7

Research and innovation

7.1 This chapter discusses the capacity of the NBN to contribute to the research and development (R&D) conducted by both public research institutions and by private industry. It primarily addresses term of reference (g), focusing on the NBN's 'interaction with research and development and related innovation investments'.

7.2 The Committee heard that while most major research facilities already have a high level of connectivity through existing fibre networks, the NBN will enable research to take place in a wider range of locations and improve the ability of researchers to collaborate with stakeholders.

7.3 The NBN will also provide critical enabling infrastructure for innovative practices and products to be developed in Australia which impact all industry sectors. This will generate new opportunities for industry to develop high-bandwidth applications that could both improve both the productivity and the quality of life of Australians, and potentially be exported to the world.

ICT investment, innovation, R&D and productivity improvement

7.4 The importance of innovation to Australia's productivity, global competitiveness and long term economic growth has been well-recognised. This was highlighted, for example, in the Federal Government's 2009 innovation agenda, *Powering Ideas*:

> Innovation is the key to making Australia more productive and more competitive. It is the key to answering the challenge of climate change, the challenge of national security, the age-old

> challenges of disease and want. It is the key to creating a future that is better than the past.[1]

7.5 Mr John Grant, Chair of the Information Technology Industry Innovation Council (ITIIC), told the Committee:

> … we are operating in a global context and our success or otherwise will depend on how competitive we are globally, and how competitive we are is determined by how productive we are. How productive we are is determined by how innovative we are …[2]

7.6 Mr Grant added that Australia's innovation performance and resulting productivity growth has been weak in recent years.[3] Australia ranked 21st in the world for innovation on the most recent 'Global Innovation Index' produced by INSEAD, well behind many other high income countries including Singapore, the United States, the United Kingdom and New Zealand.[4] Mr Grant largely blamed this on the relatively low level of R&D spending in the Australian economy:

> If you believe research and development fuels innovation, which subsequently fuels productivity, which subsequently fuels competitiveness, R&D as a percentage of GDP in Australia is 1.7 per cent, which is 16th of OECD nations. In product innovation in large firms, we are 20th of OECD nations … The fact is that statistically we do not sit strongly today to position ourselves as a competitive nation.[5]

7.7 The link between Australia's relatively low level of R&D investment and the impact on the nation's competitiveness was noted by a number of other inquiry participants. For example, the Australian Information Industry Association (AIIA) submitted that:

> Australia spends some 2.01% of GDP on research and development (R&D) compared to the OECD average of 2.26% … By any measure, Australia is lagging behind the key developed economies against whom we benchmark ourselves'.[6]

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1 Commonwealth of Australia, *Powering Ideas: An Innovation Agenda for the 21st Century*, 2009, p. 1.

2 *Committee Hansard*, Brisbane, 18 April 2011, p. 26.

3 *Committee Hansard*, Brisbane, 18 April 2011, p. 27.

4 Soumitra Dutta, INSEAD, *The Global innovation Index 2011: Accelerating Growth and Development*, 2011, p. xviii.

5 *Committee Hansard*, Brisbane, 18 April 2011, p. 27.

6 AIIA, *Submission 184*, p. 21.

7.8 Optus put forward a similar view:

> The current lack of private ICT investment in R&D has been well documented. Many large global ICT multinational corporations have closed down or moved their R&D operations outside Australia. Investment in public sector R&D has been similarly difficult to secure …
>
> A competitive R&D sector will see accelerated innovation. [7]

7.9 While it is clear that there is not a single factor that will alone turn around this performance, the Committee was provided with a wide range of evidence indicating that investments in ICT infrastructure, in particular broadband, have the ability to significantly contribute to improving innovation and productivity.

7.10 A recent report to the Australian Industry Group (Ai Group) by the industry-based Innovation Review Steering Group involved over 400 Australian firms in a detailed collaborative study aimed at finding ways to strengthen Australian innovation.[8] According to the report, the industry participants identified broadband as one of the most important contributors to the nation's innovative capacity:

> The technologies viewed as most promising by firms for creating future innovation opportunities are fast broadband and software applications …
>
> The rollout of a very high speed national broadband network provides an unprecedented opportunity for Australian businesses to transform their innovation practice, in terms of realising cost-savings, productivity, extending market reach and introducing brand new types of products and services …
>
> … irrespective of the detail of broadband deployment and the particular technologies used, the prospect of ubiquitous connectivity, across both businesses and households, represents a real opportunity to achieve a step-change in Australian innovation.[9]

7.11 Dr Ian Oppermann, Director of the CSIRO ICT Centre, told the Committee:

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7 Optus, *Submission 179*, p. 11.

8 Report to the Australian Industry Group (Ai Group) by the Innovation Review Steering Group, *Innovation: New Thinking New Directions*, October 2010.

9 Report to the Australian Industry Group (Ai Group) by the Innovation Review Steering Group, *Innovation: New Thinking New Directions*, October 2010, pp. 6–8.

> Almost all sectors of the Australian economy are underpinned by information and communications technologies. Innovative ICT research provides opportunities for improving productivity and transforming industries. It is likely that high-speed broadband will offer a transformation in communications on a scale similar to that which followed the introduction of the electricity grid and railway networks in Australia, creating new business opportunities of considerable economic value.[10]

7.12 The Australian Computer Society (ACS) described the NBN's ability to promote innovation as being obvious:

> With respect to ICT stakeholders this view is a 'no brainer'—the NBN is a 'game changer' and in implementing the NBN, Australia will lead the world in innovation and drastically improve national productivity.[11]

7.13 The ITIIC explained in its submission that:

> … underpinning innovation is the development and application of the appropriate skills; the appropriate legislative, policy and incentive settings; and the *infrastructure* of the digital economy—ubiquitous, high speed, high capacity, broadband communications.[12]

7.14 Similarly, the AIIA's submission stated that a high-speed fibre network offers a unique opportunity for a resurgence in R&D and innovation and was essential to Australia's future economic growth and competitiveness:

> … the NBN infrastructure provides the platform for technology innovation using high performance computing capabilities—essential for virtually all modern day, sophisticated research activities. As we transition to a more advanced, complex knowledge society, access to information is not enough. Increasingly the ability to filter, manipulate, retrieve, model and share information in real time is the norm—not the exception. If Australia is to compete effectively in the international R&D environment, we must have the capability to handle, filter and make sense of large, complex volumes of data. Only a high speed fibre broadband network provides this—reliably and with the

10 *Committee Hansard*, Canberra, 4 March 2011, p. 69.

11 Australian Computer Society (ACS), *Submission 146*, p. 6.

12 ITIIC, *Submission 111*, p. 1.

> ability to scale as research activities become increasingly data and knowledge intensive.[13]

Attracting foreign ICT investment in Australia

7.15 In its submission to the inquiry, the Department of Broadband, Communications and the Digital Economy (DBCDE) pointed to the following characteristics of the NBN that will help to drive research-based innovation in Australia:

- Capacity for both high-speed download and upload services, which enable collaborative research both locally and overseas;
- Ubiquitous coverage, which both lowers the costs of innovation and increases the size of potential markets for new products and services; and
- Highly stable and reliable connectivity, which provides a suitable platform for research and innovation.[14]

7.16 One result of these network characteristics is expected to be an improvement in Australia's global competitiveness as a destination for private sector investment in ICT research. DBCDE noted that the 'roll out of the NBN may attract international and domestic companies to invest in research and development that promotes and expands Australia's innovative capacity'.[15]

7.17 Optus made similar comments:

> Optus believes with the right incentives Australia has the potential to attract back many of the large multinational ICT innovation centres. Important incentives such as the NBN and attractive tax structures would encourage larger and small businesses to invest in innovation.[16]

7.18 Several submissions mentioned the positive impact that the government's commitment to the NBN has already had in encouraging IBM to set up a Global Research and Development Laboratory in Australia.[17] The

13 AIIA, *Submission 184*, p. 21.

14 DBCDE, *Submission 215*, p. 75.

15 DBCDE, *Submission 215*, pp. 75–76.

16 Optus, *Submission 179*, p. 11.

17 AIIA, *Submission 184*, pp. 21–22; ITIIC, *Submission 111*, p. 10; Department of Innovation, Industry, Science and Research (DIISR), *Submission 219*, pp. 41–42.

laboratory, based in Melbourne, is the largest investment in Australia in IBM's history and is undertaking research aligned with Australia's national research priorities. In launching the laboratory, then IBM Managing Director, Mr Glen Boreham, stated that '… delivering these types of real solutions is without question further enhanced by Australia rolling out a ubiquitous, high speed broadband network'.[18]

7.19 The local division of the large China-based telecommunications company, Huawei, told the committee that it has already begun to increase its ICT investments in Australia, with agreements now in place with RMIT University and the University of Melbourne for the supply of equipment and training to support local ICT research and skills development. Huawei stated:

> Even though the National Broadband Network is just seeing its first connections being made today, Australia is already experiencing a boost to its R&D capabilities. Thanks to the world-leading nature of the project, it has gained international attention from the world's largest technology companies—with Huawei taking the lead in partnering with Australia's R&D community.[19]

7.20 Finally, several witnesses and submitters told the Committee that the NBN will support Australia's bid to host the $2.5 billion Square Kilometre Array (SKA) radioastronomy project, both in terms of providing supporting infrastructure and providing enhanced capacity for public engagement.[20] Refer to Box 7.1 for information about the SKA.

18 IBM, 'New IBM R&D Lab to Open in Australia', *Press Release*, 14 October 2010.

19 Huawei Australia, *Submission 105*, p. 12.

20 DIISR, *Submission 219*, pp. 37–38; Professor Steven Tingay, Deputy Director, International Centre for Radio Astronomy Research (ICRAR), *Committee Hansard*, Perth, 5 May 2011, pp. 11–17; Mr Paul Nicholls, Director, Strategic Projects, Office of Research and Development, Curtin University, *Committee Hansard*, Perth, 5 May 2011, pp. 18–27.

Box 7.1 The Square Kilometre Array (SKA)

Professor Steven Tingay of the International Centre for Radio Astronomy Research told the Committee that the €1.5 billion* Square Kilometre Array (SKA) will be the most powerful instrument for astronomy ever built. It will have ability to study the evolution of the Universe, from the present day to the origin of the Universe soon after the Big Bang, over 13 billion years ago, addressing fundamental unsolved questions in physics.

Australia and New Zealand are bidding as a consortium to host the SKA, competing with Southern Africa for this opportunity. An international site selection process will come to a decision in 2012.

One of the infrastructure challenges of the SKA project will be in providing for the ability to transfer the 'massive volumes' of data produced by the SKA using long haul fibre networks. The SKA will consist of around 3000 radio antennas spread across remote parts of Australia, with each requiring 'something in the order of a couple of hundred gigabits per second' of bandwidth.

Professor Tingay noted that while the SKA's capacity requirements 'go well beyond' the capacity that the NBN alone will provide, the Perth to Geraldton route of the Regional Backbone Blackspots Program (RBBP) has already demonstrated that the NBN can play 'a crucial role' in enabling collaboratively developed fibre solutions that support the SKA. With collaboration between CSIRO, AARNet and the Government, the RBBP link to Geraldton was built with enough capacity to enable up to 8 terabits per second of accumulated bandwidth.

Professor Tingay noted that the potential for this model to be repeated along other NBN fibre routes across Australia 'is quite a strong selling point for Australian and New Zealand to win the SKA bid'.

Source: ICRAR, *Submission 228*; *Committee Hansard*, Perth, 5 May 2011.

* approximately AUD $2.1 billion as at 11 August 2011.

Research in more locations and improved collaboration

7.21 The NBN will benefit research and innovation by extending the reach of high capacity networks beyond the large public research institutions, which already have access to a high bandwidth network through AARNet, Australia's National Research and Education Network (NREN). AARNet Pty Ltd is owned by the 38 universities and CSIRO. It provides specialised services to the research and education sector, with capacities

beyond those available from commercial carriers. A number of universities, schools and other research institutions told the Committee that they are already enjoying the benefits of high-speed broadband on their campuses with connections to AARNet of up to 10 Gbit/s, far beyond the initial speeds promised under the NBN.[21]

7.22 Dr Evan Arthur, Chair of the Australian Information and Communications Technology in Education Committee (AICTEC), told the Committee that the universities have benefited greatly from this high level of connectivity, and researchers were quickly able to utilise the capacity that AARNet provided:

> When we first commenced that process and asked the university researchers what they would do and what kind of bandwidth they would need, the answers were quite modest. We made a decision to provide bandwidth which was well beyond what they had said they would need. The result of that has been that the vastly enhanced connection is now, in some cases, being used to its maximum and applications are being employed which were simply inconceivable before.[22]

7.23 AARNet Pty Ltd will shortly be upgrading its network to support connections of up to 100 Gbit/s.[23] AARNet told the Committee that its interests are complementary to the NBN, and that the benefit of the NBN is that it would extend AARNet's reach to smaller university sites as well as staff and student homes.[24] At a public hearing, Mr Chris Hancock, Chief Executive of AARNet, further explained that for those reasons AARNet intends to become a service provider of the NBN outside its core network:

> We have applied … to be an access seeker and we have been approved as one of those … The reason we have done that is that we believe that, with collaborative research opening up across the community and given the time zones that Australia is in, with Europe and North America, we actually want to take a connection

21 La Trobe University, *Submission 48*, p. [3]; Australian Institute of Marine Science (AIMS), *Submission 60*, p. 2; University of Newcastle, *Submission 93*, p. 13; University of Sydney, *Submission 114*, p. [1]; University of Queensland, *Submission 153*, p. 4; CSIRO, *Submission 171*, p. 17; Monash University, *Submission 205*, pp. 204-05; Dr Jill Abell, Director of IT, The Hutchins School, *Committee Hansard*, Hobart, 11 March 2011, p. 42; Professor Ian Atkinson, Director, eResearch Centre, James Cook University, *Committee Hansard*, Townsville, 19 April 2011, p. 2; Professor Gerard Sutton, Vice-Chancellor, University of Wollongong, *Committee Hansard*, Wollongong, 28 April 2011, p. 7.

22 *Committee Hansard*, Canberra, 4 March 2011, p. 56.

23 AARNet, 'AARNet terabit ready with Cisco', *Media Release*, 28 June 2011.

24 AARNet, *Submission 46*, p. 1.

> to the home from, for example, UNE in Armidale to a climate change researcher's home, so they can be doing their collaborative work at night over an AARNet connection via the NBN, taking that wholesale service.[25]

7.24 Other submitters and witnesses also told the Committee about the NBN's potential to extend research outside the large campuses. For example, Intersect Australia Ltd, an eResearch consortium consisting mainly of NSW universities, submitted that:

> The NBN would provide an important and substantial functional extension to AARNet, allowing connectivity to smaller but important research sites, facilitating broadband access to non-university research partners, and allowing research staff and students to access the research infrastructure from wherever they are. Achieving this level of connectivity would (a) maximise the return on the existing investments made in research infrastructure, and (b) maximise the competitive advantage of Australian research on a world scale.[26]

7.25 The Committee notes with interest the view of the Department of Innovation, Industry, Science and Research (DIISR) and National ICT Australia (NICTA) with regard to the extension of research beyond the AARNet network. DIISR told the Committee:

> Research is no longer traditionally happening just in labs; it is happening everywhere. People are in the field, people are in their homes, people want to access huge data sets from institutions that are not universities and therefore are not connected to AARNet. So we see the opportunities of that broader connection for the research sector as being absolutely enormous. We see already the requirements that people might have for access to data sets in, for example, state government departments and in field stations in relatively remote areas. We can see already that this will enhance the capacity for them to undertake that research significantly.[27]

7.26 NICTA noted that the NBN would provide the following benefits beyond those provided by AARNet:

- Connecting smaller, outlying research sites;

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25 *Committee Hansard*, Canberra, 27 May 2011, p. 29.

26 Intersect Australia, *Submission 89*, p. 2.

27 Ms Anne-Marie Lansdown, Head of Science and Infrastructure Division, DIISR, *Committee Hansard*, Canberra, 4 March 2011, p. 97.

- Connecting staff and students to high speed services from their homes, enabling researchers to be 'as productive at home as they are at work';
- Potentially providing 'backbone' capacity in areas not currently served by the AARNet backbone; and
- Proving more options for connecting K-12 institutions that are not currently connected with fibre. [28]

7.27 NICTA further submitted that:

> As digital technology lowers the cost base, innovation can move to smaller companies or even to private homes as the consumer becomes an innovation co-inventor. The NBN will bring richer digital tools to consumer and small business and make it easier to collaborate with others in an innovation ecosystem and provide a more powerful platform to share the results. This kind of effect is already being seen in the media industry where graphic designers, musicians, video-producers and visual effects artists can now run their micro-SMEs from home.[29]

Research in remote locations

7.28 A number of witnesses and submitters told the Committee about the capacity of the NBN to enable data-intensive research, particularly environmental research, to take place in a wider range of locations. Chapter 5 on infrastructure and the environment includes some discussion of the possibilities for enhanced environmental monitoring and resource management under the NBN. This section refers to more explicit implications for research, including the benefits of satellite broadband in the production of high quality data for analysis. As noted in Chapter 5, the application of remote sensors in environmental monitoring is increasing in prevalence, and the importance of connectivity between researchers working on collaborative projects should not be underestimated. CSIRO notes that:

> … sensor networks have been deployed in remote locations, with the data traffic generated per sensor varying from a few bytes to gigabytes. Broadband networks will enable the transfer of data from the sensors back to laboratories.[30]

28 NICTA, *Submission 198*, p. 29.
29 NICTA, *Submission 198*, p. 29.
30 CSIRO, *Submission 171*, p. 17.

7.29 The Australian Institute of Marine Science (AIMS), a publically funded research agency that carries out marine science across northern Australia, told the Committee that it currently depends on expensive mobile and satellite services to support its remote monitoring stations. AIMS submitted that the improved capacity and affordability of the NBN, particularly in satellite broadband, will have a significant impact on their work:

> For very remote locations, such as outer reefs, we only have very limited access to expensive and slow satellite communications and this is true for much of Northern Australia. Access to high speed cost-effective internet would dramatically change how we can work in these areas and open up entirely new studies and science outcomes from these regions.[31]

7.30 The Committee heard that the NBN's satellite component provides exciting new possibilities for research and innovation. Thales Group, the world's largest producer of commercial spacecraft, argued that satellite is the most effective technology for remote scientific monitoring:

> Where scientific measurement or monitoring requires long term data collection using remote equipment stations, satellite broadband coverage is the most effective solution. Instruments that measure a broad range of geological and atmospheric conditions are increasingly vital components in our ability to monitor and understand our environment. Remote instruments connected to a satellite broadband system can meet higher demands for data and real time manipulation by remote control.[32]

7.31 Professor Ian Atkinson, Director of the eResearch Centre at James Cook University (JCU), explained how satellite services provided by the NBN would enable research in the Daintree Rainforest to be undertaken far more effectively. Professor Atkinson discussed plans for JCU to introduce a research station at the university's 'canopy crane' in the rainforest. The crane 'can go across the canopy and sample the rainforest at various depths and locations', and the university intends to place sensors there that are capable of sending real-time information back to researchers:

> It turns out that those scientists need very high resolution information. They need information around the microclimates, not just one square kilometre; they want to know the microclimate variations up a tree so that they can understand animal habitats in

31 AIMS, *Submission 60*, p. [i].

32 Thales Group, *Submission 109*, p. A-4.

> a very detailed and fine way. They want to be able to do that so that they can understand how the rainforest will respond to changes in climate, how its carbon balance changes, how those animal populations change.
>
> To actually get communications into that area is quite diabolical. For us to get any sort of communications into the deep rainforest, mobile phone coverage just does not exist at the moment. With the satellite systems we think that we can really be stepping forward not just one or two steps, but 10 or 11 steps … It is going to take a long time and other sorts of development, but it is the ability to communicate in real-time that unlocks that potential for them.[33]

7.32 The Space Industry Innovation Council also advised the Committee about the broad potential for scientific innovation enabled by the satellite component of the NBN:

> The NBN satellites will be state of the art, and could well generate new products, services, processes and therefore new jobs in Australia as this highly performing communications capability is brought online.[34]

7.33 Additionally, the Space Industry Association of Australia (SIAA) submitted that there may be other opportunities beyond just faster broadband made possible from the launch of NBN satellites, in respect to additional monitoring equipment being attached to the satellites:

> … the SIAA notes the in principle prospects of placing smaller secondary or 'hosted' payloads on the NBN satellites. These payloads might include devices which assist with precision navigation and sensors which monitor green house gases and other atmospheric and solar phenomena … the SIAA commends the NBN Co and Government to consider the opportunity of fitting hosted payloads to future NBN satellites …[35]

Research collaboration

7.34 Professor Craig Bonnington, Director of the Monash E-Research Centre, told the Committee that although Monash University enjoys a 10 Gbit/s connection at its main campus, due to a lack of more ubiquitous connectivity its researchers are unable to collaborate online as effectively

33 *Committee Hansard*, Townsville, 19 April 2011, p. 9.

34 Space Industry Innovation Council, *Submission 73*, p. 3.

35 SIAA, *Submission 94*, p. [1].

with colleagues in Australia as they are with international counterparts.[36] Professor Adam Shoemaker, Deputy Vice-Chancellor of Education at Monash, elaborated:

> It is fair to say that while we are in a 'privileged island' position … the communities immediately outside our campus are completely off the island. That is really the problem.[37]

7.35 The Committee accepts the view expressed in Monash University's submission that issues such as 'climate change modelling, population distribution and green energy solutions are extremely data centric' and that access to a high speed affordable data network is needed for 'the free flow of information and research data between universities, research institutes, business, industry and the community as a whole'.[38] This concern about the ability to collaborate was echoed by other universities and research institutions around Australia who recognised the NBN's potential to enable improved linkages to industry partners, community groups, remote sites and other research collaborators.[39] For example, the University of Sydney submitted that:

> Providing the vast majority of Australian homes, schools and businesses with an optical fibre connection to a national network, will mean that high speed broadband connectivity will no longer be limited to a relatively small number of public and private sector organisations … As a result, we expect that the capacity for collaboration in teaching, training and research between employers, schools, vocational education providers, universities and other organisations will be enhanced greatly.[40]

7.36 AIMS suggested that issues around equity of access to communications services will potentially be addressed by the NBN. AIMS noted that many of its remote and regional stakeholders are currently 'excluded from opportunities that affordable high speed communications enables'.[41] The

36 *Committee Hansard*, Melbourne, 18 March 2011, p. 26.

37 *Committee Hansard*, Melbourne, 18 March 2011, p. 26.

38 Monash University, *Submission 205*, pp. 18–19.

39 La Trobe University, *Submission 48*, p. [3]; Australian Institute of Marine Science (AIMS), *Submission 60*, p. [i]; University of Newcastle, *Submission 93*, p. 13; University of Sydney, *Submission 114*, p. [1]; University of Technology Sydney, *Submission 200*, p. 1; Monash University, *Submission 205*, pp. 16–19**;** Professor Nicholas Glasgow, Dean, Medicine and Health Sciences, Australian National University (ANU), *Committee Hansard*, Canberra, 4 March 2011, pp. 83–84; Professor Ian Atkinson, Director, eResearch Centre, James Cook University, *Committee Hansard*, Townsville, 19 April 2011, p. 2.

40 University of Sydney, *Submission 114*, p. [1].

41 AIMS, *Submission 60*, p. [i].

potential for the NBN to enable improved research collaboration is particularly significant because a lack of collaboration is widely recognised as an area of weakness in Australia's research performance. The AIIA submitted that:

> Australia ranks last in the OECD on collaboration for innovation between business and higher education institutions. This is notwithstanding that collaboration is regarded as one of the single most important contributors to innovation development …[42]

7.37 Similarly, Professor Doan Hoang of the University of Technology, Sydney, told the Committee:

> The recent Excellence in Research for Australia (ERA) initiative has affirmed that on the whole the research quality of Australian institutions are above the international benchmark, however, research collaboration amongst them and with international partners is insignificant.[43]

7.38 Professor Hoang continued to explain that the current lack of collaboration is partly due to funding models and partly due to a lack of facilitating infrastructure. According to Professor Hoang, the NBN would overcome the latter problem by providing a platform for high-bandwidth interaction and data transfer between collaborators:

> With the NBN, the distance barrier between institutes/organisations is no longer an issue as the network performance provides adequate bandwidth for just-in-time collaborative environments and fast response times for real-time interaction at minimal costs to the institutions (compared to the current situation). Furthermore, the NBN provides abundant bandwidth to support the transfer of the massive amount of data often required …[44]

7.39 In his presentation to the Committee, Professor Bonnington of Monash University stressed the importance of data-based collaboration, suggesting it is a more important component of research collaboration than person-to-person interaction:

> Videoconferencing is good, but it has been designed for the sort of environment where we want to talk to somebody. True research collaboration is actually about collaborating around the data. You

42 AIIA, *Submission 184*, p. 22.

43 Prof. Doan B. Hoang, *Submission 177*, p. 4.

44 Prof. Doan B. Hoang, *Submission 177*, p. 4.

> cannot actually represent that data through a video linkage very well—in fact, it works very poorly … However, if you can push it through in other forms, and even develop new technology that will go beyond what is available, you are able to get new forms of collaboration happening.[45]

7.40 By way of example, Monash told the Committee in its submission about the Australian National Data Service (ANDS), a government-funded eResearch facility that provides a central repository of data collections available to be used by research teams around the country. ANDS seeks to 'create the infrastructure to enable Australian researchers to easily publish, discover, access and use research data'.[46] Monash told the Committee that the benefits of ANDS could increase significantly if bandwidth is made more widely available, and the facility could even be used by schools for education purposes:

> For society to obtain the maximum benefit from these facilities, it is vital that they be utilised by as many researchers as possible both within and beyond university circles … Making greater bandwidth available to other educational sectors is critical to opening up opportunities of this type.[47]

7.41 NICTA submitted that the NBN's capacity to promote sharing and manipulation of data outside the public sector research networks could have a major positive effect on the formation of research partnerships and the participation of private industry:

> By upgrading broadband access to every premise[s], the private sector will begin to have access to the kinds of broadband performance and digital tools currently available largely to the public sector innovation system. When connected, smaller private organisations engaged in research could have affordable access to massive public sector computational research clouds. This may encourage better operation of ecosystems which mix the public and private sectors, most notably the ARC Cooperative Research Centres and Industry Linkages programs.[48]

7.42 Cooperative Research Centres (CRCs) provide particularly good examples of the type of research models that could flourish under the NBN. CRCs are 'large, multi-participant collaborative organisations which operate

45 *Committee Hansard*, Melbourne, 18 March 2011, p. 26.

46 Monash University, *Submission 205*, pp. 16–17.

47 Monash University, *Submission 205*, p. 17.

48 NICTA, *Submission 198*, p. 29.

from multiple sites or nodes across Australia'. The CRC Committee, which provides advice to the government on CRC funding and operational management, told the Committee that collaboration between CRC participants would be enhanced by the NBN:

> CRC participants (research organisations and end-users) are geographically dispersed. The NBN will generate efficiencies by making it possible to use high definition, two-way real time video, opening up a new dimension in terms of video meetings and the ability to concurrently work on data. In addition, many CRC participants are international organisations and, to participate economically and effectively in a CRC, need to be able to access and interact with their CRC partners electronically. The NBN will facilitate greater involvement of overseas participants.[49]

7.43 RMIT University also told the Committee about the potential for the NBN to improve collaboration internationally, not just locally. Their submission suggests that if the current limitations in connectivity can be overcome, similarly to the business community (as discussed in Chapter 6), Australia's research community could actually benefit from being in a time zone that is offset from North America and Europe:

> Australia's geographical position has placed limitations on international collaboration with peers around the globe. Multiple time zones can enable international research teams to work on a problem around the clock. However, limited communications have made it difficult to share large data sets, to discuss technical problems and areas of contention in a timely manner. NBN infrastructure has the potential to resolve this limitation for collaboration with other NBN-enabled countries, giving Australian researchers a stronger position in global research.[50]

Increased public engagement in science

7.44 An extension of the NBN's capacity to extend the reach of research collaboration to more people is its ability to facilitate a higher level of engagement of ordinary people in science and research projects.

7.45 The Government of South Australia told the Committee about the Royal Institution of Australia (RiAus), a science-outreach organisation based in Adelaide. RiAus has a focus on promoting public awareness and

49 Cooperative Research Centres (CRC) Committee, *Submission 196*, p. 2.

50 RMIT University, *Submission 180*, p. 4.

understanding of science by 'bringing science to people and people to science'. Its media-rich website, which includes streamed videos of its programs and lectures for those who cannot attend in person, is expected to become more widely accessible when the NBN is rolled out:

> Video content such as that at RiAusOnDemand can only be accessed with a fast internet connection. The NBN will ensure that such opportunities to engage with Australian science are available in population centres domestically, even overseas, as well as in more remote Australian communities.[51]

7.46 Questacon, Australia's National Science and Technology Centre, is also largely focussed on engaging students and other members of the public in science using online services, made possible through their fibre connectivity. Mr Graham Smith, General Manager of Development at Questacon, told the Committee about some of Questacon's recent activities in online science engagement using video-conferencing technologies:

> We are on AARNet, so we have been able to make use of that capability to reach a lot of schools. We have been using it for about 18 months, and trialling a variety of different formats. What we are able to do now is link institutions such as CERN [the European Organization for Nuclear Research], for instance, into schools. We have linked up with Japanese research groups and taken, in a virtual sense, schools so that they can do live interactive Q&As with international and Australian institutions. It is quite remarkable, mainly because of the speed and the lack of delay.[52]

7.47 The Committee notes the extensive benefits accruing to Australian students and teachers from such linkages with scientists in world-leading research facilities, in multiple disciplines and locations. Apart from Mr Smith's reference to CERN, where the Large Hadron Collider is located, the Committee heard that Questacon links online to Arctic and Antarctic scientists participating in the global Polar Palooza event in Canberra and in the field in Antarctica; and Cooperative Research Centres in the field of robotics.[53]

7.48 Mr Paul Nicholls, Director of Strategic Projects, Office of Research and Development at Curtin University, told the Committee that if Australia is successful in its bid to host the SKA, ordinary people with an NBN

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51 Government of South Australia, *Submission 195*, p. 12.

52 *Committee Hansard*, Canberra, 4 March 2011, p. 95.

53 DIISR, *Submission 219*, p. 38.

connection will be able to participate in research related to the project through the 'Skynet' program.[54] See Box 7.2 for more information.

Box 7.2 Skynet

'Skynet' is a citizens' science program that will enable members of the public to use their personal computers, with fast broadband connections, to help process radio astronomy data generated by the Square Kilometre Array (SKA). Not only would this assist professional SKA researchers with their work, it could also have significant benefits for increasing the level of interest of students in pursuing future science careers.

Mr Paul Nicholls of Curtin University explained that Skynet is 'about motivating students and teachers and helping them to participate in the broader science field'. He added that 'having teachers that can provide context for students is really important: this is a real project that is really happening'.

Source: *Committee Hansard*, Perth, 5 May 2011.

7.49 A major long term benefit of this type of public engagement in science is that it can provide motivation for young people to become involved in maths and science careers, thereby increasing Australia's long term capacity to undertake leading-edge research. Monash University envisaged a scenario where Queensland rainfall data was available to schools via ANDS:

> Students returning to school after a flood event could be led on a discovery process by their teachers examining historical and current rainfall data. A football-mad student could use real sports statistics as a pathway into understanding statistical problems generally. These immersive and real world experiences that allow students to pursue an area of current interest, or a long-held passion, may well be critical to forming their career path. For some of them, this might be the transformative moment that sets them on a career of research and discovery.[55]

54 *Committee Hansard*, Perth, 5 May 2011, p. 22.

55 Monash University, *Submission 205*, p. 17.

Promoting application development

7.50 It is clear from the evidence noted above that the NBN has much to offer the world of research and innovation in terms of providing infrastructure that encourages R&D investment, equips researchers, and promotes better collaboration and public engagement. It is also clear that the NBN has the potential to promote innovation in a broad sense, increasing productivity across the economy as innovative new products and ways of doing things are employed. The types of specific applications that could be developed and utilised in Australia as a result of the NBN are discussed in detail throughout the other chapters of this report. However, the Committee heard from several inquiry participants that government support is required to underpin the development and utilisation of these broadband applications.

7.51 In terms of public sector R&D, there are a number of research institutions around Australia that are focused on developing innovative new applications based on broadband technologies, most of whom already receive significant government support. DBCDE advised the Committee that such institutions were taking pioneering roles in driving innovation ahead of broader industry sectors:

> For many potential users the benefits or value of the NBN is in the network effect. For example it is only when a critical mass of customers or clients is able to access the NBN that some firms will start to explore its potential. However the work of organisations such as CSIRO, NICTA and IBES make an important contribution to identifying and proving the ideas that innovative firms will capitalise on in the medium term as the NBN rollout gets more extensive.[56]

7.52 During the course of the inquiry, the Committee took the opportunity to visit one of these institutions, the Institute of a Broadband-Enabled Society (IBES). IBES is based at the University of Melbourne and receives additional funding from both the Victorian Government and from industry partners. It is focused on developing high-bandwidth solutions for a wide range of social and economic applications. For more information on IBES, refer to Box 7.3 below.

56 DBCDE, *Submission 215*, p. 76.

Box 7.3 The Institute for a Broadband-Enabled Society (IBES)

IBES is a cross-disciplinary research institute dedicated to innovations in products, services and end-user experiences that maximise the benefits of new broadband technologies to Australian society. Research at the Institute focuses on a wide range of fields including education and learning, health and wellbeing, network deployment and economics, service and business transformation and social infrastructure and communities.

The Institute was founded in July 2009 and is jointly funded by the University of Melbourne and the Victorian State Government. The Society has stated that the NBN will shape the delivery of education, provision of health care, management of resources and connections with others.

Projects include Uni TV (see Box 4.4) which aims to deliver tertiary education services through a web-based portal; development of e-health applications, including youth mental health and wellbeing, tele-health and electronic health records; natural resource and environmental management through the use of sensor networks; and research into the community and social benefits of broadband uptake including social inclusion and social diversity, improved service delivery to urban, regional and remote communities, and the development of innovative applications which find new uses for Australia's cultural heritage, but that also facilitate new possibilities for user-led innovation.

Source: IBES, *Submission 84*.

7.53 In December 2010, an institution with a similar mandate to IBES, the Australian Centre for Broadband Innovation (ACBI), was launched in Sydney. ACBI was established by CSIRO in partnership with NICTA and the NSW Government. ACBI will 'develop and trial new applications and services for the NBN with a particular focus on regional service delivery'.[57] CSIRO and NICTA are also developing new high-bandwidth applications independently.

7.54 The Committee heard that there is further scope for investment in research and development of broadband applications for particular industry sectors and to address particular issues. While NBN-enabled applications for the agricultural sector are discussed more broadly in Chapter 6, the Committee notes at this point their particular relationship to R&D. The National Farmers Federation told the Committee that:

57 DBCDE, *Submission 215*, p. 76.

> Commercial and export opportunities may exist in the development of … applications to improve the efficiency and productivity of Australian agriculture. Some work has been undertaken by the CSIRO ICT centre on the use of information technology in agriculture, including virtual fencing, bull separation, pasture management, water quality monitoring and agricultural robotics. However, significant further work is required; particularly research and development work in partnership with farmers.[58]

7.55 Mr Nicholls of Curtin University also told the Committee that more investment in application development will be required: 'the biggest issue in securing the potential is a lack of investment in development of quality content and quality research'.[59] In its submission, Curtin University expressed interest in contributing to an 'Australian National Broadband Strategic Research Facility', which would focus on providing content for the NBN to 'providing major city levels of service, especially those services delivered by Government, to all Australians'.[60]

7.56 With regards to the private sector, the Committee heard from some organisations that although fast, ubiquitous broadband would enable innovation to take place, the infrastructure of the NBN alone would not be enough to drive innovation to the maximum extent possible.

7.57 The Business Council of Australia (BCA) submitted that ICT 'was critical to Australia's improved productivity performance during the 1990s' and 'will continue to make an important contribution'.[61] However, BCA also noted that Australia's taxation system and regulatory frameworks are at least as important as infrastructure like the NBN in promoting productivity-enhancing ICT investments.[62] BCA wrote:

> The first step in using ICT as an enabler for productivity growth should be to ensure that Australia's taxation system and regulatory framework adequately support ICT innovation and investment. The regulatory framework encompasses not just regulations but the wide range of government settings that affect the incentives of firms, such as funding arrangements, supply quotas and price caps.[63]

58 National Farmers' Federation, *Submission 197*, p. [4].
59 *Committee Hansard*, Perth, 5 May 2011, p. 20.
60 Curtin University, *Submission 91*, p. [2].
61 Business Council of Australia (BCA), *Submission* 207, p. 5.
62 BCA, *Submission 207*, pp. 8–9.
63 BCA, *Submission 207*, p. 9.

7.58 Scientific Applications International Corporation (SAIC), a large US-based scientific, engineering and technology company, cautioned that the NBN's large potential to be a 'platform for innovation' would only be maximised if the Government acts to focus application development on 'forging new partnerships between industry, universities, and national laboratories'.[64] SAIC explained:

> While we believe that Australian government R&D and university institutions are positioned to advance the state-of-the-art in many aspects that touch on the NBN, we have taken a position … that the opportunity exists to exercise a new R&D investment paradigm when it comes to the NBN. The R&D investment for the NBN could involve industry and the extending competition for R&D funds on an equal footing between government labs, universities, and industry (small and large) could greatly enhance the outcomes of the investments. The government should encourage collaboration among these institutions, and commercialisation should be emphasised in order to turn these investment dollars into enduring Australian jobs.
>
> The government could also consider an R&D framework that allows private funding to augment public investment …[65]

7.59 Optus submitted that in addition to government support for development of broadband applications, 'further assistance for commercialisation of NBN services and applications will help see these ideas through to market'.[66]

7.60 The ITIIC told the Committee that if businesses can lift their level of innovation by leveraging the NBN, there is a 'considerable opportunity for the local IT industry' to develop high-bandwidth software applications. These applications could be exported to the world, shifting the balance away from Australia's traditional status as being 'great users but not producers of ICT'.[67]

64 Scientific Applications International Corporation (SAIC), *Submission 35*, p. 2.

65 Scientific Applications International Corporation (SAIC), *Submission 35*, p. 6.

66 Optus, *Submission 179*, p. 11.

67 ITIIC, *Submission 111*, p. 6.

Committee conclusions

7.61 The Committee received convincing evidence that the NBN will provide a critical enabling platform for improving Australia's R&D and innovation performance.

7.62 As a world class, high speed and ubiquitous network, the NBN will provide incentives for foreign companies to set up research and development facilities in Australia. These investments are already becoming apparent, with IBM recently launching a Global Research and Development Laboratory in Australia. The Square Kilometre Array project will represent a major investment in Australia's research capabilities, should Australia's bid be successful.

7.63 The NBN will also provide opportunities to improve the way research and development is undertaken in Australia. The ubiquity of the network will enable research to be undertaken in places where it is currently limited by geography and lack of connectivity. The NBN's satellite component, in particular, will enable a much higher quality environmental science to take place in remote areas. By extending high speed broadband outside the major research campuses, the NBN will enable vast improvements to the ability of researchers to collaborate with stakeholders in private industry and the broader community, a widely acknowledged area of weakness in Australia's current research activities. By connecting fibre to homes and schools, the NBN will also enable an increased level of engagement in science with the general public, which has the potential to improve the level of interest in high-demand science- and mathematics-based careers.

7.64 Furthermore, the NBN will provide Australia with the opportunity to lead the world in the development of applications that use high-speed broadband across all sectors of society, including business, education and environmental management. Such development could lead to improved export outcomes for Australia's ICT sector. According to the OECD, Australia's export of ICT products as a proportion of total merchandise exports is currently among the lowest in the world, at only 1.5 per cent, compared to 27 per cent in South Korea.[68] The NBN will be an important factor in driving a higher level of ICT exports.

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68 Australia's 'share of ICT goods in total merchandise exports' in 2008 was second lowest in the OECD, and decreased from 3.6 per cent in 1996 to 1.5 per cent in 2008. See *OECD Information Technology Outlook 2010*, pp. 90, 116.

7.65 For this potential to be realised, the Committee recognises there is a need for continued government support for organisations, such as IBES and ACBI, which are involved in developing applications to utilise the NBN.

7.66 The Committee also recognises that, provided appropriate regulatory structures are in place, the NBN has the potential to underpin resurgence in private sector R&D investment.

7.67 Given the high level of potential benefit to the research community that the NBN offers, particularly due to its ubiquitous coverage, the scientific community should be seen as an important stakeholder during the NBN's design and rollout. There is already a precedent for this: during the recent construction of the RBBP fibre link from Geraldton to Perth, CSIRO, AARNet and DBCDE co-operated to ensure that additional capacity was built into the fibre route to enable use by the SKA project. Other examples of where these types of mutually beneficial arrangements can be made could include allowing NBN satellites to carry additional 'hosted payloads' that would be able to increase scientific outcomes for little additional cost. The Government and NBN Co should recognise the potential value of their infrastructure to the research sector and maintain ongoing dialogue with representative research bodies to identify how the potential benefits can be maximised in the NBN's final design.