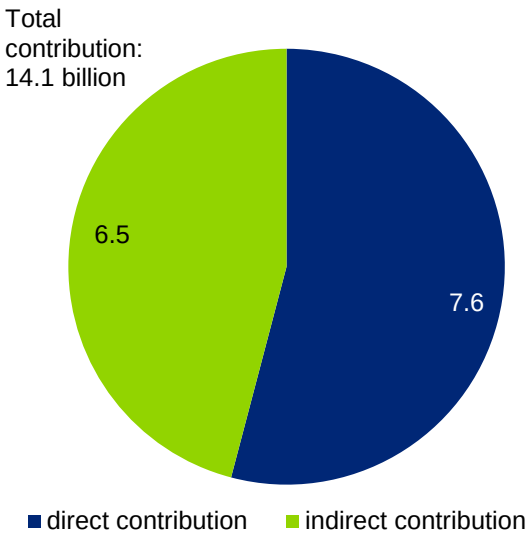
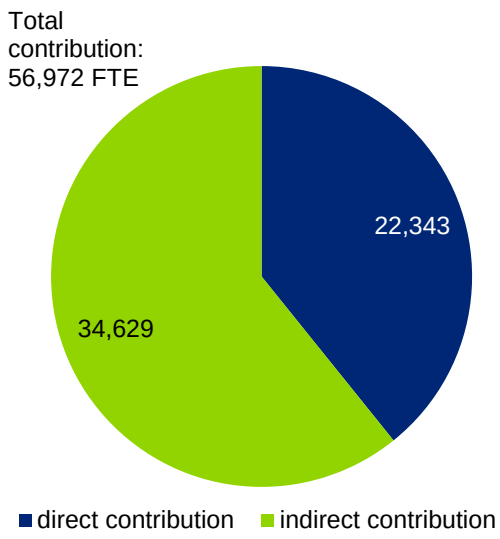


Figure 3.2: Total employment contribution



3.4 Forecasts

After years of strong growth, weaker conditions in the mobile telecommunications sector have seen forecasts for revenue revised down.

Table 3.7 presents five-year forecasts for industry revenue and employment. These were based on a number of sources including IBISWorld data, industry data, forecasts by market analysts. A midpoint view is that after contraction in 2011-12 and stagnation (in real terms in 2012-13), the industry will experience a modest recovery in 2013-14.

The medium term outlook for the industry is unusually uncertain. On the one hand, strong growth in demand for data and the increased capability of 4G networks will support growth. Some factors that have weighed on growth recently will have passed. On the other hand, recent weaker conditions could reflect structural change in the industry. Strong competition, especially from over-the-top (OTT) operators using mobile apps could change industry dynamics considerably. How fast machine to machine technologies grow also contributes to uncertainty.

With this uncertainty in mind, industry revenue is expected to have grown to $25.9 billion by 2016-17 (2011-12 terms) – an 18% increase compared with 2011-12. Total value add is expected to grow to $16.6 billion.

By 2016-17, total employment by the industry (direct and indirect) will have grown by 8% to over 61,280 FTE jobs.

One observation is that growth in the mobile telecommunications industry itself is forecast to be driven by a greater reliance on capital than increased employment, which also means that labour productivity is expected to increase.

The completion of the spectrum auction in April 2013 and the development of a spectrum policy road map that details how future demand for mobile broadband will be met will provide greater certainty for the industry going forward.

Table 3.7: Industry forecasts

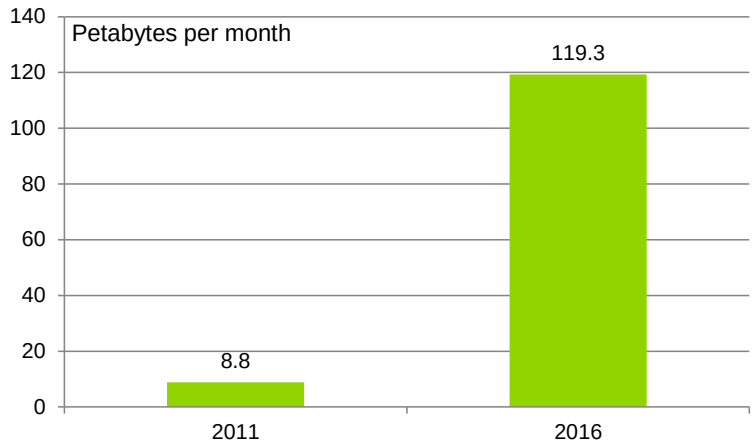
	2011-12 (actual)	2012-13	2013-14	2014-15	2015-16	2016-17
Industry revenue	21,972.3	21,949.0	22,761.2	24,081.3	25,116.8	25,945.7
Industry total value added	14,066.1	14,051.2	14,571.1	15,416.2	16,079.1	16,609.7
Direct gross value added	*7,608.7*	*7,600.6*	*7,881.8*	*8,339.0*	*8,697.5*	*8,984.6*
Indirect value added	*6,457.5*	*6,450.6*	*6,689.3*	*7,077.3*	*7,381.6*	*7,625.2*
Employment (FTE)	56,972	56,911	59,017	60,052	60,724	61,284

Source: Deloitte Access Economics calculations using industry and IBISWorld data

While there have been mixed revenue outcomes for the industry, the growth of Australians' use of mobile technology is much clearer: it is expected to grow strongly. This means carriers will invest more in infrastructure to support data usage growth but not receive as high revenue growth.

Australian mobile broadband traffic growth is expected to grow strongly over the next five years. In 2011, an average of 8.8 petabytes per month were used, with this anticipated to grow to 119.3 petabytes per month by 2016 (Cisco, 2012). This represents a 14 fold increase, or a compound annual growth rate of 68%. Similarly, Ericsson (2012) estimates global mobile broadband traffic will grow with a compound annual growth rate of around 60% over 2011 to 2017, representing around a 15 fold increase by the end of 2017.

Chart 3.1: Mobile broadband traffic growth, Australia



Source: Cisco (2012)

3.5 Mobile enabling productivity growth

This section outlines the benefits of mobile telecommunications to business productivity in the Australian economy. Mobile devices can increase productivity by:

- increasing the effectiveness of employees or managers, or by saving them time (labour productivity); or
- by increasing the effectiveness or reducing the need for computers, vehicles, office space or other capital (capital productivity).

Multifactor productivity is the best overall measure of productivity – it is when a business achieves an increase in output with a given level of both labour and capital; that is, it is not just substituting between input types.

A study by DeMaagd (2008) suggests that in developed countries, mobiles have a negative short-term effect on economic growth, but that this short-term investment translates into long-term productivity improvements in labour and capital. It suggested that the short-term decline in economic growth could be attributed to the diversion of resources away from other productive uses, while learning and integration with business processes could lead to these becoming productive investments in the long-term. This study used data from 84 countries, both developed and developing, for the period 1985 to 2007.

We begin by analysing the business applications of mobile technology and then measure the productivity benefits of mobile devices by analysing their impact as a share of economy-wide productivity benefits from ICT.

3.5.1 Business productivity enabled by mobile technology

There are many ways mobile technologies enable increased productivity for an individual business. This can be through improvements in labour or capital (including land) productivity. This is summarised in Figure 3.3 below.

Figure 3.3: Productivity gains from mobile devices

Source: DAE

Mobile technology can improve labour productivity through allowing communication on the go. Workers who are travelling can be in touch with others in the office through making calls as well as through sending and receiving emails or accessing information by utilising mobile internet.

Earlier work by CEBR, on behalf of mobile phone provider O2, in the UK had estimated that, on average, each worker in the UK in 2004 saved 20 minutes per week from the use of mobile phones (2006).

> "Being able to communicate with workers who are not in the office and being able to send files and photos using smartphones increases productivity."
>
> Malcolm Parker – Wyndham Vacation Resorts (Deloitte Access Economics consultation, July 2012 – see Chapter 4 for more details).

In addition to communication, mobile devices allow for productive use of "down time". That is, time which was previously unutilised or under-utilised due to not being able to

access a desktop computer is no longer unproductive. Through use of tablets or smartphones, people can review documents and make edits without being in the office (Ovum, 2008).

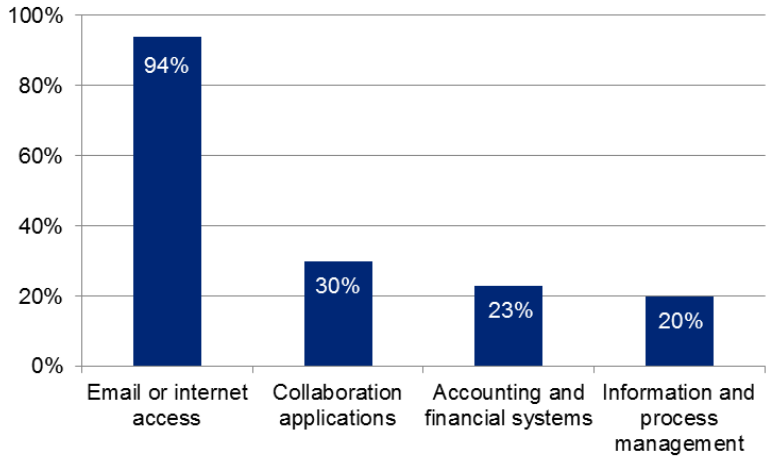
Surveys conducted by Telstra indicated that on average, commercial users of the Next G™ network felt that their productivity had been improved on average by 9.3%. The productivity improvements were quantified as estimated cost savings that the businesses using Next G™ have achieved in different areas (such as travel costs, administration costs and monitoring of staff costs) (Econtech, 2007, cited in Access Economics, 2010).

Productivity apps have also revolutionised mobile devices, contributing benefits not available on fixed devices. 'Voice notes' allow people to store audio information, and calendar applications assist in time management. A number of apps for smartphones and tablets also allow streamlining of repetitive tasks or can make simple administrative tasks faster, allowing more time for workers to engage in more productive work. Examples of productivity apps include Tasktick, Timebox, and Deadlines Manager (WindowsPhone, 2012).

> "Productivity gains arise from the ability for employees to utilise downtime, as well as the use of integrated mobile technologies to digitise manual processes."
>
> Denise Carson - UXC connect (Deloitte Access Economics consultation, July 2012 – see Chapter 4 for more details).

As seen below, 94% of organisations in 2012 have email or internet access available over the corporate network for mobiles, smartphones and tablets. Businesses have also been making collaboration applications, accounting and financial systems and information processes and management available on the corporate network. This trend of moving to mobile devices is expected to increase over the coming years (Optus, 2012).

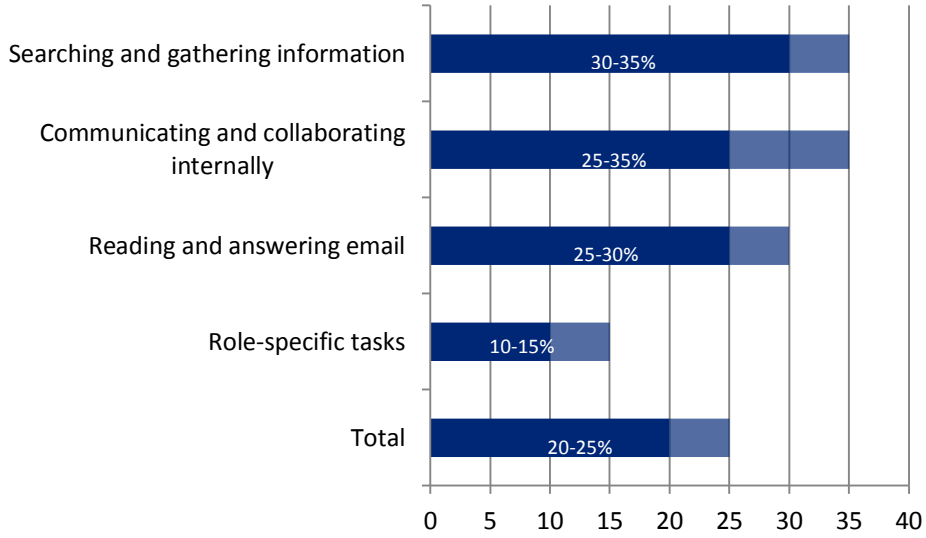
Figure 3.4: Productivity applications made available on the corporate network for mobiles, smartphones and tablets



Source: Optus Future of Business Report: Research and Findings, 2012

There is significant productivity potential for businesses, in utilising social apps during down time. The McKinsey Global Institute (2012) estimated that 30% of current total email time could be re-purposed by moving communication to a social collaboration platform. This can be seen in Figure 3.5 below. Further, access to a searchable store of social messages could reduce information searching time by up to 35%. Overall, it was estimated that social technologies could result in productivity improvements of the magnitude of 20-25%.

Figure 3.5: Productivity improvements from collaboration through social technologies



Source: McKinsey Global Institute, 2012, Deloitte Access Economics

Further, decision making can be more efficient due to mobile technology (Ovum, 2008). As managers can be contacted, review information and communicate with the office without being physically present, they are able to increase the speed of information transfer and make timely decisions which can enable other follow-on tasks to be accelerated, improving the efficiency of business.

Mobiles, as part of total ICT, facilitate communication and the creation of new knowledge through improving the efficiency of collaboration and information processing. This can allow firms to develop new methods of communication with suppliers or distributors, and reduce co-ordination costs and the number of supervisors required (Kretschmer, 2012).

Mobile telecommunications can also increase productivity through improvements in the efficiency of capital. Capital use by business by business includes machinery and equipment (such as computers, electronics, and trucks), land, and intellectual property (such as software and R&D).

Mobile telecommunications can change the need for investment in some ICT equipment. For example, a business's need for investment in desktop computers can be reduced if it can instead invest in a laptop, or allow an employee to use their own laptop to connect to the workplace's network (ie bring your own device, BYOD). According to the Optus Future of Business Report: Research and Findings (2012), the proportion of large businesses issuing desktop computers will fall from 96% to 69% over the next three to five years.

An example of a machine to machine technology that will enhance productivity is Farmnet – a web portal system developed by NICTA that uses wireless sensors to measure soil moisture, soil quality and microclimates. A recent Deloitte Access Economics (2012) report found that it could reduce water and fertilizer costs in the dairy industry by between $1.6 million and $34 million a year.

There is great potential in use of these 'smart technologies' and systems, for example in the electricity, irrigation, health transport and broadband communications sectors. Access Economics (2009) was commissioned by IBM to investigate "The economic benefits of intelligent technologies" and found that adoption of these resulted in an increase in the net present value of GDP of between $35 billion and $80 billion over the first ten years, depending on the amount of spare capacity in the economy.

Land is also a component of capital. Mobile technology contributes to improved land productivity through teleworking. Employees may use smartphones, laptops and mobile broadband when doing work at home. As such, teleworking can reduce business costs in terms of reduced rent, less desk space and lower electricity costs.

On the retail side, e-tailing and m-commerce can lead to cost savings for bricks-and mortar stores through reductions in occupancy cost, as a smaller floor space would result in a lower rent. Operations can be conducted out of back-offices or warehouses rather than in shops, which can reduce storage costs for business.

A Nielsen study in 2011 estimated the size of the Australian mCommerce market to have reached $155 million in total payments. The potential for growth in this market is significant as around 68% of surveyed Australians stated they would use mobile devices for purchases, transactions and payments in the near future (Nielsen, 2011).

> The Australian Chamber Orchestra (ACO) offers an app to deliver free programs prior to concerts, and a mobile optimised website. While few tickets are currently purchased using mobile devices, mobile traffic is high, and there is potential for growth.
>
> Ken McSwain – Australian Chamber Orchestra (Deloitte Access Economics consultation, July 2012 – see Chapter 4 for more details).

An example of how stock can be warehoused or moved to areas with cheaper real estate costs is in clothing retail. For example, Sportsgirl Mobile allows customers to browse and purchase clothes on their phones, potentially allowing stock to be moved from (lower cost) warehouses rather than being stocked in (higher cost) retail stores.

Businesses can take advantage of this in their product sourcing – in one study, US-based businesses said they cut costs by 19% through sourcing products and materials from cheaper markets (Chief Learning Officer, 2012).

Part of the contribution of mobile devices to productivity is a result of the contribution of broadband to productivity, and the ability of mobile devices to make these more accessible. A study by Holt and Jamison (2009) found that broadband has a positive contribution to economic growth, but that the quantitative impact could not be measured with great precision. Similarly, it is difficult to provide a figure of mobile's contribution to productivity

with strong precision, hence a range has been estimated, which is outlined in the following section.

3.5.2 A share of economy-wide ICT productivity benefits

What are we modelling?

We estimate the productivity benefits of mobile devices by considering the growth in the economy's multifactor productivity across all industries from ICT. We attribute a proportion of this increase in productivity to the contribution that mobile ICT makes.

This approach would have been less applicable as recently as 5 years ago, when mobile phone calls represented only a fraction of overall ICT developments, which also included developments in computer software and the internet that was not used in mobile. Mobile phone calls were a discrete business activity with specific impacts. Mobile data has evolved from being mostly SMS/email use to downloads and use of apps.

In 2012, mobile technology is a pervasive component of overall business ICT strategy. As we describe in the next chapter: mobile has moved from being a device for certain communications functions towards being a platform for all ICT.

Beyond voice calls, and simple text, mobility is integrated in most aspects of communication, and data creation and transfer. New developments in recent years include the growth in penetration in data-enabled phones, the emergence of tablets as a rival to laptop as the key business device, growing use of mobile email, mobile apps, machine-to-machine technologies, and m-commerce. For example, mobile is linked to developments in cloud technology: mobile cloud traffic is expected to exceed mobile non-cloud traffic by 2013 (Cisco, 2012).

Business spend on ICT includes computers, software, telecommunications, and the internet. Ascribing a share to mobile technologies is difficult because beyond direct spending on mobile telecommunications, other ICT such as laptops, servers and websites are also used in mobile telecommunications. Therefore, our approach is to measure the share of ICT consumption based on mobile's share of business use in telecommunications and different scenarios of mobile's share of non-telecommunications ICT.

An overview of the modelling inputs

To model these productivity benefits we are assessing the contribution business use of mobile solutions makes to multifactor productivity. The value of this productivity benefit is summarised in the following equation:

$$Productivity\ benefit = ICT\ impact\ on\ MFP \times \frac{Business\ use\ of\ mobile}{Business\ use\ of\ ICT}$$

where:

- ***Productivity benefit*** is the annual percentage boost to multifactor productivity through use of mobile telecommunications devices;

- ***ICT impact on MFP*** is the contribution that sector makes to multifactor productivity; and
- $\frac{Business\ use\ of\ mobile}{Business\ use\ of\ ICT}$ is the modelled contribution mobile technology has to ICT

ICT Impact on MFP

The most recent Productivity Commission estimate of the contribution of ICT to multifactor productivity growth suggested that growth in ICT use in the late 1990s accounted for around 1½ to 2 tenths of a percentage point (PC, 2004). The contribution of ICT to multifactor productivity growth has evolved since the late 1990s. Back then, the development of a user-friendly computer interface (Windows) and the emergence of the Internet revolutionised ICT. They improved productivity by allowing a non-expert to be able to interact with ICT. These developments had a dramatic impact over the 1990s as these technologies became more widely accessible.

On the other hand, the recent changes to mobile devices have been arguably as significant; their diffusion through the Australian economy has certainly been more rapid. Mobile broadband and smartphone capabilities have exploded since Access Economics' 2010 report for AMTA. While difficult to estimate the precise productivity impact while the impacts are occurring, the current contribution of ICT to multifactor productivity is likely to be as significant as the 1990s estimate.

As such, we use the estimate of a contribution of 1½ to 2 tenths of a percentage point as a conservative estimate in this analysis. The change in ICT is occurring at a faster pace today than compared with two decades ago, and has a large potential for productivity enhancement, but this has not yet have been clearly identifiable in productivity statistical analysis.

The Productivity Commission's 2004 estimate, still cited today, utilised the most recent data available at the time, which was for the late 1990s. This is confirmed by Lehr (2012); although several studies were able to demonstrate positive productive contributions of computers in the 1990s, it was not until after 2000 that the contribution of ICT to economic growth was demonstrable in macroeconomic data.

In the analysis that follows, we calculate the productivity benefits under low, medium and high scenarios. The low scenario uses the PC's lower estimate. The high scenario uses the PC's higher estimate. The medium scenario uses the average.

Business use of mobile

Data from the ABS (2007) outlines the share of total ICT spend conducted by major industry sectors, as shown in Table 3.8. Telecommunications services accounts for 40% of this total spend, with around half of this (19.8%) being mobile-related spend. It is unknown how much of the 60% of ICT that is not telecommunications, is mobile.

Table 3.8: ICT and mobile use

Sector	Turnover	Share of total ICT spend
Manufacturing	2,265.4	2%
Wholesale trade	28,377.4	31%
Telecommunication services	37,224.2	40%
Mobile		*19.8%*
Non-mobile		*20.6%*
Computer services	24,124.1	26%
Total ICT	91,991.1	100%

Source: ABS cat. no 8126.0, IBISWorld 2012

Business use of ICT

To estimate the proportion of business mobile use as a share of overall business ICT, we analyse the ICT industry class statistics from the ABS and the business use figures from IBISWorld.

This was explored through the four scenarios modelled in this analysis. These scenarios took into account that while telecommunications is 40% of ICT, the other 60% of ICT also has a mobile component or capability. For example, while a computer server in an office may not be classified as a mobile device, it may be hosting a webpage optimised for mobile use, or it may be collected big data on consumers' m-commerce shopping habits.

The first scenario is a 'telco only' scenario – that is, it assumes that mobile does not have any broader ICT impacts other than through its telecommunications impact. The 19.8% of mobile-related ICT spend (from above) then flows into the contribution to productivity. For the 'telco only' scenario, this is the total attributable share of ICT.

For the low, medium and high scenarios, part of the 60% of ICT that is non-telecommunications related is apportioned to mobile.

These three scenarios are based on the central proposition of this paper: that mobile has moved from being an individual device to a platform for all ICT. Our high scenario of 50% is based on mobile achieving parity with fixed ICT. We also model 20% and 33% of other ICT activities, reflecting the likelihood that, while growing strongly, considerable business ICT activity is still focused fixed systems.

As shown in 0, these three scenarios result in total attributable shares of 31.7%, 39.5% and 49.6% of ICT for the scenarios respectively. Approximating, the four scenarios for mobile as a share of total ICT are then 20%, 32%, 39% and 50%.

Table 3.9: Productivity scenario

		Mobile and other ICT		
	Telco only	Low	Medium	High
Mobile contribution	19.8%	19.8%	19.8%	19.8%
Non-telecommunications contribution				
Share of ICT turnover		*60%*	*60%*	*60%*
Attributable to mobile assumptions		*20.0%*	*33.0%*	*50.0%*
Contribution		11.9%	19.6%	29.8%
Total attributable share	19.8%	31.7%	39.5%	49.6%

Source: Deloitte Access Economics

Total contribution to productivity

These proportions are then returned to the original equation and multiplied by the contribution of ICT to MFP.

This results in ranges for the impact of mobile technology on MFP as shown in Table 3.10: 0.03%, 0.05%, 0.07% and 0.1%. These productivity values were used as the inputs to the Deloitte Access Economics' Computable General Equilibrium Model (DAE-GEM).

Table 3.10: Mobile contribution to productivity

	Telco only	Mobile and other ICT		
		Low	Medium	High
ICT Contribution to MFP	0.150%	0.150%	0.175%	0.200%
Attributable mobile share	19.8%	31.7%	39.5%	49.6%
Mobile contribution to MFP	0.030%	0.048%	0.069%	0.099%

Source: Deloitte Access Economics

It is not expected that all the productivity impacts from mobile devices will happen immediately. This is accounted for in the model by having the modelling commence in 2010, with the initial wave of impacts in 2011, increasing in 2012, and a mature impact from 2013 onwards. It was anticipated that the impacts would extend to the end of the decade, hence the shocks are applied until 2020 and modelling extending to 2025.

This 'ramp up' in productivity impacts is based on the time needed for businesses to productively use new ICT. The 2004 Productivity Commission study noted that there were time lags between the introduction of new ICTs and the manifestation of associated performance improvements. Its research found that this lag could be between six months to four years. We use a three year ramp up period in this study to account for the time to absorb changes, while noting they are faster than in the 1990s. In 1993-94, around 30% of firms had internet access, growing to 70% by 2000-01. In comparison, Google has estimated smartphone penetration in Australia at 52% in 2012, a rapid increase since the first iPhone was released in 2007.

3.5.3 Modelling results

The modelling shows us the impact of the different scenarios on GDP and employment in the Australian economy. The modelled shocks of the impact of mobile technology start in 2012 and the impacts are modelled out to 2025. We produce a net present value figure for the cumulative benefits out to 2025 in in 2012 dollars using a discount rate of 7%.

Our central result is that the *current wave* of mobile technologies will result in a productivity benefit to the Australian economy of $11.8 billion. In the year 2011 alone, this contribution to the Australian economy is estimated to be $495 million. These productivity benefits are expected to grow over time – to $1.3 billion by 2016 and to $1.8 billion in 2025. The peak contribution to (full-time equivalent) employment (in 2013) would be 3,600.

By comparison:

- Where the benefits of mobile technologies are limited to the mobile telecommunications (and do not extend to wider ICT), the benefits would be $5.1 billion, with a peak contribution to employment in 2013 of 1,500.
- Under our low case, we estimate the benefit to the Australian economy of $8.1 billion, with a peak contribution to employment in 2013 of 2,500.
- Our high case, we estimate the benefit to the Australian economy of $17.0 billion, with a peak contribution to employment in 2013 of 5,300.

Table 3.11 summarises the modelling outputs. It presents the cumulative productivity benefit of the current wave of mobile technologies to the Australian economy, the contribution in 2011, and the peak employment contribution of the industry, which is expected to occur in 2013.

Table 3.11: Summary

Scenario	NPV for GDP	GDP (2011)	Employment FTE (peak = 2013)
Telco only	$5.1 billion	$210 million	1,500
Low	$8.1 billion	$340 million	2,500
Medium	$11.8 billion	$495 million	3,600
High	$17.0 billion	$712 million	5,300

Source: Deloitte Access Economics

Further detail

These results are not directly comparable with the 2010 Access Economics study for AMTA, which looked at the labour-saving benefits of mobile phone calls and falling mobile phone prices.

Deloitte Access Economics has moved from a labour saving and price reduction approach to one focusing on the contribution to multi factor productivity (MFP). The previous approach

focussed on the benefits of mobile phones related to voice calls, with an emphasis on how this saved both time and money.

The new methodology provides a platform for future analysis in terms of ICT's contribution to multifactor productivity, which is particularly relevant given the nation's weak productivity performance in recent years. It takes into account the evolution of mobile phones to data devices through highlighting the enabling benefits of telecommunications to support productivity across all sectors.

We also note that an alternative approach would estimate the contribution of mobile technology compared with fixed telecommunications or non-telecommunications ICT) by analysing share of data transfer. However, consumption in dollar terms is a more appropriate measure as it captures the *value* of mobile ICT compared with the *value* of fixed ICT. While the data share on mobile devices is relatively small (around 7% of total data downloaded) (ABS Cat No 8153.0, 2011), it does not include voice the value of mobile data is greater than fixed data, as it allows for productivity benefits while on the go and business are willing to invest in mobile broadband plans to facilitate this.

We also note that MFP growth has been declining, with negative market sector MFP over the period 2005-06 to 2010-11. While overall productivity growth has been negative, ICT has had a positive contribution to productivity. That is, in its absence, it is likely that productivity would have fallen further.

Enabling Productivity in the Australian Economy

Mobile's contribution to productivity growth is also important in the context of Australia's overall productivity performance. Productivity is important because it the long term, it represents technical progress that contributes to economic growth and improved living standards (ABS, 2011).

In the most recent productivity cycle (from 2003-04 to 2007-08), Australia's 'multifactor' productivity growth (MFP), which measures output per unit of labour or capital input, was 0.0% a year. That compares with 1.2% in 1998-99 to 2003-04 and a massive 2.5% in 1993-94 to 1998-98.

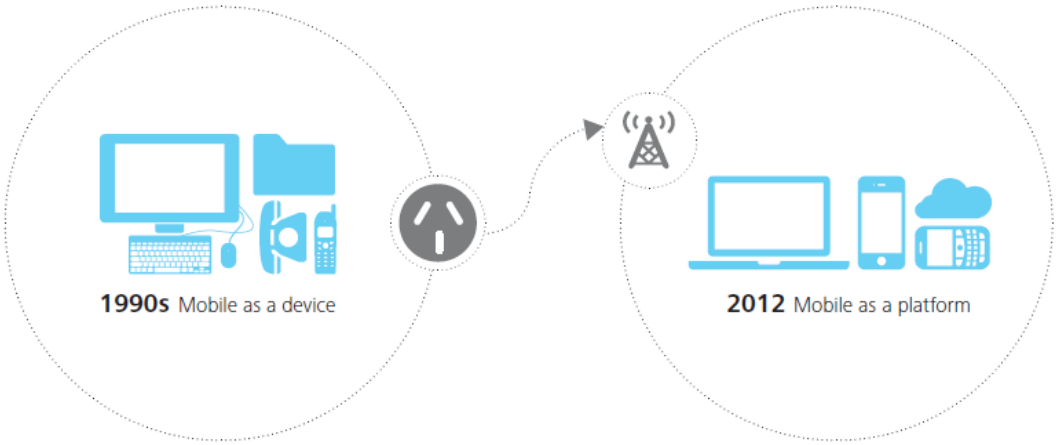
With the capacity to enable more productivity growth, technology developments in the mobile sector and their diffusion throughout the economy has the potential to reverse Australia's declining productivity performance.

4 Business impacts of mobile

Businesses do not need to look over the horizon to see the transformative impact of mobile telecommunications because they are here right now – that key message of surveys, research and our in depth consultations with Australian business leaders.

In 2013, the key change is that mobile telecommunications is becoming a deeply integrated part of an organisation's digital strategy. While mobile phones have been an important business tool for at least 15 years, they have stood separate from other digital technologies. Now, everything digital is also going mobile: computers, software, the internet, cloud and social media.

Figure 4.1: Going mobile



Source: DAE

The latest wave in mobile innovation is being driven by people – consumers and by employees. This reverses the trend of previous decades when technological developments came from government research agencies and the IT departments of large businesses. With the simple motivation for more convenient and easy to use devices, individuals are dramatically changing how business operates. In the words of Marc Andreessen, "the polarity has reversed in the technology industry" (The Economist, 2011).

The consumerisation of mobile technology has meant that business use of IT has become more responsive. Businesses are responding to the demands of consumers and employees. In Australia, almost two thirds of businesses said that meeting customer expectations was one of the three most important reasons that the business had adopted digital applications (Optus Future of Business Report, 2012). Organisations are no longer in direct control of technology. Instead, they must choose their response to trends and try to shape usage.

Mobile is changing interactions with customers – it is a source of sales / revenue, and a marketing and engagement opportunity, with new behavioural and geo-locational targeting strategies. For some businesses it is a service delivery channel. Many businesses are expected to adopt point of sale technologies, such as virtual wallets, in coming years.

Mobile is also changing business operations. The trend towards bring your own device (BYOD) is an opportunity to build engagement with employees, and possibly achieve greater retention and loyalty. Increased communications and applications can mean better use of 'down time', and present administrative and organisational opportunities. Machine to machine technologies have the potential to transform capital use.

In this chapter we analyse some of these dimensions of mobile technology and provide the insights of key Australian business leaders.

4.1 Customers

Business are increasingly using mobile to connect with customers.

The growing adoption of mobile devices introduces a new revenue channel for all businesses. Mobile commerce – known as m-commerce – is currently quite small in Australia, valued at $155 million in 2011 (SMH, 2011). However, it is expected to grow rapidly, with the m-commerce predicted to constitute almost 25% of global e-commerce by 2017 (ABIresearch, 2012).

Mobile devices serve as a new service delivery channel for information and media based businesses. This is demonstrated by the rapid expansion in mobile broadband, which is suspected to increase from 7% of total IP traffic in 2011 to 23% in 2016 (Cisco, 2012). It is predicted that the average mobile connection will use nearly 3000 Mb in mobile traffic per month by 2016, a tenfold increase on current volumes (Cisco, 2012).

The majority of increased traffic in coming years will be from media consumption and broadcasting. Mobile video is expected to constitute two thirds of total mobile broadband traffic by 2016 (Cisco, 2012).

Smartphones and tablets have redefined and expanded on-the-go capabilities. With large screens, engaging user interfaces and new cross-platform tools, devices on the market are entertainment-oriented, immersive and an ideal platform for businesses to capture audiences.

For customer facing businesses, mobile advertising and apps form a new marketing channel. A recent report by Deloitte Access Economics (2012) estimates that the market for mobile app development will be worth $600m in Australia by 2015. BuddeComm estimates that mobile advertising revenue was approximately $37m in 2011, and is expected to grow (BuddeComm, 2012).

4.2 Marketing mobilised

Beyond customer touch points, mobile is also changing marketing by providing companies with an explosion in data sets – big data.

Big data has dramatically improved the ability of advertisers to respond to consumers' preferences in terms of their behaviour, social networks and location.

A prominent example is geo-targeting technology, which determines the geographic location of a website visitor, and delivers different content to that visitor based on his or her location. Geo-contextual targeting adds a social dimension to this, offering information on the type of person you are based on where you spend your time. Next generation behavioural and social targeting, such as proximity-based targeting, will focus on not only where you spend your time, but with whom you spend it.

Analysing the large data sets now available – so-called big data - will give businesses more information with which to specifically respond to a customer's preferences and needs. This will be of benefit to consumers in reducing the volume of unrelated or irrelevant marketing material. McKinsey (2011) predicted that this new frontier will be a key basis for future competition, productivity growth, innovation and consumer surplus.

Box 4.1 Wyndham Vacation Resorts

Providing 260 smartphones, 300 laptops, and an increasing number of tablets to staff, time-share holiday company Wyndham Vacation Resorts has extensive use for mobile telecommunications to drive sales and productivity.

"Being able to communicate with workers who are not in the office and being able to send files and photos using smartphones increases productivity," says Procurement Director Malcolm Parker.

As a business that manages time-share accommodation and property development, mobiles allow increased communication with staff (critical for a workforce so geographically spread), as well as allowing staff to make use of rosters, apps, and emails. Staff are able to contact management and have decisions made in real time rather than having to wait for them to return to the office, which boosts staff productivity.

The mobile strategy includes both mobile websites and apps, such as a geolocation app for customers to find local restaurants, cinemas and other places of interest. Google Analytics is utilised to monitor the number of people visiting their websites, and how many are doing this via their mobile phones. Text messages are used to contact potential customers and remind them of upcoming sales presentations.

Future options for use of mobile devices include integration into finance management, where staff can take photos of receipts and upload these into the expense claims system without having to be in the office. While not currently adopted by Wyndham, there is potential for use of machine-to-machine technology in using mobile phones to lock doors, and near-field communication (NFC) devices which could make phones into 'mobile wallets'.

4.3 Sales and finance

The prevalence of data-enabled mobile devices has also increased the ability of consumers to satisfy their demands whenever and wherever they want, and will require businesses to facilitate the use of the increased possibilities.

Virtual wallets utilise near field communication (NFC) technology, which allows smartphones and similar devices to establish radio communication with each other by bringing them into close proximity. NFC devices can be used in contactless payment systems and allow mobile payment to replace or supplement conventional payment systems. Google Wallet allows consumers to store credit card and customer loyalty card

information in a virtual wallet, which can be used at a NFC-enabled device at terminals that also accept MasterCard PayPass transactions.

In Australia, ANZ has trialled a mobile wallet service with Visa (Visa, 2011). This involved an iPhone case containing an NFC-enabled microSD card that was linked to a prepaid ANZ account. The device allowed payments of up to $100 at any of the 20,000 plus merchants equipped with a contactless payment terminal across Australia. Similarly, the Commonwealth Bank has introduced the iCarte case which when used along its Kaching iPhone application allows for a similar payment function. Also, Optus has collaborated with Visa and Heritage Bank to trial a smartphone contactless payment product, ahead of the launch in 2013 of a commercial Optus m-wallet.

Box 4.2 Tools of the trade: Australian Chamber Orchestra

In the days before digital, the tools of the trade for the Australian Chamber Orchestra (ACO) were cellos and music stands. Today, Ken McSwain, the ACO's Systems and Technology Manager, sees mobile devices as being equally important – allowing musicians to share new musical ideas and amend the notes for concerts while on the go.

The Australian Chamber Orchestra tours both nationally and internationally. Its musicians use mobile devices to collaborate, and a cloud file-sharing system to write and rearrange music, as well as share recorded interpretations.

The ACO's collaboration uses rich media, and requires heavy use of data. However, this can come at significant cost to the organisation. "Within Australia, the system works very well. Unfortunately, when musicians are overseas, international data roaming charges can be very high."

The administrative sections of the business also see the benefits from mobile devices. According to Mr McSwain: the ability for organisational staff to be virtually in the concert hall with the musicians instead of tethered to a phone line is invaluable.

Mobile devices are also used to communicate with customers. But they don't want to be stuck on one platform; "we have tried to optimise our offerings so that they can be accessed on any device, anytime," says Mr McSwain. He sees further convergence in digital offerings in the future.

The ACO's mobile offerings include an app to deliver free programs prior to concerts, and a mobile optimised website. While few tickets are currently purchased using mobile devices, Mr McSwain says that mobile traffic is high. "People use their mobile devices for product research, but they tend to purchase on a computer or laptop."

"As a mobile organisation, we inherently need mobile solutions. Increased mobility has allowed us to become a leaner operation; we are more dynamic and able to adapt to changes," says Mr McSwain.

4.4 Flexible HR, building engagement

Instead of relying solely on company-issued, standard equipment, employees are increasingly utilising personal devices, such as smartphones and tablets, at the workplace. This is known as the bring-your-own-device (BYOD) trend.

Recent survey results show an increase in all types of personal devices used to access company networks. Laptop computers, tablets and smartphones are the dominant types of devices, with 49%, 43% and 56% of businesses allowing employee access with the

respective devices in 2012. Moreover, this trend is expected to grow – 49%, 56% and 58% of respondent businesses expect to allow access for employees' personal laptops, tablets and smartphones respectively in three to five years (p. 34, Optus Future of Business Report – Research and Findings, 2012).

The widespread coverage of mobile broadband networks in Australia mean the use of personal devices for work purposes can potentially occur not only on company premises but also on client sites both inter-city, interstate or internationally, as well as at employee's homes. This has led to increased enterprise mobility – an organisation's ability to digitally connect employees, assets, suppliers and consumers from any location and in real time.

The introduction of 4G technology is expected to allow greater broadband capacities across the network, which will increase the flexibility and mobility of work. Fox example, staff may be able to utilise data-rich teleconferencing and videoconferencing facilities. Whilst the advent of high-performance mobile broadband capacity affords businesses more dynamic human capital strategies, there is also the potential for operating costs to increase.

A few years ago, executive employees generated the fastest mobile broadband growth in many corporations. However, the balance is now shifting. Employees who used to be confined to very basic devices are now using their own smartphones that can tap into the massive iPhone and Android application stores and mobile networks.

Businesses now have to devise and implement well-informed and considered policies that balance the needs of the day-to-day work of employees with cost control initiatives. While it requires significant investment in the shorter term, the higher technical efficiency of LTE technology lowers data cost per megabit.

A challenge to businesses is to ensure that the variety of devices that employees want to use are compatible with an ever-evolving infrastructure and are of an enterprise nature. Since most mobile devices are designed for personal use and are not necessarily compatible with enterprise-level networks, businesses will need to ensure the devices fit the network they're using before granting them access.

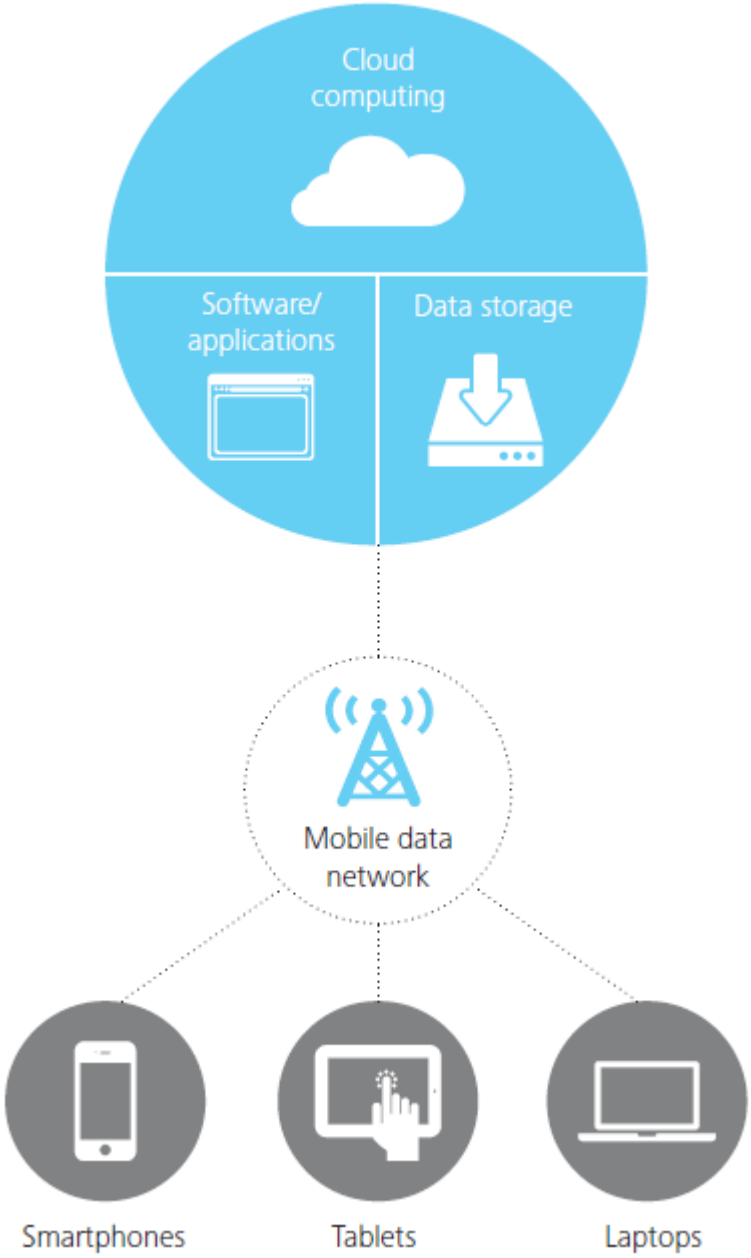
As the workplace expands and mobile devices become increasingly capable, more intellectual property will be contained outside the corporate boundaries. Dr. Michael Bennett, CIO at the US defence giant BAE Systems, points out that this will eventually force companies to adopt some type of virtual or remote IT infrastructure, where the data is protected and isolated from direct user/device contact, but served by a solution that allows users to interact with data after they have been authorized. This will allow users more freedom to use the latest technology, because corporate security will not have to depend on trusting the end points.

Freedom can be afforded through cloud computing, a technology which allows end users to access applications through a web browser or mobile app while the business software and data are stored on servers at a remote location.

Cloud based services allow device and location independence; users are able to access systems using a web browser regardless of their location or what device they are using. As infrastructure is off-site and accessed via the Internet, users can connect from anywhere.

The cost of cloud technology is potentially lower than that of conventional in-house IT infrastructure. Cloud infrastructure is typically provided by a third party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing may be usage-based so that relatively fixed capital expenditure may be converted to more flexible operational expenditure.

Figure 4.2: Mobile technologies and the cloud



Source: DAE

Corporate IT functions are being transformed from one involving the active rollout of in-house equipment and applications to one more focused on facilitation, monitoring and potentially regulating the digital data usage of employees.

Three related trends are the main catalysts for this change:

- the blurring of the lines between business and personal use;
- the increasing expectation that information be available from anywhere on any device; and
- three, the rising demand for IT personnel to collaborate with outside service providers to provide the required data infrastructure.

There is also a need for closer collaboration between IT and senior management, with IT having an added role in the area of corporate cost control.

Box 4.3 'Deny, Control, Embrace': UXC Ltd.

Organisational attitudes to mobiles evolve overtime, says Denise Carson, business manager for enterprise mobility solutions at UXC, the largest Australian owned provider of ICT services.

"The first stage is denying mobile technology, the second controlling it, and the third is embracing it," says Ms. Carson.

In the first stage, organisations block individual mobile devices connecting to their networks. The majority of Australian organisations are currently moving into the second phase; they have accepted the bring-your-own-device (BYOD) mobile trend, and have started to implement policies addressing security, governance and compliance concerns along with device and application management. The final phase involves a broad roll-out of mobile devices and apps, both for employees and clients.

"We're starting to see the first glimmers of this in Australia; some other countries such as the United States have already reached this point."

Mobility is becoming increasingly important in organisational strategy. Internally, more C-level executives are getting involved. "There are a line of business executives driving the need for mobility within a business. They're putting a lot of pressure on IT to deliver," says Ms Carson.

According to Ms Carson, there are three key drivers of enterprise mobility: productivity gains, cost reductions and employee satisfaction.

Productivity gains arise from the ability for employees to utilise their time far more efficiently, as well as the use of integrated mobile technologies to digitise and optimise manual business processes. Cost savings will arise in the long-run as a result of increased mobility and productivity; however, Ms Carson notes that rolling out new technology may increase costs in the short term. Finally, she says "employees, in particular younger ones, are accustomed to their devices, and demand that companies enable their usage. Allowing BYOD helps build loyalty and attract talent."

5 Social impacts of mobile

Mobile technologies are changing the way we experience and engage with everyday life. Beyond the transformative impact of mobile phone calls; mobile technology now has mobile web, apps, smartphones and mobile broadband to influence every sphere of society. The impacts of these technologies are still evolving, but it's clear that they extend from individual identity and leisure time, right through to how our nation and society function.

Mobile technology and its associated devices are enablers, providing individuals with more choice and freedom. We also must ask questions about the other consequences, including some negative impacts, of the mobile revolution. According to social researcher Hugh Mackay, it will be years before the answers to these questions are known.

People must determine their own level of usage, and the way in which they use the technology to change their lives, relationships and communities. Policy makers are also grappling with how to manage such dramatic changes. Collectively, that will be how we use mobiles as a society.

Figure 5.1 Mobiles affecting all aspects of society

Source: DAE

5.2 Personal

Mobile technologies offer the convenience of fully portable, fully integrated devices. Smartphones are not just communication devices. They offer rich digital experiences on the go. Photos, music, games, location-based services, maps, the internet and the millions of features offered by apps can all fit in your pocket. According to ACMA, almost a third of Australians listened to music from their phone, while thirty per cent played games (ACMA, 2010). This accessibility makes idle time productive. Commuters can use social networking sites on the train. Queuing shoppers can reply to work emails.

The high penetration of mobile devices has helped them become a new frontier of personal identity. The choice of apps, ringtones, hardware and cases allows people to express their personality, preferences and tastes. This is clearly valuable to individuals. The worldwide ringtone market is worth over $2 billion (Gartner, 2011) while ABIresearch estimates that the market for mobile phone accessories generated over $34 billion in revenue in 2011 (The Fiscal Times, 2011, ABIresearch, 2011).

Box 5.1 Increased connectivity – but at what cost? : Hugh Mackay

INCREASED CONNECTIVITY – BUT AT WHAT COST? : HUGH MACKAY

According to social researcher Hugh Mackay, mobile devices are the centre of a new wave of the information technologies, giving people a powerful device that fits in their pocket and offers unprecedented connectivity. Individuals have embraced the mobile revolution with enthusiasm. However, Mr. Mackay notes that society has not stopped to reflect on the potential downsides of mobile technology, and how this may impact on our relationships and society.

Connectivity anytime, anywhere has been a major driver of take up: "It allows people to feel connected in a way which has not been possible in Western society since the start of the urbanised 'big city' living in the 18th century. You have this sense of continuous connection; it's like being in a strand of a web which is continuously vibrating," says Mr Mackay.

"This sense of connectedness includes family, friends, and even strangers. New services such as mobile gaming allow us to widen our circle of contacts, linking us to people we would otherwise never have met. These 'cyber tribes' give us the sense of being connected, making individuals feel like a part of the herd. Part of this feeling is illusory, but some of it is real; it is important to note that some of this tribalism is purely cyber", says Mr Mackay.

This tribalism comes at a cost, according to Mr Mackay. "The big emotional benefit of this revolution is paradoxical. If you're contacting people using a mobile device, you are further away from them; the richness of interpersonal encounters is largely lost if you rely on a mobile connection." Much of the meaning gained in face-to-face encounters comes from non-verbal sources, such as facial expressions and gestures. Mackay says that all of the audio-visual elements of a personal encounter are necessary in order to communicate fully, with feedback and subtlety. "We're treating the exchange of data as if it is the same thing as communication. In doing so, we lose something quite precious in the richness of our encounters."

Higher levels of interconnectivity also have an impact on individuals, who feel the need to be 'always on'. This may lead to overstimulation and a lack of silence, making it difficult for people to find time to reflect. Mr Mackay says that the long-term consequences of this might make the net effect of mobile devices be more negative than positive. "The effect of this incessant stimulation on the brain is unknown, but likely to be detrimental," says Mr Mackay.

Overall, the impacts of mobile devices depend on individual choices over when, and for how long, to use them. "The more time we devote to the phone or the computer, the less time we

have available for anything else, especially for nurturing personal relationships. It will be a generation before the full impacts will be known."

5.3 Relationships

Mobile technologies have dramatically increased interpersonal connectivity. They allow us to contact friends and family at any time, from anywhere. Lenhart et. al. find that 74% of US teenagers use texting as a means of exchanging information privately.

Box 5.2 Mobiles and teenage dating rituals

Contrary to perceptions that digital trends are making relationships more complicated for teenagers, some say it is getting easier.

Gone are the days of passing a note across the classroom for an introduction to a potential boyfriend or girlfriend – a few text messages are a more discrete way of gauging interest.

Letting others know about a relationship is easy too: just update your Facebook page (Ericsson, 2012).

Mobiles play a vital role in 'micro-coordination'; arranging meetings with family members, or telling loved ones when we will be home. According to Wajcman et. al. (2008), over 80% of phone users rate their mobiles as being important or very important for this purpose. **Location based services** now enable physical connections as well, with finding nearby people in your network only a swipe away.

However, higher connectivity does not necessarily mean a better quality of connections. Does being a connected nation make us a distracted nation? Personal choices on mobile use can affect engagement with those in our immediate environment. Playing a game with a friend overseas might mean that you are less engaged in the conversation with the person next to you. Only one in six Australians switch off their phone during meals at home (Wajcman et. al., 2008).

Poor use of mobile devices can also be associated with relationship problems. According to a survey by Relationships Australia Victoria (RAV), half of relationship counsellors have had to deal with concerns about mobile internet devices (Yorston, 2012). According to Sue Yorsten from RAV, social media and mobile devices may negatively affect relationships because online interactions are lower quality than face-to-face interactions (ABC Radio, 2012). However, other mediums of communication – letters, emails and phone calls – also suffer from the loss of visual cues. Are mobile interactions inherently less rich? Are they replacing face-to-face communications, or complimenting them? These are questions without clear answers.

Box 5.3 Necessity for modern life: Yvonne Adele

According to Yvonne Adele, formerly "Ms. Megabyte", mobile devices have become a necessity for modern life. "You used to hear people say 'I'm not a doctor or a nuclear scientist. Why do I need to be contactable all the time?' Now the same people find mobile phones compelling and useful; they feel like they couldn't do without them."

While there may be debates about the impacts of mobiles, usage, along with its benefits and consequences, is ultimately determined by individual discretion. "As blogger Chris Brogan put it, we now have the means to find each other. Technology facilitates the start of relationships, and technology can sustain them. However, it's up to the individual to enrich the relationship by bringing it in to the real world," says Ms. Adele.

As the founder of a social media community management company, Ms. Adele says that building successful digital networks is about more than just connecting like minds. "It needs to be interesting to each individual and focus on shared interests or goals, as well as having leadership and maintaining continuous dialogue." However, those trying to build digital communities should not simply focus on building membership. "In managing community projects, it's not about the numbers; it's about what you're going to drive the community to do," according to Ms. Adele.

Mobile technologies can also strengthen non-digital communities by allowing greater spontaneity and increasing communication between group members. Ms. Adele explains that "micro-coordination allows large organisational tasks to be broken up in to more digestible pieces, which can be done by multiple individuals."

Traditional methods of communicating on a broader scale have also been changed by mobile technologies. The key change is the shift from broadcasting to narrowcasting. News is increasingly specialized. "Instead of being delivered in broadcast from major national news chains on television and in print, we have a more authentic experience; community curators on services such as Twitter choose what to pass on to their communities," says Ms. Adele.

Yvonne Adele, creator of the "Ms. Megabyte" character, has been a guru of technology since Internet and email took off in the 1990s. The author of a six time best seller, she has appeared on TV and the speaking circuit, and has started a successful online crowd-sourcing business, and online community management businesses.

5.4 Work

There are mixed effects of mobile phones on work-life balance. The shift to data-enabled devices makes it even easier for employees to work from home without being tied to the office desk. They enable the shift to telework. Mobile dongles allow employees to work from laptops at home, while smartphones allow workers to view documents and reply to emails in transit.

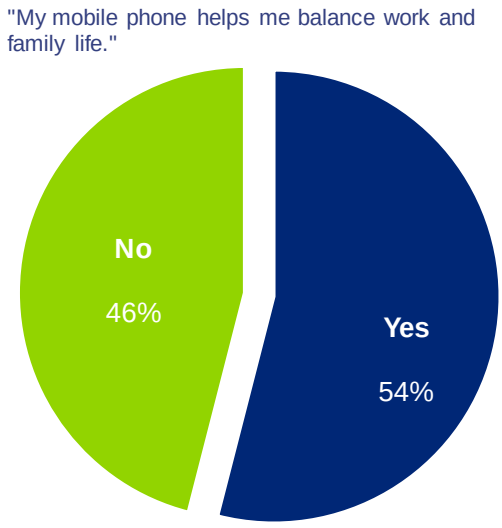
Those who work long hours can still manage family and other personal commitments. Increased flexibility offered by mobile means that people can be in the workforce whilst still being at home for other commitments. 54% of Australian workers think that mobile phones help them to balance work and family life (Wajcman et. al., 2008).

Of course, some people conjecture that more work during time at home can make people feel "always on" and affect the quality of leisure time. 43% of mobile workers keep their smartphone within arm's reach when they sleep at night (iPass, 2011).

Some businesses are becoming actively involved in ensuring that employees have personal time. To encourage employees to balance work and life, Boston Consulting Group includes

a measure of how reliably employees meet personal commitments when assessing worker performance (SMH, 2012).

Figure 5.2: Work-life balance and mobile devices



Source: Wajcman et. al., 2008

Increased mobility is also shaping physical workplaces. According to Phillip Ross, CEO of Unwork.com, the ability to work from anywhere will create new work spaces, designed for collaboration and interaction (ABC Radio, 2012). This process has already begun, with co-working spaces in capital cities across Australia allowing individuals short-term access to a desk and amenities, reception services, and larger spaces such as boardrooms (The Australian, 2010).

5.5 Community

Mobile technologies are creating and maintaining new communities, Over 38 million US smartphone owners use their mobiles to connect with online communities “almost every day” (ComScore, 2012).

They are not just creating new communities, but facilitating existing communities. The ability to micro-coordinate allows large organisational tasks to be broken into smaller ones which can be shared amongst a group. Traditional communities, from children’s soccer clubs to local farmers markets, are using mobiles to build engagement and knowledge.

Even language is being shaped by mobile devices. ‘Text speak’ is widely used, not just by Generation Y, but by Generation X and Baby Boomers. Further, it is gaining acceptance. In New Zealand, high school students are allowed to use SMS language in official tests (USAToday.com, 2006).

Communities are beginning to establish social norms around mobile use. The question is what these rules will be. Even when mobile etiquette has been established, it is up to each individual to determine their own level of usage. In the US, 31% of mobile users would answer an incoming call while at a restaurant, while 39% would answer a call while in the bathroom (LetsTalk.com, 2000).

Mobile phone users are more likely to know at least some of their neighbours.
- Pew Internet, 2011

According to Pew Internet, controlling for demographic factors, Facebook users are statistically significantly more likely to participate in the political process, both by attending meetings and by attempting to influence another person's vote (Pew, 2011). Mobile phone users are more likely to know some of their neighbours, as well as having a statistically significantly higher social network size (Pew, 2011).

Box 5.4 Mobile technology and community participation

While four in five smartphone users visit a social network on their smartphone at least once a month, the question remains as to whether mobile devices help or hinder participation in the wider community –communities are difficult to define and measure.

Consider the Rugby League 'community': measured by participation, the community might be defined as the around 450,000 registered players, but from a different view could be the 140,000 weekly attendees at NRL games, the 200,000 members of NRL clubs, or the hundreds of thousands of TV viewers. Online social media adds a layer to the community – mobility enhances it even further. For many of the 80,000 people who 'like' the NRL's Facebook page, this digital engagement is an integral part of being in the rugby league community.

According to Pew Internet, mobile phone users are more likely to know some of their neighbours, and have a statistically significantly higher social network size than others. Facebook users are statistically significantly more likely to participate in the political process, even after controlling for demographic factors.

ABS statistics suggest that the explosion of mobile devices has not had a negative impact on community participation. If anything, the impact has been positive. Volunteerism has increased rather than decreased in Australia in recent years, with 36% of Australians having undertaken voluntary work in the twelve months to November 2010, up from 34% in 2002. Participation in social and civic groups has remained steady between 2006 and 2010, at 62% and 18% respectively, while participation in community support groups has risen by 1.6%.

Mobile technologies are helping people connect when they are away from each other; however, individuals still recognise the value of in-person interactions. While marginally less Australians are meeting face to face (79.0% in 2010 compared to 79.3% in 2006), a greater proportion of Australians are spending time in internet social activities (40% spent some time in 2010 compared to 20% in 2006), and more individuals are using mobiles and SMSes to contact friends and family (84.3% in 2010 compared with 77.4% in 2006).

5.6 National

On a national level, mobile devices are changing the nature of the media. Mobile technologies have allowed every individual to become a broadcaster. Videos and photos taken by those present at events can be widely distributed, whether through text, email or social media. The rise of 'citizen journalism', demonstrated in the recent Middle East protests, has brought increased timeliness and transparency.

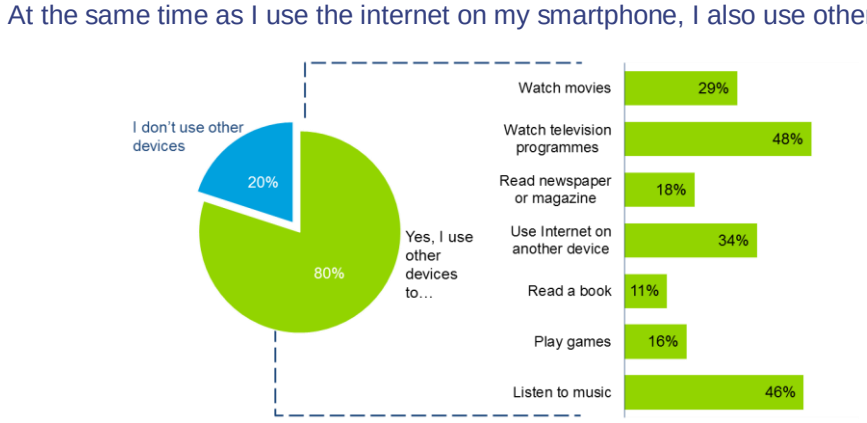
In Australia, crowd-sourced 'on the spot' reporting has been used for everything from traffic updates to monitoring bushfires. During the 2011 Margaret River bushfires, for instance, the Bushfire Connect website aggregated reports submitted by individuals using smartphones, twitter and SMS, and then used this data to provide real-time SMS updates to people in affected areas.

Mobile devices are also shaping the public debate. They give users the ability to engage with multiple forms of media at the same time, as can be seen in Figure 5.3. Individuals can join the conversation; while watching a program on TV, they can share their reactions, which are then broadcast on the program. This allows for the 'atomization' of the media; where before individuals were connected 'up' to big media, they can now be connected 'across' to each other (Rosen, 2009).

The increasing integration of social media with TV allows people to connect 'up' and 'across' simultaneously, with examples such as the twitter conversation on ABC's Q&A and Fango on Yahoo!7.

And yet, contrary to the common perception recent trends allow broader participation in national debates, research from Queensland University of Technology suggests that political debate on Twitter is relatively concentrated, with 1% of users creating two-thirds of tweets under the hashtag 'auspol' (ABC Radio, 2012). There is also some public commentary that the quality of national debate in Australia has declined or become more simplistic during the Twitter era, but this is difficult to measure or verify.

Figure 5.3: Parallel media usage in Australia, %, 2012



Source: ourmobileplanet.com, 2012

Note: does not add to 100% as individuals may use parallel devices for more than one purpose. Figures on the right refer to proportions of total

6 Conclusions

Mobile telecommunications have greatly increased in importance across the economic, business and social spheres. Exponential growth in mobile broadband traffic and rapid expansion in smartphone capabilities have occurred in recent years, with the changes being significantly driven by individuals – both as customers and employees.

It is difficult to analyse the broad and diverse range of impacts and quantify their benefits while such dramatic changes are taking place. Overall, however, there are some key conclusions.

Firstly, the mobile industry is changing. It is evolving away from a supply chain structure to an integrated ecosystem, affecting media, content and interaction across businesses. While mobile was always a business that was connected to other sectors, the lines between the mobile industry and other industries are becoming increasingly blurred. After years of strong growth, weaker conditions in the mobile telecommunications sector have seen forecasts for revenue revised down. After contraction in 2011-12 and stagnation (in real terms in 2012-13), the industry will experience a modest recovery in 2013-14. The medium term outlook for the industry is unusually uncertain.

Secondly, it is undeniable that mobile telecommunications are altering the way the world conducts business. The convenience benefits are evident; improved accessibility and connectivity are resulting in productivity gains. The story is still unfolding and we will not know all the impacts for some years.

Third, we can see that mobile is making its mark on society. From individual leisure activities, to relationships and community building, people are using mobiles more and in innovative ways.

Of course, the full long term social impacts of mobiles may not be unambiguously positive, and are emerging only slowly. As they do, policy makers are being asked to make ongoing assessments to also shape the impacts.

A supportive and responsive policy framework will allow the full benefits of a competitive mobile market and a mobile revolution to flow to the businesses and consumers making their own decisions in applications and uses. Policy decisions made now will shape the future impacts of mobiles, and will ensure Australia stands to gain from the opportunities offered by these latest innovations.

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Appendix A: Economic contribution studies

Economic contribution studies are intended to quantify measures such as value added, exports, imports and employment associated with a given industry or firm, in a historical reference year. The economic contribution is a measure of the value of production by a firm or industry, in this case Brisbane Airport.

Value added

Value added is the most appropriate measure of an entity's economic contribution to gross domestic product (GDP) at the national level, or gross state product (GSP) at the state level.

The value added of each industry in the value chain can be added without the risk of double counting across industries caused by including the value added by other industries earlier in the production chain.

Other measures, such as total revenue or total exports, may be easier to estimate than value added but they 'double count'. That is, they overstate the contribution of a company to economic activity because they include, for example, the value added by external firms supplying inputs or the value added by other industries.

Measuring the economic contribution

There are several commonly used measures of economic activity, each of which describes a different aspect of an industry's economic contribution:

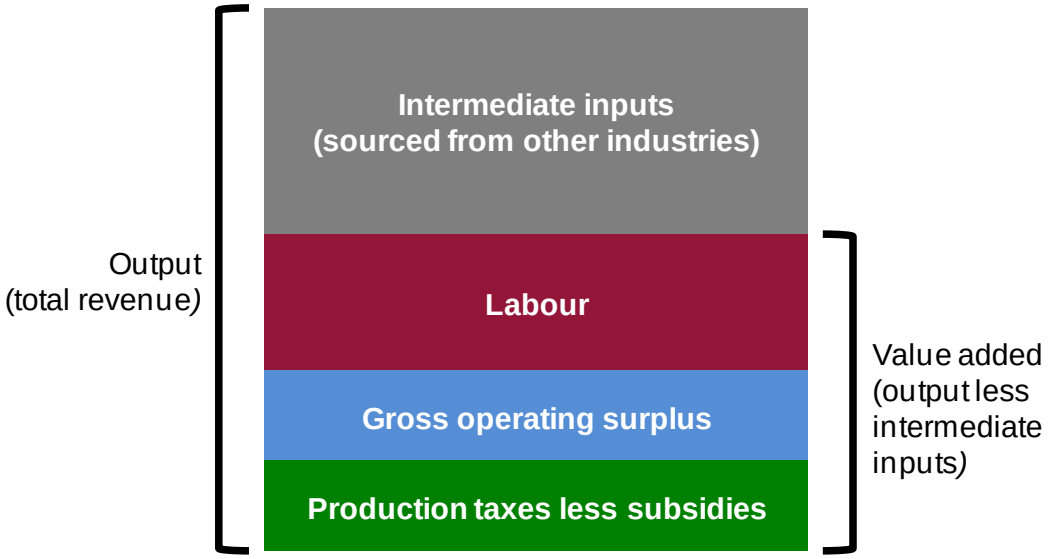
- **Value added** measures the value of output (i.e. goods and services) generated by Brisbane Airport's factors of production (i.e. labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals gross domestic product or in the case of a state, Gross State Product. Given the relationship to GDP (GSP), the value added measure can be thought of as the increased contribution to welfare.
- Value added is the sum of:
    - Gross operating surplus (GOS). GOS represents the value of income generated by the entity's direct capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA).
    - Tax on production less subsidy provided for production. This generally includes company taxes and taxes on employment. Note: given the returns to capital before tax (EBITDA) are calculated, company tax is not included or this would double count that tax.
    - Labour income is a subcomponent of value added. It represents the value of output generated by the entity's direct labour inputs, as measured by the income to labour.
- **Gross output** measures the total value of the goods and services supplied by the entity. This is a broader measure than value added because it is an addition to the value added

generated by the entity. It also includes the value of intermediate inputs used by the entity that flow from value added generated by other entities.

- **Employment** is a fundamentally different measure of activity to those above. It measures the number of workers that are employed by the entity, rather than the value of the workers' output.

Chart A.1 shows the accounting framework used to evaluate economic activity, along with the components that make up gross output. Gross output is the sum of value added and the value of intermediate inputs. Value added can be calculated directly by summing the payments to the primary factors of production, labour (i.e. salaries) and capital (i.e. gross operating surplus (GOS), or profit), as well as production taxes less subsidies. The value of intermediate inputs can also be calculated directly by summing up expenses related to non-primary factor inputs. In this case this would be the intermediate inputs purchased by Brisbane Airport and companies operating in the Brisbane Airport precinct such as supplies for the food and beverage outlets and retail shops, aircraft, cleaning equipment and rental vehicles.

Chart A.1: Economic activity accounting framework



Direct and indirect contributions

The **direct** economic contribution is a representation of the flow from labour and capital at Brisbane Airport.

The **indirect** contribution is a measure of the demand for goods and services produced in other sectors as a result of demand generated by Brisbane Airport. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics input-output tables which report the inputs and outputs of specific sectors of the economy (ABS 2010).

The indirect contribution to the Australian economy is then adjusted based on the proportion of intermediate inputs sourced from Queensland (compared to the rest of

Australia) in order to determine the indirect contribution of Brisbane Airport to the Queensland economy.

This is done by examining the proportion of intermediate inputs to the Queensland Tourism and Other services sector in the MMRF (Monash Multi-Regional Forecasting) Model which come from Queensland and then applying this proportion to the Australia wide estimates of the indirect contribution of Brisbane Airport.

In apportioning the indirect contribution based on intermediate inputs from Queensland and the rest of Australia it is assumed that the production function for Queensland is the same as for Australia as a whole.

In the present case, it was found that 81% of the value of intermediate inputs to the Queensland tourism services sector came from Queensland while 82% of the intermediate inputs for the Other Services sector came from Queensland. The tourism services sector was regarded as being most relevant to the aviation, other transport and retail industries while the other services sector was seen as most relevant for the government and other industries. These proportions were then applied to the indirect contribution of these industries in the Airport precinct for Australia as a whole to estimate the indirect contribution of Brisbane Airport for just the Queensland economy.

The total economic contribution to the Queensland economy is the sum of the direct and indirect economic contributions.

Limitations of economic contribution studies

While describing the geographic origin of production inputs may be a guide to a firm's linkages with the local economy, it should be recognised that these are the type of normal industry linkages that characterise all economic activities.

Unless there is significant unused capacity in the economy (such as unemployed labour) there is only a weak relationship between a firm's economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community. Indeed, the use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

This is not to say that the economic contribution, including employment, is not important. As stated by the Productivity Commission in the context of Australia's gambling industries (PC, 1999):

> *Value added, trade and job creation arguments need to be considered in the context of the economy as a whole … income from trade uses real resources, which could have been employed to generate benefits elsewhere. These arguments do not mean that jobs, trade and activity are unimportant in an economy. To the contrary they are critical to people's well-being. However, any particular industry's contribution to these benefits is much smaller than might at first be thought, because substitute industries could produce similar, though not equal gains.*

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No 'what-if', or counterfactual inferences – such as 'what would happen to living standards if the firm disappeared?' – should be drawn from them.

The analysis – as discussed in the report – relies on a national input-output table modelling framework and there are some limitations to this modelling framework. The analysis assumes that goods and services provided to the sector is produced by factors of production that are located completely within the state or region defined and that income flows do not leak to other states.

The IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be regarded as an upper-bound estimate of the contribution made by the supply of intermediate inputs.

Similarly the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like the CGE model.

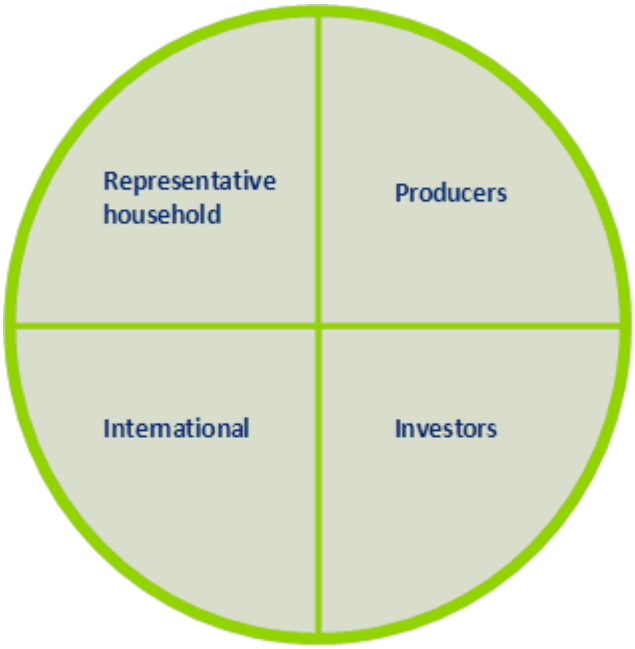
Appendix B DAE-RGEM

The Deloitte Access Economics – Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as GDP, employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various components of the model, each which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works.

Figure A.1 shows the key components of the model for an individual region. The components include a representative household, producers, investors and international (or linkages with the other regions in the model, including other Australian States and foreign regions). Below is a description of each component of the model and key linkages between components. Some additional, somewhat technical, detail is also provided.

Figure B.1: Key components of DAE-RGEM



DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).

- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.
- Producers are cost minimisers, and in doing so, choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
- The model contains a more detailed treatment of the electricity sector that is based on the 'technology bundle' approach for general equilibrium modelling developed by ABARE (1996).
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But, in relative terms, imported goods from different regions are treated as closer substitutes than domestically-produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.

- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

Households

Each region in the model has a so-called representative household that receives and spends all income. The representative household allocates income across three different expenditure areas: private household consumption; government consumption; and savings.

Going clockwise around Figure B, the representative household interacts with producers in two ways. First, in allocating expenditure across household and government consumption, this sustains demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) as well as net taxes. Factors of production are used by producers as inputs into production along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The representative household's relationship with investors is through the supply of investable funds – savings. The relationship between the representative household and the international sector is twofold. First, importers compete with domestic producers in consumption markets. Second, other regions in the model can lend (borrow) money from each other.

- The representative household allocates income across three different expenditure areas – private household consumption; government consumption; and savings – to maximise a Cobb-Douglas utility function.
- Private household consumption on composite goods is determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. Private household consumption on composite goods from different sources is determined is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption on composite goods, and composite goods from different sources, is determined by maximising a Cobb-Douglas utility function.
- All savings generated in each region is used to purchase bonds whose price movements reflect movements in the price of generating capital.

Producers

Apart from selling goods and services to households and government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another's production. For example, coal producers supply inputs to the electricity sector.

Capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region's capital stock, is undertaken by producers. In other words, investment demand adds to household and

government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. First, they compete with producers in overseas regions for export markets, as well as in their own region. Second, they use inputs from overseas in their production.

- Sectoral output equals the amount demanded by consumers (households and government) and intermediate users (firms and investors) as well as exports.
- Intermediate inputs are assumed to be combined in fixed proportions at the composite level. As mentioned above, the exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the 'technology bundle' approach developed by ABARE (1996).
- To minimise costs, producers substitute between domestic and imported intermediate inputs is governed by the Armington assumption as well as between primary factors of production (through a CES aggregator). Substitution between skilled and unskilled labour is also allowed (again via a CES function).
- The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply is (assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as DAE-RGEM. There are other labour market 'settings' that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand changes being absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destination based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

International

Each of the components outlined above operate, simultaneously, in each region of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions must be met such as global exports and global imports are the same and that global debt repayments equals global debt receipts each year.

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