ICT workforce study

July 2013

Information and communications technology workforce study

July 2013

Letter to the Minister

Dear Minister

On behalf of the Australian Workforce and Productivity Agency (AWPA), I am pleased to present our ICT workforce study. This report is an important part of AWPA's commitment to ensure that Australia has the workforce it needs for the future.

Across our economy, ICT is driving innovation and productivity. From the productivity benefits of cloud computing, to the transformative impact of mobile telephony and tablet devices, businesses across every industry sector are utilising ICT to streamline business processes, improve service offerings and simplify operations. The rollout of the National Broadband Network will facilitate and strengthen these activities, and ICT-savvy businesses will also increasingly look to emerging Asian economies for the provision of niche ICT services.

In turn, workers across the economy require a range of skills to support these developments. This includes the specialist ICT skills required to develop, deliver and promote ICT services, products and advice, and the generic skills and 'digital literacy' to facilitate and support these changes.
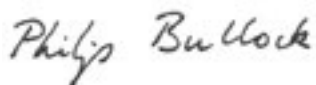
However, we face several challenges in preparing the domestic workforce for the ICT skills demands of the future. Low engagement in ICT skills in schools leads to a less than satisfactory pipeline of ICT skills, and many employers signal dissatisfaction with the quality and quantity of domestic ICT graduates. Reform is required to boost perceptions of ICT careers, enhance the work readiness of ICT graduates and improve industry engagement in upskilling and professional development in an industry characterised by rapidly changing skill sets.

This report is informed by extensive consultation with industry, universities, vocational education and training bodies, industry associations and unions. Following the release of an issues paper in January 2013, AWPA received 19 submissions from stakeholders, and convened meetings with stakeholders including an industry forum in November 2012 and a roundtable meeting in February 2013.

I would like to express my gratitude to stakeholders across industry, the tertiary sector and government who have provided their invaluable insights and guidance to the project. I would particularly like to thank the chair of the ICT workforce study and AWPA board member, Ms Marie Persson, my colleagues on the AWPA board, and our critical friends who have so ably assisted in the development of this study.

I trust this report, and the recommendations featured in it, will assist decision-makers across the sector to bolster the quantity and quality of the ICT skills which will be so crucial to our future economic growth.

Yours sincerely

Philip Bullock

Philip Bullock
Chair, Australian Workforce and Productivity Agency
July 2013

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Abbreviations and acronyms

ABS	Australian Bureau of Statistics
ACDICT	Australian Council of Deans of ICT
ACS	Australian Computer Society
AGIMO	Australian Government Information Management Office
Ai Group	Australian Industry Group
AIIA	Australian Information Industry Association
ANZSCO	Australian and New Zealand Standard Classification of Occupations
APESMA	Association of Professional Engineers, Scientists and Managers, Australia
APS	Australian Public Service
AWPA	Australian Workforce and Productivity Agency
CITT	Communications and Information Technology Training
DEEWR	Department of Education, Employment and Workplace Relations
GDP	gross domestic product
IBSA	Innovation and Business Skills Australia
ICT	information and communications technology
IT	information technology
ITCRA	Information Technology Contract and Recruitment Association
ITPA	Information Technology Professionals Association
NAGCAS	National Association of Graduate Careers Advisory Services
NBN	National Broadband Network
NICTA	National ICT Australia
NVEAC	National VET Equity Advisory Council
NWDF	National Workforce Development Fund
OECD	Organisation for Economic Co-operation and Development
SME	small to medium-sized enterprise
STEM	science, technology, engineering and mathematics
TAFE	Technical and Further Education
VET	vocational education and training
WIL	work-integrated learning
WSIS	World Summit on the Information Society

Glossary

big data	High-volume, high-speed and diverse modes of information that require advanced analytical techniques to organise, interpret and process.
cloud computing	Enables on-demand and convenient access to computing resources including but not limited to data storage and application services. These services are usually sourced by enterprises from external service providers and are located off premises. Cloud computing can result in savings for enterprises as it enables outsourcing of specialised expertise across a diversity of ICT needs.
cognitive computing	Systems that learn and interact with people to enhance the capabilities of the person or machine. Often used to assist decision making when analysing big data.
collaborative intelligence	The use of technology, such as social media, to engage broad problem-solving networks.
cyber	Relating to electronic communication networks and virtual reality.[1]
data analytics*	Analysis of internally generated and publicly available data and information to predict outcomes and identify trends.[2]
digital economy	The global (or Australian) economic and social interactions and activities enabled by platforms such as the internet, mobile appliances and sensors. In its broadest definition it can include almost all of the activities in which we engage including health services, online retail and education and online government service delivery.
digital literacy	Is concerned with enabling people and communities to become 'cybercitizens' by acquiring skills to effectively participate in the digital economy. Digital literacy will become increasingly important as the NBN is rolled out.
e-commerce	Online, electronic transactions between businesses, consumers and/or government organisations.[3]
groupware*	Electronic software and applications supporting communication, coordination and cooperation between members of a group. These can range from electronic mail to complex structured systems.
haptic technologies*	Also known as tactile feedback technologies. Technological devices which incorporate tactile feedback to develop virtual objects on the screen.

* These words are adapted from the source at footnote 2.

1 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* Glossary, www.nbn.gov.au/files/2011/06/Advancing-Australia-as-a-Digital-Economy-BOOK-WEB.pdf, accessed 12 June 2013.

2 Adapted from Gartner, *IT Glossary,* http://www.gartner.com/it-glossary/groupware, accessed 17 June 2013.

3 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* Glossary.

internet	The global system of interconnected computer networks.[4]
knowledge-based industries	Refers to parts of the economy that deliver specialised, technical outputs based on the production and customisation of information, rather than traditional goods and services. The ICT services sector is often identified as a knowledge-based industry.
learning systems	Technology programmed to use available information to make real-time, evidence-based decisions.
online	Connected to the internet and able to share data and information with other computing devices.[5]
QR codes*	Quick response codes. Two-dimensional bar codes linked to a website which can be read by a mobile phone or other device with the appropriate software installed.
security	Refers to technology that detects threats and responds to these appropriately. It also deals with historical analysis of security issues, compliance and investigation. Security demands analytical skills as well as ability to correlate a diverse range of events and information.
social media	Online technologies and practices that people use to share opinions, insights, experiences and perspectives. Can take many different forms, including internet forums, social networking, social blogs, wikis, podcasts, pictures, video, rating and bookmarking.[6]
software	Programs used to operate computers and related devices.[7]
teleworking	Refers to 'working from a distance' and includes a range of modes such as remote access, remote work, mobile work, e-work, telecommuting and working from home. It does not only deal with technology although technology can be a central mode in enabling telework. For enterprises telework means a structure which supports employees working from non-traditional locations.
T-shaped professionals	Employees with broad knowledge and deep expertise, including technical skills, subject matter knowledge and soft skills (such as communication and business skills).
vendor certification*	Approval or licencing offered by technology retailers and manufacturers to distribute services or to maintain their products.
work-integrated learning	Occurs where students combine their formal studies with work in the relevant industry. The work is usually structured and assessed as part of their studies. It provides opportunities for students to practice in their relevant professions and explore career options. Work-integrated learning also provides enterprises with opportunities to identify new entrants for entry-level positions.

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4   Ibid.
5   Ibid.
6   Ibid.
7   Ibid.

Overview

Introduction

Information and communications technology (ICT) is arguably the key driver of productivity growth and innovation in the twenty-first century. The uptake and effective utilisation of ICT services has facilitated innovation across an increasingly diverse range of areas including, for example, advanced environmental management solutions, new diagnostic and preventative health techniques, and methods to detect, respond to and recover from natural disasters and emergency situations.[8]

And the future for technological innovation looks bright. Of course, it is difficult to predict the future with certainty, but the diffusion of ICT across all industry sectors, and the pace of technological change, will ensure that ICT continues to generate change and drive innovation in our economy. Research conducted by IBISWorld indicates that a range of technological trends including 'ubiquitous high-speed broadband, analytics, learning systems and cognitive computing'[9] will transform all aspects of Australian society.

Substantial growth in data usage will create huge demand for cloud computing services as businesses try to store more information than ever before. The resulting proliferation of information will increase demand for data analytics expertise to facilitate effective information management, and information and cyber security services to ensure the safety of this data. The next generation of technological change will also effect considerable change on the way we live, work and play, as automation, remote sensing and robotics are applied to an increasing range of activities, sophisticated haptic technologies (also known as tactile feedback technologies) that respond to human senses are developed, and brain–machine interfaces are created to enable neural control of ICT systems and devices.[10]

As one of the key sectors in the knowledge-based industries grouping, the ICT sector is at the coalface of fundamental changes to industry, work and skills needs. Knowledge-based industries are concerned with processes that identify knowledge and utilise it to maximise growth, and those processes that identify and gain new knowledge. Driven by technology as their main vehicle, knowledge-based industries are shaped by global rather than local influences. This has implications for the ways in which industry, government and training providers can intervene in this sector to create local impacts.

The ICT sector is characterised by fluidity in various domains including in organisational structures, job designs and recruitment strategies. Themes inherent in this sector such as knowledge management, groupware and collaborative intelligence will lead to organisational

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8   Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2013, *ICT Centre,* www.csiro.au/ict, accessed 29 March 2013.

9   IBISWorld, 2012, *A Snapshot of Australia's Digital Future to 2050*, p. 9, www-07.ibm.com/ibm/au/digitalfuture, accessed 11 March 2013.

10   Ibid., p. 10.

restructuring and reengineering.[11] This creates a need for nonlinear organisational models where production flows are idea driven and not always sequential.[12]

It is thus inevitable that the same fluidity that characterises organisational structures is reflected in the skills needs of the sector. The jobs and work of the future demand broad skills that are increasingly difficult to place in existing categories of occupations as defined by the Australian Bureau of Statistics (ABS). The skills needs of the future require capabilities to engage with 'collaboration strategies, use of collaboration tools, and cross-cultural communication, to collaborate with ICT professionals both in Australia and offshore'.[13] The impacts of these skill requirements include continuous learning and 'learning by doing' to develop new kinds of 'tacit knowledge'. It also requires skills to handle codified knowledge[14] and inter-firm and interactive learning to acquire new research, and to develop various stages of a technological process which is key to technological progress and change.[15]

Skill sets in this globalised sector have become global commodities and online talent sourcing companies such as freelancer.com facilitate a global market for skills. Recruitment of ICT workers is now often done through 'non-traditional channels, in ways that can directly assess capabilities rather than formal qualifications or work experience'. Other examples of online recruitment platforms include TopCoder, Gild, RemarkableHire and TalentBin, many of which 'identify the highest potential ICT recruits on the basis of their contributions and recognition to developer communities'.[16]

These trends require countries like Australia to build clusters of specialised skills and talents, which will create demand for specialised ICT skills in addition to the generic skills required for organisational support tasks.

Many of these skills are developed outside of formal contexts, particularly for ICT-related skills. The role of emerging modes of knowledge sharing such as mashups (collaborative events) and online education forums such as massive open online courses are central to the facilitation of upskilling and reskilling in the ICT workforce. The trend within the ICT sector is for self-directed learning and lifelong learning. While structural support in organisations and in workforce policies is required for the emerging need for lifelong learning culture, these channels of knowledge acquisition are also widely accessed and directed by workers outside of work and formal education channels.

Human capital is the key to realising the innovative potential of ICT. Whatever the future holds, the challenge for industry will be to enable innovation by attracting workers with the specialist skills and capabilities required to deliver and manage technological change, investing in ongoing skills development to promote the deepening and broadening of skills, and committing to flexible organisational practices to facilitate retention and the effective utilisation of skills including, for example, job redesign, job rotation and employee participation in decision making.

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11 Wood, J, 2003, 'Australia: an underperforming knowledge nation?', *Journal of Intellectual Capital,* vol. 4, no. 2, p. 147.

12 Dzinkowski, R, 2012, 'How to price human capital', *In the Black,* October 2012, www.itbdigital.com/opinion/2012/10/05/how-to-price-human-capital, accessed 24 October 2012.

13 Dawson, R, input provided to the AWPA ICT workforce study report, May 2013.

14 Organisation for Economic Co-operation and Development (OECD), 1996, *The Knowledge-Based Economy,* p. 14, www.oecd.org/science/scienceandtechnologypolicy/1913021.pdf, accessed 18 June 2013.

15 Ibid., p. 12.

16 Dawson, R, input provided to the AWPA ICT workforce study report, May 2013.

Accordingly, the knowledge, skills and competencies required to engage with ICT have taken precedence in early twenty-first century societies. Generic ICT skills and 'digital literacy' have emerged as prerequisites or highly desired skills for jobs across the economy, and are also central to the process of learning, as primary, secondary and tertiary educational institutions increasingly utilise technology in the delivery of educational programs. At the higher end of the skills spectrum, advanced ICT skills offer career prospects across a range of sectors as ICT moves from the backroom to the forefront of enterprise activity. As a result, the skills required to understand and use ICT have emerged as a fundamental concept in all levels of education, from the foundational years through to senior schooling and across a range of tertiary education offerings both in ICT and non-ICT disciplines.

Many Australian businesses and workers are integrating ICT into their day-to-day activities. This adoption is not new, but the standardisation of hardware and software has shifted business demand from customised hardware and software, to a range of sophisticated ICT services. In particular, companies are increasingly seeking to utilise cloud computing services to facilitate shared access to a range of ICT resources. Demand for data analytics has also increased in recent years, as companies across the economy seek to generate, utilise and manage an array of complex information related to business processes and consumer behaviour. The rollout of the National Broadband Network (NBN) is expected to accelerate the effectiveness and use of these services.

At the same time, however, many Australian businesses, particularly small to medium-sized enterprises (SMEs), are still not engaging effectively with ICT. For example, in a 2010–11 ABS survey, 46 per cent of small businesses (5–19 persons) and 26 per cent of medium-sized businesses (20–199 persons) reported that they did not have an online presence.[17] In addition, small, medium-sized and large businesses report lack of access to ICT-related knowledge and/or technology as a barrier to innovation.[18] Finally, several recent surveys suggest a lack of capability related to computer-based and/or technological skills acts as a key inhibitor to enterprises seeking to improve their digital profile.[19]

Many businesses also report difficulty recruiting capable, confident, work-ready ICT specialists.[20] In some cases business demands very specific skills that are generally held by very few job candidates. Enrolments and completions in ICT-related disciplines in the tertiary education sector have declined for much of the last decade, although there has been some recent improvement in enrolment figures.[21] Accordingly, the focus needs to be on increasing both the number of enrolments and completions in ICT-related disciplines as well as the number of entry-level opportunities available in the industry.

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17 ABS, 2011, 'Summary of IT Use and Innovation in Australian Business, 2010–11' (cat. no. 8166.0), www.abs.gov.au/ausstats/abs@.nsf/mf/8166.0, accessed 15 March 2013.

18 Department of Industry, Innovation, Science, Research and Tertiary Education, 2012, *Australian Small Business: Key Statistics and Analysis*, p. 64, innovation.gov.au/SmallBusiness/KeyFacts/Documents/AustralianSmallBusinessKeyStatisticsAndAnalysis.pdf, accessed 18 March 2013.

19 See Sensis, 2012, *e-Business Report: The Online Experience of Small and Medium Enterprises*, p. 27, about.sensis.com.au/DownloadDocument.ashx?DocumentID=423, accessed 13 March 2013; MYOB, 2012, *MYOB Business Monitor—National Report July 2012*, p. 21, myob.com.au/myob/backing-aussie-business/myob-business-monitor-1258090877325, accessed 13 March 2013..

20 Australian Learning and Teaching Council and University of Wollongong, 2009, *Managing educational change in the ICT discipline at the tertiary education level,* p. 22, www.olt.gov.au/project-managing-educational-change-ict-uow-2006, accessed 20 March 2013.

21 DEEWR, 2013, *ICT Labour Market Indicators*, www.skillsinfo.gov.au/documents/ict-labour-market-powerpoint-presentation, accessed 20 March 2013.

Throughout this period, skilled migrants have played a significant role in filling skilled ICT positions. However, over the longer term, as Australia competes with emerging economies for this skilled labour and the requirement for ICT specialists increases in concert with the implementation of the NBN and other developments, a substantial increase in the domestic supply of ICT specialists will be required. Part One of this report examines this demand, and assesses the potential supply of skills from all sources.

Challenges related to ICT skills supply

Part One of this report profiles the Australian ICT workforce. The Australian Workforce and Productivity Agency (AWPA) finds that increasing the supply of domestic ICT specialists is a difficult task for four key reasons.

First, the ICT industry carries a legacy of negative perceptions of desk-bound, repetitive, isolating jobs, perceptions that do not bear a close relationship to the contemporary emergence of dynamic, creative, flexible, interdisciplinary ICT jobs. These perceptions have implications for the pipeline of ICT skills from schools to tertiary education. They have to change if Australia is to take full advantage of the digital opportunities of the future. In addition, a range of stakeholders have suggested to AWPA that the provision of ICT education in schools often reinforces these negative perceptions by presenting an outdated view of the industry.

Second, skills supply is limited by the low levels of female and mature-aged workers in the ICT workforce. Women occupy less than 20 per cent of positions in the majority of ICT occupations, well below the percentage of women employed in all occupations (just over 45 per cent).[22] And a high proportion of workers in ICT Professional occupations are aged between 25 and 44 years (67.8 per cent compared with 45.5 per cent for all occupations).[23]

Third, many students who pursue an ICT education experience difficulty in finding employment in the sector upon graduation, and many graduates use their qualifications to pursue other careers outside ICT. Despite the young age profile of the ICT workforce, there appears to be a limited number of entry-level positions for persons in the 20 to 24 years age group, with many employers complaining that tertiary graduates do not possess the desired combination of technical and complementary business and communication skills to contribute effectively in the workplace. The apparent shortage of entry-level opportunities contributes to the relatively high level of occupational wastage for ICT graduates. In 2011, 37 per cent of ICT graduates aged 20 to 29 years were employed as ICT Professionals, and a further 51 per cent were employed in other occupations.[24] Issues of wastage and attracting students to ICT courses may improve with stronger pathways for graduates at entry level.

Fourth, despite the increasing complexity of ICT services and the growing demand for these skills, the engagement and investment of industry in ICT skills development remains low.[25] While many multinational ICT organisations have put in place highly effective workforce

22 ABS, 2013, 'Labour Force, Australia, April 2013' (cat. no. 6202.0), www.abs.gov.au/AUSSTATS/abs@.nsf/productsbyCatalogue/F756C48F25016833CA25753E00135FD9?OpenDocument, accessed 27 May 2013.

23 DEEWR, 2013, *ICT Labour Market Indicators,* slide 13.

24 Ibid., slide 26.

25 IDC, 2012, 'ICT Skills in the Workplace Forum: Market Overview', unpublished presentation for the Australian Government ICT Skills in the Workplace Forum, 21 November 2012.

development strategies, there is limited collaboration between large ICT organisations to build the general pool of skills all employers draw from, and there are issues as well with skills development for contractors. In relation to SMEs, submissions provided to AWPA indicate that many of these organisations have limited capacity to support skills development.[26] However, there is also evidence that SMEs often collaborate to meet shared skills needs. For example, Google and a range of innovative start-up companies have convened a small group to consider strategies for 'build[ing] the tech start-up ecosystem in Australia', with a focus on education and training.[27]

Of course, the responsibility for ICT skills development extends beyond mainstream ICT organisations. As enterprises across the economy increasingly draw on ICT services for a range of business needs, managers and leaders will be required to acknowledge the importance of ICT skills to their organisations, and position the acquisition and development of ICT skills as a high priority. In some cases, enterprises will outsource the majority of ICT requirements to third-party providers, but the successful management of this outsourcing, and the achievement of quality outcomes that represent value for money, will depend on the cadre of basic and intermediate ICT skills that these organisations can draw on.

There is some evidence that graduates securing employment go on to experience rewarding, secure careers in ICT. Low employment rates, for ICT professionals in particular, suggest that graduates who manage to get the right foothold in the labour market experience positive longer term employment outcomes marked by varied and challenging job roles. ICT career pathways are suited to resilient, highly motivated self-starters who take a degree of responsibility for their own ongoing training and career development, since ICT industry investment in training and skills development is low compared to other industries. However, there are many examples of ICT organisations that demonstrate an enduring, organisation-wide commitment to staff development. In particular, many large multinational organisations with operations in Australia have put in place sophisticated workforce development plans that facilitate high levels of worker satisfaction and productivity.

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26   NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

27   Fox, M, 2013, 'Growing Australia's Tech Startup Ecosystem—I'd Love Your Thoughts', 22 *Michaels* (8 February), www.22michaels.com/2013/02/growing-australias-tech-startup.html, accessed 29 April 2013.

Potential solutions—workforce development strategies for the ICT workforce

Part Two of this report proposes some potential solutions to these challenges, through a set of workforce development strategies to stimulate the attraction, retention, development and effective utilisation of ICT skills. These strategies, which have been identified in collaboration and partnership with industry, the education and training sectors and government, seek to:

➢ **Change and improve perceptions of ICT careers**—AWPA recommends collaboration between stakeholders to develop a suite of targeted careers promotion products for different cohorts and audiences to promote career opportunities in ICT.

➢ **Improve the quality of ICT teaching in schools and tertiary education institutions, and excite students in ICT careers**—AWPA supports greater investment in the professional development of ICT teachers, enhanced industry engagement in schools and improved promotion for ICT career opportunities.

➢ **Improve the suitability of tertiary graduates for entry-level positions**—AWPA recommends a more strategic approach to work-integrated learning and the consideration of an apprenticeship/traineeship model for ICT skills.

➢ **Increase the quantity of workers with ICT-intensive skills**—AWPA recommends an intensive skills conversion program aimed at recent graduates from other disciplines.

➢ **Increase the quantity of workers with the functional knowledge of ICT required to work with ICT specialists**—AWPA supports the development of a cross-disciplinary unit to support the integration of a digital literacy component into all undergraduate degrees, and a suite of approaches to improving the engagement of under-represented groups in the ICT workforce.

➢ **Ensure that employers of ICT workers, including employers of ICT contractors, support ongoing skills development and the effective utilisation of skills in a fast-moving and rapidly changing sector**—AWPA supports the expansion of the Australian Computer Society professional development program to domestic students, and highlights the National Workforce Development Fund as a key enabler for organisations to identify and address their workforce development needs.

Improving the ICT skills pipeline—and ensuring the currency, development and retention of generic and specialist ICT skills—will require schools, tertiary education providers, workers and employers to develop the adaptive capacity required to flexibly and creatively respond to changing circumstances. Individuals require adaptive capacity to adjust to changes in the organisation of work, including the growing proportion of contract work in some areas of ICT, and to ensure ongoing skills development in a climate of skills obsolescence. Schools and tertiary education providers must ensure that graduates are equipped for a world of work that is constantly changing, including the development of complementary soft skills alongside technical competencies. And employers must adapt by developing innovative approaches to the organisation of work and job roles to maximise both skills utilisation and the lifestyles of a diverse employee cohort.

There are many examples of approaches to ICT skills development that maximise this form of adaptive capacity, and AWPA is pleased to feature these approaches in a series of case studies that appear throughout this report. Examples of approaches to skills development that confer benefits on both individuals and employers include successful schooling programs such as Queensland's Group X program and Victoria's Digital Divas program, the various forms of work-integrated learning put in place by tertiary providers in collaboration with industry, and approaches to engage groups that are under-represented in the ICT workforce including the Australian Government Information Management Office's Women in IT Executive Mentoring program.

AWPA notes that many of the strategies featured in this report may not require substantial additional funding. For those strategies that do require additional resourcing, funding could be obtained through a variety of avenues, including through changing the priorities of existing programs, funding by industry and employers, or through the use of Australian Government programs such as the National Workforce Development Fund.

AWPA notes that the Australian Government's recently announced update to the National Digital Economy Strategy states that 'the Government will also facilitate the formation of a group of industry representatives and tertiary education stakeholders to take ownership of the ICT workforce development agenda. It will implement strategies to promote and broaden the attractiveness of ICT as a digital career, share best practice models and work with tertiary education providers to ensure that graduates have appropriate skill sets.'[28] AWPA suggests that this group could consider taking forward the recommendations of this report.

AWPA's vision for this report is to contribute to the development of an innovative, productive and competitive Australian ICT workforce by highlighting the essential role of business and innovative workforce development practices in driving the industry forward. If Australia is to maximise the potential of the NBN and move confidently into the digital century, we need to ensure that the possibilities of ICT careers are effectively communicated, and that a greater proportion of the population is motivated to engage in ICT during their education and throughout their careers.

28 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 18, www.nbn.gov.au/files/2011/06/Advancing-Australia-as-a-Digital-Economy-BOOK-WEB.pdf, accessed 12 June 2013.

Recommendations

The ICT skills pipeline and the status of ICT careers

Recommendation 1

That the Australian Council of Deans of ICT, National ICT Australia and Education Services Australia develop and pilot a semester-long ICT module for secondary students that can be delivered online, administered centrally and assessed via an automated marking system to augment existing and future secondary school technology curriculums.

Recommendation 2

That the Australian Government, state and territory governments, tertiary education institutions and relevant industry bodies enhance the quality of ICT teaching in schools. Strategies should include the following:

a) that scholarships and/or VET FEE-HELP support be introduced to enable teachers and pre-service teachers to acquire additional qualifications and/or skill sets in ICT education, such as the nationally accredited Vocational Graduate Certificate in Digital Education

b) that the ACS Foundation broaden its focus on schools from its school visit matching service to the development of comprehensive support for technology teachers, including through the provision of relevant curriculum materials, the connection of students with relevant tertiary education providers, and the establishment of business mentors for interested students

c) that the Australian Government establish a program dedicated to enhancing the training of ICT teachers based on the existing Enhancing the Training of Mathematics and Science Teachers Program.

Recommendation 3

That strategies be adopted to improve the exposure of school-aged students to ICT careers. Strategies should include the following:

a) that the Australian Computer Society and the Australian Information Industry Association promote the benefits to ICT professionals of participating in the Australian Government's recently announced extension of the Scientists and Mathematicians in Schools program to showcase ICT careers, and encourage ICT professionals to visit schools to discuss their exciting careers and engage with students and teachers in ongoing discussion through social media, blogs and forums

b) that the Australian Computer Society include visits by ICT professionals and ICT researchers to school career nights and expos—and other innovative engagement strategies such

as the use of social media—on the schedule of activities for the continuing professional development of ICT professionals.

Recommendation 4

That National ICT Australia, the Australian Information Industry Association and the Australian Computer Society develop a suite of targeted careers promotion products for different cohorts and audiences (for example, youth, mature-aged workers, women and parents) to demonstrate how ICT skills can be an enabler across a range of careers, and make a difference in a range of sectors. These products should have a presence across all media and platforms, including widely adopted tablet and smartphone apps, gaming and social media.

Ensuring the supply of high-quality ICT skills

Recommendation 5

That the Australian Government, tertiary education providers and industry expand and improve work-integrated learning and other professional experience programs by:

a) increasing funding support for work-integrated learning and facilitating the expansion of these programs to a greater proportion of the student population

b) improving the integration between various forms of work-integrated learning and course learning objectives to ensure a balance between employability skills and lifelong learning, building on the work-integrated learning outcomes project funded by the Australian Government's Office for Learning and Teaching

c) engaging more small to medium-sized enterprises in work-integrated learning programs by promoting the mutual benefits of these programs

d) supporting a thorough, longitudinal evaluation of the various models of work-integrated learning and professional experience, with a focus on the contribution of these programs to employment outcomes and career progression.

Recommendation 6

That the Australian Government and industry associations monitor the outcomes of the Australian Government ICT Apprenticeship Program and the Australian Information Industry Association and Victorian Government's ICT-VET Pathways project, and if successful, develop and pilot a national apprenticeship/traineeship model for ICT technicians and trades workers.

Recommendation 7

That the Australian Council of Deans of ICT and other deans' councils promote the incorporation of digital literacy into all undergraduate degrees by developing and piloting a cross-disciplinary unit that could be customised for particular disciplines.

Recommendation 8

That the Australian Council of Deans of ICT, the Australian Computer Society, the Australian Information Industry Association and other industry associations develop a pilot ICT-intensive skills conversion program aimed at recent graduates from other disciplines. This program could be delivered at Australian Qualifications Framework Level 9 (master degree by coursework).

Developing, retaining and effectively using ICT skills in the workforce

Recommendation 9

That the Association of Professional Engineers, Scientists and Managers, Australia, the Australian Information Industry Association and the Australian Computer Society develop a pilot cross-sector program highlighting high-performing workplaces using ICT-intensive skills by featuring case studies, testimonials and instructional guides for other organisations.

Recommendation 10

That the Australian Computer Society and the Australian Information Industry Association introduce a one-year professional experience program for entry-level ICT professionals. This experience is already available to international students seeking employment in Australia, and could be extended to domestic students.

Recommendation 11

That the Australian Computer Society, the Australian Information Industry Association and Innovation and Business Skills Australia work with industry bodies and ICT organisations, particularly ICT small to medium-sized enterprises, to promote the National Workforce Development Fund as a key enabler for organisations to identify and address their workforce development needs, including in relation to the National Broadband Network.

Increasing the diversity of ICT employment

Recommendation 12

That industry and professional associations build employer commitment to improving the attraction and retention of mature-aged workers. Strategies should include the following:

a) that Innovation and Business Skills Australia, industry bodies and ICT organisations develop and pilot short online modules to provide retraining opportunities for mature-aged workers wishing to enter the ICT workforce

b) that industry associations, organisations and recruitment firms develop a register of flexible, part-time ICT positions targeted to mature-aged workers.

Recommendation 13

That industry and professional associations and the Australian Government build employer commitment to improving the attraction and retention of Indigenous Australians, including by promoting the development of enterprise-level Reconciliation Action Plans and through assistance and tools available from Reconciliation Australia.

Recommendation 14

That industry associations and women within IT organisations build employer commitment to improving the attraction and retention of female workers, including by:

a) developing a code of best practice for women in ICT in collaboration with female academics and industry leaders

b) promoting mentoring services for female ICT workers, and providing advice on how to set up an in-house mentoring service.

Recommendation 15

That the Australian Computer Society, the Australian Information Industry Association, relevant employment services organisations and tertiary education providers develop place-based approaches to matching job seekers with ICT employers and recruitment organisations, building on existing regional networks, including Local Employment Coordinators and Regional Education, Skills and Jobs Coordinators.

Strategies to improve data collection on ICT skills supply and demand

Recommendation 16

That the Australian Bureau of Statistics (ABS), together with the Australian Computer Society, the Australian Information Industry Association and other key ICT industry bodies, review ABS ICT-related collections to help ensure accurate, comprehensive and up-to-date measurement of the ICT workforce and ICT activity in the economy.

Part One: Profiling the Australian ICT industry—economic impact, key trends and workforce profile

Chapter One: Global and national outlook for ICT

Introduction

This chapter sets the context for this report by providing an overview of the Australian ICT industry, examining the impact of ICT across the economy, and assessing the impact of globalisation and the rise of Asia on the Australian ICT sector.

ICT is a vital enabler of productivity and innovation in a range of industry sectors across the Australian economy, and many of these sectors are set to be transformed by ICT in coming years. However, there are a number of issues that limit the potential of the digital economy in Australia.

First, Australia's ICT infrastructure is still poorer than many other comparable Organisation for Economic Co-operation and Development (OECD) countries.[29] Considerable progress is being made on this front, however, through the rollout of the NBN.

Second, many Australian businesses, including many SMEs, are yet to engage effectively with ICT, and the evidence suggests that many do not possess the skills or capacity to change the situation.

Third, the potential for Australian-based ICT firms to benefit from export opportunities in emerging Asian economies is yet to be fully realised.

The attraction, development and utilisation of high-quality ICT skills will assist businesses across the economy to prosper in the digital economy. Part Two of this report details a set of workforce development strategies that seek to improve the availability of these skills to Australian businesses.

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29   OECD, 2012, *Internet Economy Outlook 2012*, www.oecd-ilibrary.org/science-and-technology/oecd-internet-economy-outlook-2012_9789264086463-en, accessed 19 March 2013.

1.1   The global and national ICT industry

Overview

The ICT industry includes the production, distribution and maintenance of goods and services, such as computer hardware and software, and the development and provision of specialised computer and telecommunications services.[30] ICT thus involves much more than the development and provision of desktop and laptop computers, smartphones and software packages. These technologies are now thought of as enablers that facilitate an ever-expanding array of networked communications. Cisco forecasts that, globally, there will be 10 billion networked devices in 2017, exceeding the world's population.[31]

Mobility is expected to be a key feature in the ICT sector in the years to come. More than 50 per cent of mobile data traffic will be via smartphones in 2013, and 10 per cent via tablets. Global mobile data traffic is predicted to grow thirteenfold by 2017, with tablets responsible for more data traffic in 2017 than the entire mobile network in 2012. Mobile video will also consume more than two-thirds of mobile data traffic by 2017. Meanwhile, the consulting firm IDC anticipates that the rise of 'third platform technologies' (mobile devices and apps) will drive 98 per cent of information technology industry growth to 2020.[32] It predicts public cloud services platforms will grow tenfold, converged systems (combining server, storage and network systems) will account for more than one-third of enterprise cloud computing and more than $20 million will be spent on 'big data' technologies.

The World Bank estimates that 2.4 billion people use the internet around the world, and it puts the number of fixed broadband subscriptions at 600 million at the end of 2011.[33] As the internet continues to grow and ICT devices become increasingly mobile, rapidly developing ICT technologies will have an impact on how and where people work, and how they shop, socialise and live in Australia. In her 2013 *Internet Trends* report, US technology analyst Mary Meeker stressed the rapid shift in internet use from desktop personal computers to smartphones and tablets and a corresponding increase in personal digital-media uploads as more people share more of their lives online. Meeker predicts that the next internet trends will be the development and increased use of wearable computing devices, connected cars, remotely piloted drones and QR (quick response) codes.[34] The June 2013 *Ericsson Mobility Report* likewise emphasises the impact that increased mobility will have on society: 'In the Networked Society connectivity will be key to how people innovate, collaborate, and socialise.'[35]

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30   IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013,* p. 3, www.ibsa. org.au/Portals/ibsa.org.au/docs/Research%20&%20Discussion%20Papers/Escan/EScan2013/Escan%20 2013%20Information%20&%20Communication%20Technology%20Industry.pdf, accessed 3 April 2013.

31   Cisco, 2013, *Cisco Visual Network Index: Global Mobile Data Traffic Forecast Update,* 2012–2017, www.cisco. com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-520862.html, accessed 4 June 2013.

32   IDC, 2012, 'Top 10 Predictions', *IDC Predictions 2013: Competing on the 3rd Platform,* www.idc.com/research/ Predictions13/downloadable/238044.pdf, accessed 4 June 2013.

33   World Bank and International Telecommunication Union, 2012, *The Little Data Book on Information and Communication Technology 2012,* p. v, www.itu.int/ITU-D/ict/publications/material/LDB_ICT_2012.pdf, accessed 25 March 2013.

34   Meeker, M, and Wu, L, 2013, *Internet Trends, D11 Conference, 29 May 2013,* Kleiner Perkins Caufield Byers, www.kpcb.com/insights/2013-internet-trends, accessed 4 June 2013.

35   Ericson, 2013, *Ericsson Mobility Report, June 2013: On the pulse of the Networked Society,* www.ericsson.com/ res/docs/2013/ericsson-mobility-report-june-2013.pdf, accessed 4 June 2013.

Increased mobility and access to cloud computing will allow opportunities for flexibility and agility through teleworking and secure virtualised work environments. The Australian Government's National Cloud Computing Strategy (May 2013) stresses the need for 'a highly skilled and capable ICT workforce … able to create as well as adopt cloud services', and calls for ongoing dialogue between government, industry and the tertiary sector to ensure that graduates have the right skill sets to provide a strong and sustainable skills base.[36] The potential of telework was also highlighted in the Australian Government's update to its National Digital Economy Strategy, which includes a commitment to continuing the coordination of the National Telework Week and to engaging 'private sector leaders in telework'.[37]

The digital economy is becoming a key generator of wealth across the globe. Oxford Economics estimates the total size of the digital economy at $20.4 trillion, which represents approximately 13.8 per cent of all sales across the world economy.[38] The Australian ICT sector is diverse and includes multinational companies that base their Asia–Pacific operations in Australia, and a range of small, medium-sized and large enterprises that provide computer and telecommunications services, hardware sales and services, ICT support, digital media and various other services and products. ICT end users including banks and government departments are among the biggest employers of ICT workers.[39]

Figure 1 shows that New South Wales and Victoria dominate ICT industry employment, together making up 70.7 per cent of total national ICT employment.

36 Department of Broadband, Communications and the Digital Economy, 2013, *The National Cloud Computing Strategy,* pp. 26–7, www.dbcde.gov.au/digital_economy/cloud_computing, accessed 31 May 2013.

37 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 73.

38 Oxford Economics, 2011, *The New Digital Economy*, p. 9, www.pwc.com/gx/en/technology/publications/assets/the-new-digital-economy.pdf, accessed 20 March 2013. 'Sales' includes the sale of digital products and services together with e-commerce (defined as online business-to-business and consumer transactions).

39 McLeod, P, 2011, ˈSkills shortage to become critical', *The Australian* (28 May), www.theaustralian.com.au/careers/skills-shortage-to-become-critical/story-fn717l4s-1226063877709, accessed 22 March 2013.

Figure 1:   Proportion of ICT employment in Australia by jurisdiction, as at December 2011
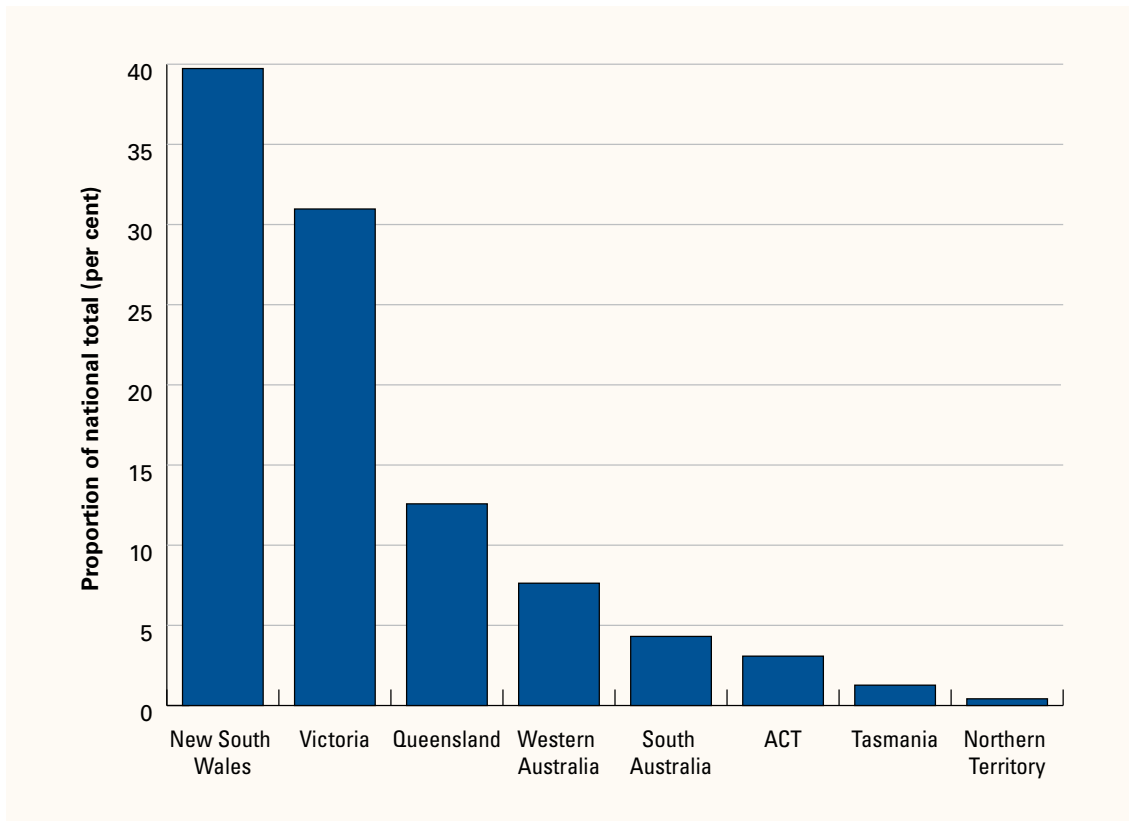
Source: CIIER Whitehorse Top 250 ICT Industry Survey and Model December 2011, cited in Australian Computer Society, *2012 Australian ICT Statistical Compendium*, p. 43, www.acs.org.au/_data/assets/pdf_file/0014/13541/2012_Statcompendium_final_web.pdf.

While the eastern states dominate the employment profile, it is important to note the different industry specialisations across jurisdictions. The ICT software and services, telecommunications, and wholesale and trade sectors are much larger in New South Wales than in other states, due to the high proportion of Australia's population in New South Wales.[40] ICT investment in manufacturing is strong in both Victoria and South Australia, reflecting the significant role of manufacturing in those economies.[41] Western Australia and Queensland have demonstrated the strongest growth in ICT employment since 2003, reflecting the strong performance of those economies over this period, and the increasing importance of ICT to the mining and resources industry. Both states recorded cumulative ICT industry employment growth of 50 per cent between 2003 and 2011.[42]

40   IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013,* p. 7.

41   Ibid.

42   ACS, 2012, *Australian ICT Statistical Compendium 2012,* p. 43, www.acs.org.au/__data/assets/pdf_file/0014/13541/2012_Statcompendium_final_web.pdf, accessed 10 February 2013.

Across the jurisdictions, a significant proportion of Australian ICT organisations are SMEs. Looking at the two Australian and New Zealand Standard Industrial Classification divisions that capture the majority of ICT organisations, SMEs constitute:

- 96.9 per cent of organisations in the Professional, Scientific and Technical Services industry division
- 93.8 per cent of the Information Media and Telecommunications industry division.[43]

Chapter Two provides additional information on the distribution, demographics and skills profile of the Australian ICT workforce, which comprises 18 occupations at the Australian and New Zealand Standard Classification of Occupations unit group (four-digit) level that fall across Australia's 19 industry divisions.

Recent developments and future prospects for Australian ICT investment

In recent years, the Australian ICT industry has changed substantially. Demand has shifted from bespoke ICT hardware and software products to a range of increasingly sophisticated ICT services, as consumers and businesses engage with a range of digital media and services and benefit from advances in connectivity and internet speeds. In this climate, ICT is no longer relegated to the 'back room' of business operations but, rather, takes precedence at the forefront of business activity.

At the same time, the types of services in demand are changing rapidly. Companies are increasingly seeking to utilise cloud computing services to facilitate shared access to a range of ICT resources. In recent years, demand has also increased for data analytics, as companies across the economy seek to generate, utilise and manage an array of complex information related to business processes and consumer behaviour. It is expected that the rollout of the NBN will accelerate the effectiveness and use of these services.

The outlook for ICT investment is positive. Whereas global ICT investment and utilisation was defined by a series of peaks and troughs over the past decade, strong growth is likely in the period ahead as technological capability continues to improve, and the connections between ICT, innovation and productivity in all industry sectors become increasingly apparent. In the short term, Gartner Research estimates a 5 per cent increase in enterprise IT spending in Australia, from $69 billion in 2012 to $73 billion in 2013.[44] In the medium to long term, IBISWorld predicts that 'ICT, enhanced with the inclusions of ubiquitous high-speed broadband, analytics, learning systems and cognitive computing' will 'evolve from a "value add" to becoming Australia's new utility'.[45]

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43 Department of Innovation, Industry, Science and Research, 2011, *Key Statistics—Australian Small Business*, p. 10, www.innovation.gov.au/SmallBusiness/KeyFacts/Documents/SmallBusinessPublication.pdf, accessed 29 March 2013.

44 Gartner, Inc., 2012, 'Gartner Says Consumer-Facing Industries Will Drive IT Investment in Australia During the Next Five Years', press release (19 November), www.gartner.com/newsroom/id/2244515, accessed 20 March 2013.

45 IBISWorld, 2012, *A Snapshot of Australia's Digital Future to 2050*, p. 10.

Contribution to productivity

Across all parts of the Australian economy, the use of innovative digital technologies and services has transformed business and household practices, from the comprehensive use of smartphones and personal computing devices, to the streamlining and automation of business processes by tailored applications and software.

However, calculating the precise contribution of ICT to Australian labour or multi-factor productivity is a difficult exercise. To estimate the contribution of ICT to productivity, a reliable figure on the contribution of ICT to gross domestic product (GDP) is first required. This figure is difficult to generate, since the use of ICT is spread throughout the economy. The most authoritative research on the contribution of ICT to GDP national productivity is the ABS satellite account on ICT, which was last produced in 2002–03. The satellite account isolates the economic value of ICT products[46] from within the Australian System of National Accounts. This publication estimates that in 2002–03 ICT products accounted for $36.2 billion or 4.6 per cent of total GDP.[47]

Research by economic consulting firm ACIL Tasman estimates that ICT-related technology factors are responsible for 33 to 65 per cent of multi-factor productivity growth, and this figure increases to 45 to 75 per cent for the manufacturing industries.[48] Another estimate puts the contribution of ICT to all Australian business productivity at 50 per cent.[49] While these figures provide a useful point of comparison with the 2002–03 satellite account, they are not as authoritative as the ABS approach. Indeed, ACIL Tasman concedes that 'many industry-level studies are affected by problems of aggregate industry data and statistical biases'.[50]

AWPA sees value in the ABS producing an updated satellite account for ICT products. Another option is for the Australian Computer Society (ACS) to adopt the ABS methodology for its productivity estimates published in its annual statistical compendium. An updated figure would provide a useful point of comparison with the 2002–03 figure, and a useful baseline to enable comparisons with future measurements of the contribution of ICT to productivity.

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46 ICT products include 'computer hardware and their peripherals, parts, components and consumables, computer software, telecommunication assets, computer services, telecommunication services and wholesale and retail margins on ICT products'. See ABS, 2006, 'Australian National Accounts: Information and Communication Technology Satellite Account, 2002–03' (cat. no. 5259.0), www.abs.gov.au/AusStats/ABS@.nsf/MF/5259.0, accessed 20 March 2013.

47 Ibid., p. 7.

48 ACIL Tasman, 2009, *ICT as a Driver of Productivity,* white paper prepared for Telstra, www.telstrabusiness.com/business/ShowProperty?nodeId=%2FBEA+Repository%2F10392%2F%2Ffile.binary&versionId=4, accessed 26 November 2012.

49 National ICT Industry Alliance and ACS, 2007, *Energising Australian Innovation: a 10-year Strategic Vision for the Australian ICT sector,* p. 3, nictia.org.au/joomla/index.php?option=com_docman&task=doc_download&gid=7&Itemid=26, accessed 13 February 2013.

50 ACIL Tasman, 2009, *ICT as a Driver of Productivity,* p. 4.

1.2 The impact of ICT across the economy

The impact of ICT on specific industry sectors

The uptake and effective utilisation of ICT services by Australian businesses has facilitated a range of innovations, including technological solutions that enable efficient and streamlined business processes, advanced technological tools that open up new modes of production and new market sectors, and new ways to maximise staff productivity through mobile telephony and teleworking.

IBISWorld predicts that 13 out of Australia's 19 industry sectors will be either transformed or derive significant benefits from ICT, with key beneficiaries including public administration and safety, retail trade, mining, health care and social assistance, professional, scientific and technical services, education and training, and transport, postal and warehousing.[51]

In addition, Deloitte Access Economics has examined each of Australia's 19 industry divisions in relation to the potential impact (or 'bang') of digital innovation, and the timing (or length of the 'fuse') required for this impact to take effect. The report notes:

> For some [industries], digital disruption will be explosive and immediate—a force that rocks the foundations of their business. For others less vulnerable to digital trends, the changes will be slower and more subtle. For others again, digital innovation will be the cornerstone for future value creation.[52]

Figure 2 details the outcomes of this analysis. Some sectors, including manufacturing, mining and construction, are not expected to experience dramatic change as a result of digital innovation. The majority of sectors, however, can expect significant change in either the short or long term, with ICT and media, finance, retail trade, education, transport and post, professional services and health likely to experience the most significant impact.

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51   IBISWorld, 2012, *A Snapshot of Australia's Digital Future to 2050,* p. 12.

52   Deloitte, 2012, *Digital disruption—Short fuse, big bang?,* Building the Lucky Country: Business imperatives for a prosperous Australia series, no. 2, www.deloitte.com/au/digitaldisruption, accessed 10 March 2013.

Figure 2: Deloitte's digital disruption map
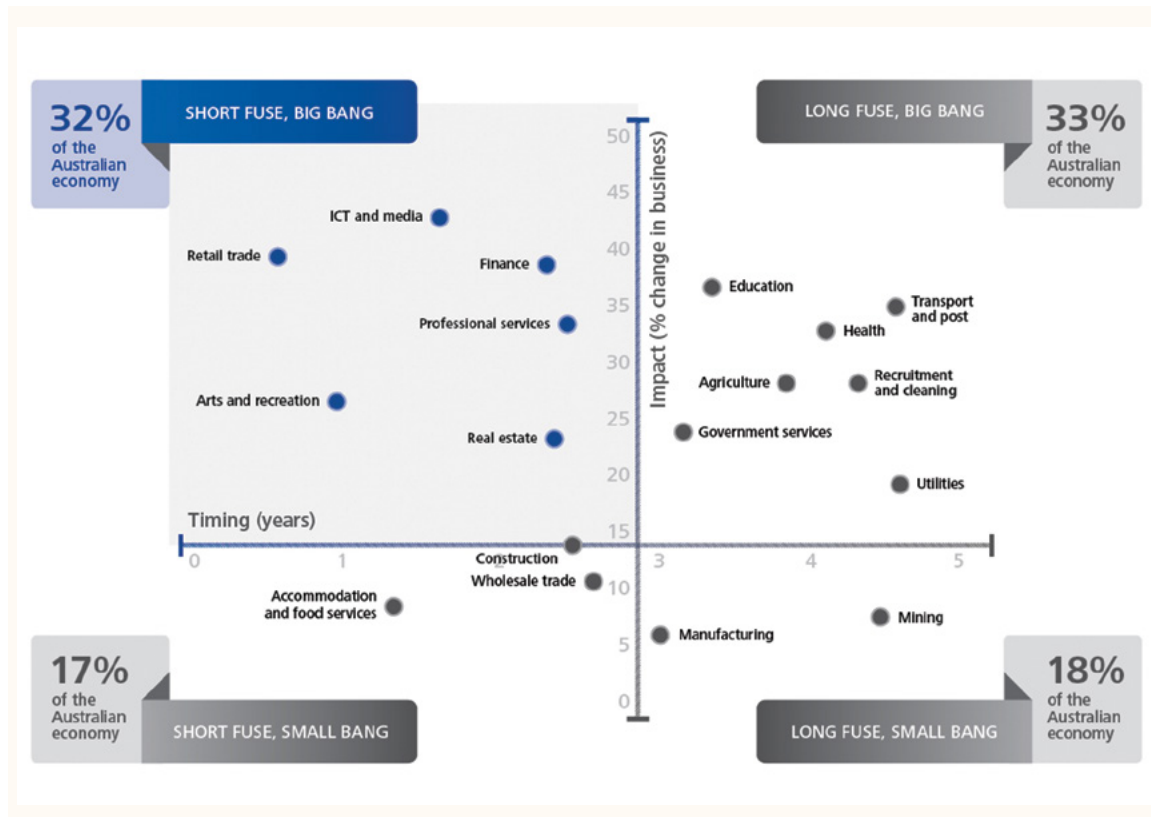
Source: Deloitte, 2012, *Digital disruption—Short fuse, big bang?,* p. 9.

Business engagement in ICT

Evidence suggests that businesses across the economy are engaging with ICT. The ABS estimated that in 2010–11, 91.2 per cent of businesses had internet access, 43 per cent of businesses reported some kind of web presence, and more than 50 per cent of businesses had placed orders on the internet.[53] This is comparable to OECD figures which show that in 2010, 94 per cent of businesses with 10 employees or more had access to broadband; however, on average, only 18 per cent used the internet for selling and 35 per cent used the internet for purchasing.[54] The numbers in Australia were particularly strong for large businesses surveyed. Nearly 74 per cent of medium-sized businesses (20 to 199 people) and 97 per cent of large businesses (more than 200 people) reported a web presence.[55]

However, the evidence suggests that many SMEs are not confident users of technology, and do not possess the skills or capabilities to change the situation. In 2010–11, 46 per cent

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53   ABS, 2011, 'Summary of IT Use and Innovation in Australian Business, 2010–11'.
54   OECD, 2012, *OECD Internet Economy Outlook 2012*, pp. 135–40.
55   ABS, 2011, 'Summary of IT Use and Innovation in Australian Business, 2010–11'.

of small businesses (5 to 19 persons) and 26 per cent of medium-sized businesses (20 to 199 persons) reported that they did not have an online presence.[56] In addition, a 2012 Sensis e-Business Report noted that 67 per cent of SMEs identified a lack of expertise and knowledge in computers as a major or minor concern about engaging in e-commerce.[57] Meanwhile, the MYOB Business Monitor found that 35 per cent of surveyed businesses without a website agreed they 'wouldn't know where to start in setting up a business website'.[58] Innovation and Business Skills Australia, in a recent report titled *Digital literacy and e-skills: participation in the digital economy*, suggests that SMEs 'should be considered at risk of digital exclusion'.[59] As business owners are 'typically time poor and operating on thin margins', there is a need for customised, digital literacy training focused on vocational, business-related needs, with an emphasis less on what technology is available and more on the development of skills required to use the technology.[60] If the benefits of digital innovation are to be realised, the uptake and effective utilisation of digital technologies by SMEs—and greater representation by Australian SMEs in the national and international supply chain related to ICT—will be vital.

A range of Australian Government programs are in place to support SMEs to engage in ICT. In particular, the Australian Government is providing $10 million over two years for the Digital Enterprise Program, which provides free group training and face-to-face support for SMEs and not-for-profit organisations to help them improve the way they do business online. Services have been available in 44 communities around Australia since February 2012. At March 2013, 6,209 participants had taken part in the program.[61] In addition, Enterprise Connect offers comprehensive advice and support to eligible Australian SMEs to help them transform and reach their full potential. This includes business reviews which may offer advice on the use of digital technology, and links to technical expertise.

The engagement of individuals in ICT

The engagement of individuals with digital technologies in Australia is significant. According to a 2012 Australian Communications and Media Authority report, Australians spent an average of 81 hours online during June 2012. The report also demonstrates that online participation is increasing across all age groups and suggests that, during June 2012, 7.8 million people performed shopping-related activities online, an increase of 27 per cent compared to June 2011.[62]

For many individuals, this engagement continues in the workplace. As the influence of ICT is felt in each and every industry sector, the skills and capabilities required to utilise and

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56   Ibid.

57   Sensis, 2012, *e-Business Report: The Online Experience of Small and Medium Enterprises,* p. 27, about.sensis. com.au/DownloadDocument.ashx?DocumentID=423, accessed 15 March 2013.

58   MYOB, 2012, *MYOB Business Monitor—National Report July 2012*, p. 21.

59   IBSA, 2013, *Digital literacy and e-skills: participation in the digital economy,* p. 1, www.ibsa.org.au/Portals/ibsa. org.au/docs/Research%20&%20Discussion%20Papers/Digital%20Literacy%20and%20e-skills.pdf, accessed 2 May 2013.

60   Ibid., pp. 32–3.

61   Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 60.

62   Australian Communications and Media Authority, 2012, *Australia's progress in the digital economy: Participation, trust and confidence,* Communications report, 2011–12 series, Report 2, www.acma.gov.au/WEB/ STANDARD/675484/pc=PC_600063, accessed 22 March 2013.

engage with ICT in the workplace form an essential part of lifelong learning and human capital development. The increasing economic importance of ICT services demands specialists with the business and communication skills to explain, promote and support service provision, and the integration of technology into a broad spectrum of jobs and industry sectors requires workers across the economy to master digital competencies and skills.

The OECD identifies three tiers of ICT competencies:

> ICT specialists who develop, operate and maintain ICT systems

> advanced users of ICT, who are competent users of advanced, and often sector-specific, software tools

> basic users of ICT, who are called to use a range of generic tools in the process of their work.[63]

Skills development is essential for each of these groups:

> For ICT specialists, a tertiary qualification in ICT is an entry requirement for most occupations, and postgraduate qualifications are often required for higher-level positions. Ongoing training and skills development is essential, given the frequent changes in skills requirements for contemporary ICT roles. However, many ICT specialists also acquire essential skills through informal learning including, for example, competency in the use of additional programming languages.

> For advanced and basic users of ICT, a firm grounding in digital literacy is a significant part of the skill set required across many occupations.

This report examines the best ways to provide these skills and competencies to the businesses and individuals that require them.

1.3 The impact of globalisation and the rise of Asia on the Australian ICT industry

The global digital economy

The use of ICT by businesses and individuals in Australia is shaped by global trends. As mentioned earlier, the Australian ICT sector forms a small part of a massive global industry.

In recent years, the divide between developed and developing countries in relation to technology diffusion and utilisation, sometimes called the 'digital divide', is closing as citizens across the globe access and use technology. The OECD identifies a 'global restructuring of ICT production' that positions China and India as the largest exporters of ICT goods and computer and information services respectively.[64] In addition to production, many developing countries as well as the OECD's 'enhanced engagement' partners—Brazil, Indonesia, India,

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63 OECD, 2010, *OECD Information Technology Outlook*, p. 136, www.oecd.org/internet/ieconomy/oecdinformationtechnologyoutlook2010.htm, accessed 10 March 2013.

64 Ibid., p. 14.

China and South Africa—are emerging as growth markets for the consumption of ICT goods and services.[65]

Australia's place in the global ICT marketplace

These global shifts have important implications for the Australian economy, as Australia transitions to the Asian century. Opportunities to move baseline ICT services offshore to emerging Asian markets offer substantial cost benefits, but also carry implications for domestic workers. At the same time, the Asian economies offer an emerging marketplace for Australian businesses across a range of industries that utilise sophisticated technologies to deliver high-end services. In this context, 'onshoring'—the delivery of niche services to overseas markets by Australian ICT companies—has become an attractive proposition.

One of the biggest economic opportunities for Australia is in the provision of professional services to Asia where Australian businesses are well placed to target niche markets in the delivery of specialised, high-end services, many of which will include ICT elements, for example, mining data analysis. The delivery of all of these professional services will require ICT, often of a high degree of sophistication.[66] The Australian Government's *Australia in the Asian Century* white paper identifies key areas for Australia to best garner the opportunities presented by the growth of Asian economies. The white paper states that to benefit from the Asian century, Australia will need 'new capabilities, new business models, open mindsets, greater investment in skills and education and a higher degree of specialisation in areas where Australia has a distinct comparative advantage'.[67]

In relation to offshoring, there are a range of views on its contribution to productivity. In October 2012, former Treasury secretary and lead author of the *Australia in the Asian Century* white paper, Ken Henry, suggested that offshoring business operations would provide 'the key source of productivity growth in the Asian Century' and that a more positive perspective on offshoring is required.[68] Ash Truscott, managing director of outsourcing firm Microsourcing Australia, concurs, suggesting that 'offshore staffing can be an innovative solution for cash-strapped small businesses looking to kick-start their growth phase' and argues that the cost and difficulty of hiring domestic expertise is often prohibitive for these firms.[69] Truscott suggests that firms that outsource well and thus 'kick-start their growth' can afford to hire skilled workers domestically down the track.

Some commentators argue that these potential benefits are outweighed by the decreasing stability of existing jobs in the service industries, including ICT jobs. A 2012 report for the Australian Services Union and the Finance Sector Union estimates that 80,000 jobs have moved overseas in the past four years and that 700,000 to one million jobs will move offshore

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65   Ibid., p. 97.

66   Dawson, R, input provided to the AWPA ICT workforce study report, May 2013.

67   Australian Government, 2012, *Australia in the Asian Century*, white paper, Commonwealth of Australia, Canberra, p. 109.

68   Lane, B, 2012, 'Get over antagonism to offshoring: Henry', *The Australian* (7 September), www.theaustralian. com.au/business/get-over-antagonism-to-offshoring-henry/story-e6frg8zx-1226466825773, accessed 10 March 2013.

69   Truscott, A, 2012, 'Shifting jobs overseas gets bad press but in the Asian Century, it's the path to business success and survival', *The Age* (17 October), www.theage.com.au/opinion/politics/offshoring-is-not-the-bogyman-20121016-27ovt.html, accessed 10 March 2013.

in the next three decades.[70] Several ICT occupations are identified as being at risk of offshoring, including ICT managers, support technicians, business and systems analysts, security specialists and computer network professionals.[71]

There are also views that offshoring has negative implications for the skills pipeline. For example, it is estimated that 'up to half of call centre employees in Australian financial organisations are university-qualified and may likely be suited to progressing to higher level positions in the firm'. The organisational benefits arising from such progression may not accrue if these call centre functions are offshored.[72]

The rollout of the NBN offers opportunities for Australia to develop domestic capacity through leveraging regional workforces which could come at a lower cost than workforces based in large metropolitan areas where the ICT industry is mostly concentrated. Part Two of this report captures some examples of large enterprises partnering with regional education providers to develop workforce skills and drawing on them for their business needs such as IBM's partnership with the University of Ballarat. While regional labour costs may not match the lower price points in Asia and Eastern Europe, they are often comparable, and through better training and management often deliver cost-effective solutions. Overall, there is no simple answer, given that ICT is a globalised industry. However, focusing on the development of domestic skills and competitive capacity is better both for regional jobs and for the Australian ICT sector as a whole.

Whatever decisions firms make about offshoring, it is evident that high-level management and leadership skills are vital to making these decisions work. Rosemary Howard from the University of New South Wales suggests that 'Australian organisations often send offshore the functions that may not be working for them. But you cannot offshore what you cannot manage well yourself.'[73]

The growth of demand for ICT services from emerging Asian economies offers great potential for ICT companies based in Australia. Australia is the fifth-largest ICT market in the Asia–Pacific region, after Japan, China, India and Korea.[74] However, the export of ICT services has trended downward in recent years—the cumulative value of Australian ICT services exports in 2011–12 was $1.93 billion, a 2.5 per cent decline over the past five years.[75] Nonetheless, the outlook for ICT services exports is positive, given estimates from IBISWorld that the value of the digital economy will increase by up to eight times its current level to $1 trillion per annum by 2050.[76] In this context, it is increasingly important for Australian ICT firms to identify and specialise

70 National Institute of Economic and Industry Research (NIEIR), 2012, *Off-shore and off work: The future of Australia's service industries in a global economy: An update,* report for the Australian Services Union and the Finance Sector Union, p. 1, www.fsunion.org.au/Upload/Campaigns/Offshoring/NIEIR_2012_report_SPE004_SSU_offshoring_update_final_011012.pdf, accessed 10 April 2013.

71 Ibid., p. 4.

72 Howard, R, 2013, 'Impact of offshoring jobs from Australian financial institutions', *The Conversation* (5 March), theconversation.edu.au/impact-of-offshoring-jobs-from-australian-financial-institutions-12484, accessed 30 April 2013.

73 Ibid.

74 Australian Trade Commission (Austrade), 2012, *Australian Industry Capability: Information Communications Technology (ICT)*, www.austrade.gov.au/Buy/Australian-Industry-Capability/ICT/default.aspx, accessed 30 April 2013.

75 Department of Foreign Affairs and Trade, 2013, *Trade in Services Australia 2011–12,* www.dfat.gov.au/publications/stats-pubs/trade-in-services-australia-2011-12.pdf, accessed 30 April 2013.

76 IBISWorld, 2012, *A Snapshot of Australia's Digital Future to 2050,* p. 7.

in niche capabilities for export to Asian markets. For example, the Information Technology Industry Innovation Council has sought to position Australia as the leading ICT cloud computing solutions provider for the Asian market.[77]

Conclusion

This chapter has provided an overview of Australia's place in the global ICT industry. It is imperative that Australian businesses across all industry sectors engage effectively with ICT, and look to emerging opportunities in Asian economies. To make the most of the opportunities flowing from ICT, businesses require a range of skills, from the specialist capabilities needed to develop, operate and maintain ICT systems and services, to the digital literacy needed to use sector-specific ICT tools in a range of industries. To shed more light on the availability of these skills, the next chapter provides a comprehensive profile of the skills base of the Australian ICT workforce.

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77 Information Technology Industry Innovation Council, 2012, 'Response to Australia in the Asian Century issues paper', asiancentury.dpmc.gov.au/sites/default/files/public-submissions/IT_Industry_Innovation_Council.pdf, accessed 15 April 2013.

Chapter Two: Supply and demand picture for ICT skills

Introduction

This chapter surveys relevant data from a range of sources to capture the current state of play in the demand for, and the supply of, ICT skills in the Australian economy.[78] The overall picture for the supply and demand of ICT skills in Australia is complex and nuanced, and is influenced by a range of factors including global economic and labour market trends, industry restructuring, student choices and the increasing prevalence of ICT across all industry sectors. While the outlook for the ICT workforce is positive, and the demand for ICT skills is projected to rise in the next five years, there are also a number of significant challenges that will need to be addressed if Australia is to meet future demand for specialist ICT skills.

First, demographic data indicates that the ICT workforce is predominantly young and male. The participation rates of women and mature-aged workers in the ICT workforce are lower than the national average. The potential of the ICT sector to engage Indigenous Australians and people with disability also remains largely untapped.

Second, while recent enrolment trends in both higher education and vocational education and training (VET) have marginally improved since 2008, high drop-out rates from courses, and graduates reporting difficulty finding employment, are causes of concern. Skilled and temporary (subclass 457 visa) migration programs have emerged as a key source of supply for the ICT sector since the mid-1990s and continue to play a significant role in addressing the demand for specialist skills not available in Australia.

Third, employers consistently express difficulties in finding suitable candidates quickly for job openings. Employers increasingly demand so-called 'T-shaped' professionals with both broad knowledge and deep expertise, including technical skills, domain knowledge and soft skills which include communication and business skills. Employer demand for experienced workers means that there are fewer entry-level positions available for new graduates. Graduates who are successful in finding employment, however, find the experience rewarding and career enhancing.

While the available data on the ICT sector provides a good indication of the general state of demand and supply of skills in the sector, there are some gaps in the information as noted in submissions received in response to AWPA's ICT Workforce Issues Paper which was released as part of the work for this report. Accordingly, Chapter Seven in Part Two of this report discusses this issue and includes a recommendation for improving the collection of data on the ICT workforce, which will hopefully better inform future workplace development policies and strategies.

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78   This chapter uses the classification of the ICT workforce developed by the ABS. This classification identifies 18 ICT occupations, and is termed the 'alternative view' of the ICT workforce as it provides data on a range of related occupations which span different industry sectors.

2.1 Snapshot of the ICT labour market

Employment profile

According to the ABS, 460,800 workers were employed in the 18 primary ICT occupations in August 2012, as shown in Figure 3. The ICT workforce accounts for 4.1 per cent of the total workforce in Australia.[79] The three occupation groups with the most workers were:

- ➢ ICT Professionals (233,300 workers)
- ➢ ICT Support Technicians (57,000 workers)
- ➢ ICT Managers (53,100 workers).

According to the Department of Education, Employment and Workplace Relations (DEEWR), the ICT Professionals grouping includes a number of different occupations. Ninety-one per cent of these were further classified into the following groups:

- ➢ Software and Applications Programmers (90,400 workers)
- ➢ Database and Systems Administrators and ICT Security Specialists (35,500 workers)
- ➢ ICT Business and Systems Analysts (32,800 workers)
- ➢ Computer Network Professionals (25,400 workers)
- ➢ Telecommunications Engineering Professionals (11,500 workers)
- ➢ Multimedia Specialists and Web Developers (9,700 workers)
- ➢ ICT Support and Test Engineers (6,900 workers).[80]

In the 10 years to 2012, the employment growth was highest among ICT Support Technicians (27,700) and ICT Managers (23,500). The growth in the employment of ICT Support Technicians suggests opportunities exist at the entry level for new VET graduates with ICT skills and perhaps highlights the role of VET in the supply of such skills, a view supported in AWPA consultations with stakeholders.

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79   ABS, 2013, 'Labour Force, Australia, Detailed, Quarterly, February 2013' (cat. no. 6291.0.55.003), www.abs.gov.
     au/ausstats/abs@.nsf/mf/6291.0.55.003, accessed 3 April 2013.

80   DEEWR, 2013, *ICT Labour Market Indicators,* slide 4.

Figure 3:   ICT occupations—snapshot of employment, August 2012

Figure 3: ICT occupations—snapshot of employment, August 2012

Occupation	Employment ('000)
Software and Applications Programmers	90.4
ICT Support Technicians	57.0
ICT Managers	53.1
Database and Systems Administrators and ICT Security	35.5
Electronics Trades Workers	33.7
ICT Business and Systems Analysts	32.8
Computer Network Professionals	25.4
Telecommunications Trades Workers	19.0
ICT Sales Assistants	15.5
ICT Sales Professionals	12.6
Web and Multimedia Designers	11.8
Telecommunications Engineering Professionals	11.5
Multimedia Specialists and Web Developers	9.7
Electronic Engineering Draftspersons, Technicians	9.0
ICT Support and Test Engineers	6.9
Electronics Engineers	6.7
ICT Trainers	5.1
Telecommunications Technical Specialists	3.9

Source: DEEWR, *ICT Labour Market Indicators, February 2013,* www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/ict_labour_market_february_2013_0.zip.

The ICT workforce is employed in all industries in varying numbers. Figure 4 shows the numbers of ICT Professionals, Managers and Technicians, Trades Persons and Sales Assistants employed by industry in 2012. Professional, Scientific and Technical Services employed by far the most ICT workers of any industry. Other industries that had a substantial number of ICT workers include Information Media and Telecommunications and Public Administration and Safety.

Figure 4: ICT Professionals, ICT Managers and ICT Technicians, Trades Persons and Sales Assistants—employment by industry, 2012
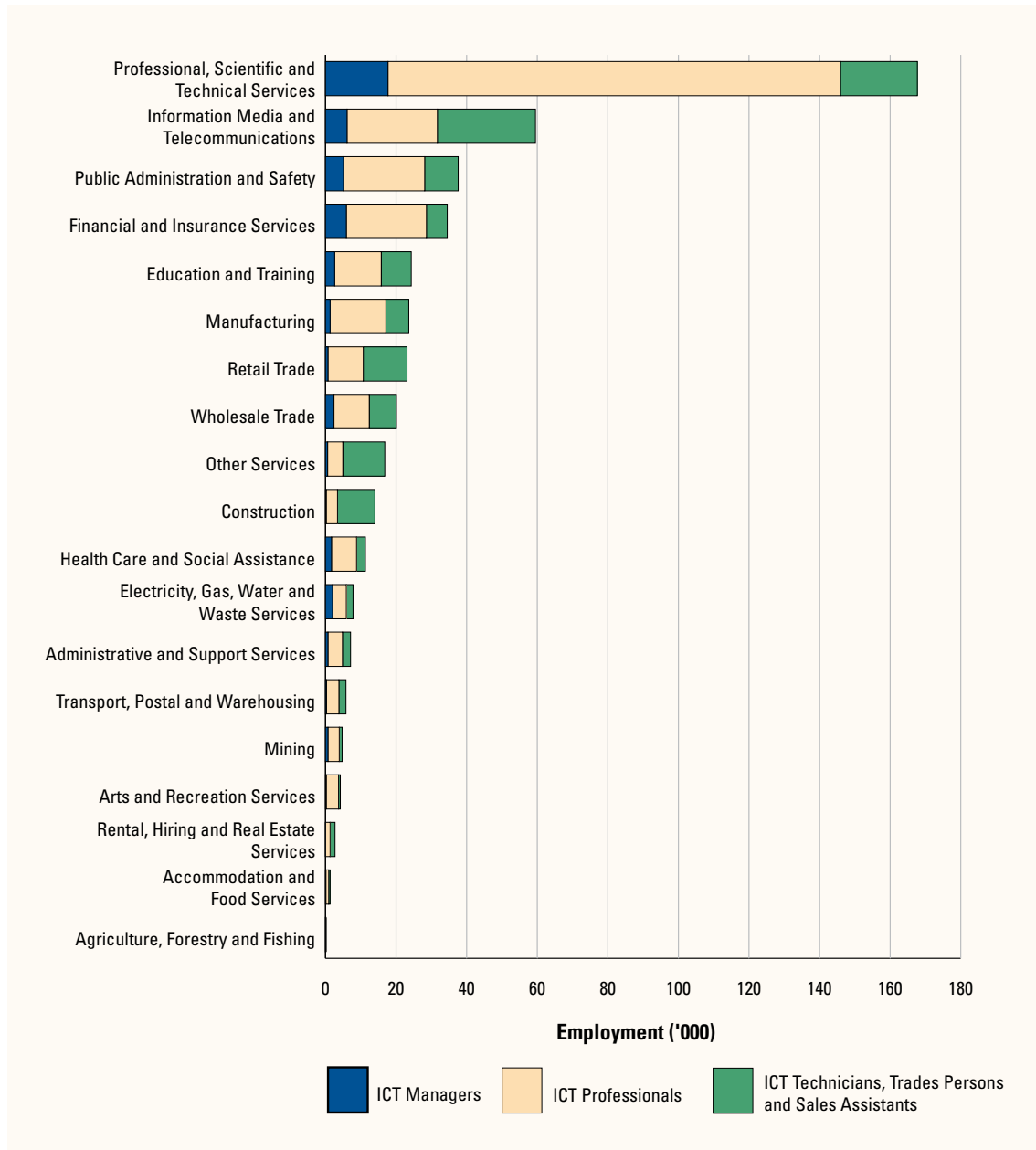
Source: AWPA analysis of ABS, 'Labour Force, Australia, Detailed, Quarterly, February 2013' (cat. no. 6291.0.55.003).

Figure 5 details employment growth for ICT occupations over the past 5 and 10 years to August 2012. While some ICT trade occupations (including Telecommunications Trades Workers and Electronics Trades Workers) have declined over the past 10 years, others have grown. The occupation of ICT Support Technicians has shown the largest growth over the 10 years to August 2012. Other ICT occupations showing growth for the same period include ICT Managers and ICT Business and Systems Analysts.

Figure 5:   ICT occupations—employment growth, 5 and 10 years to August 2012
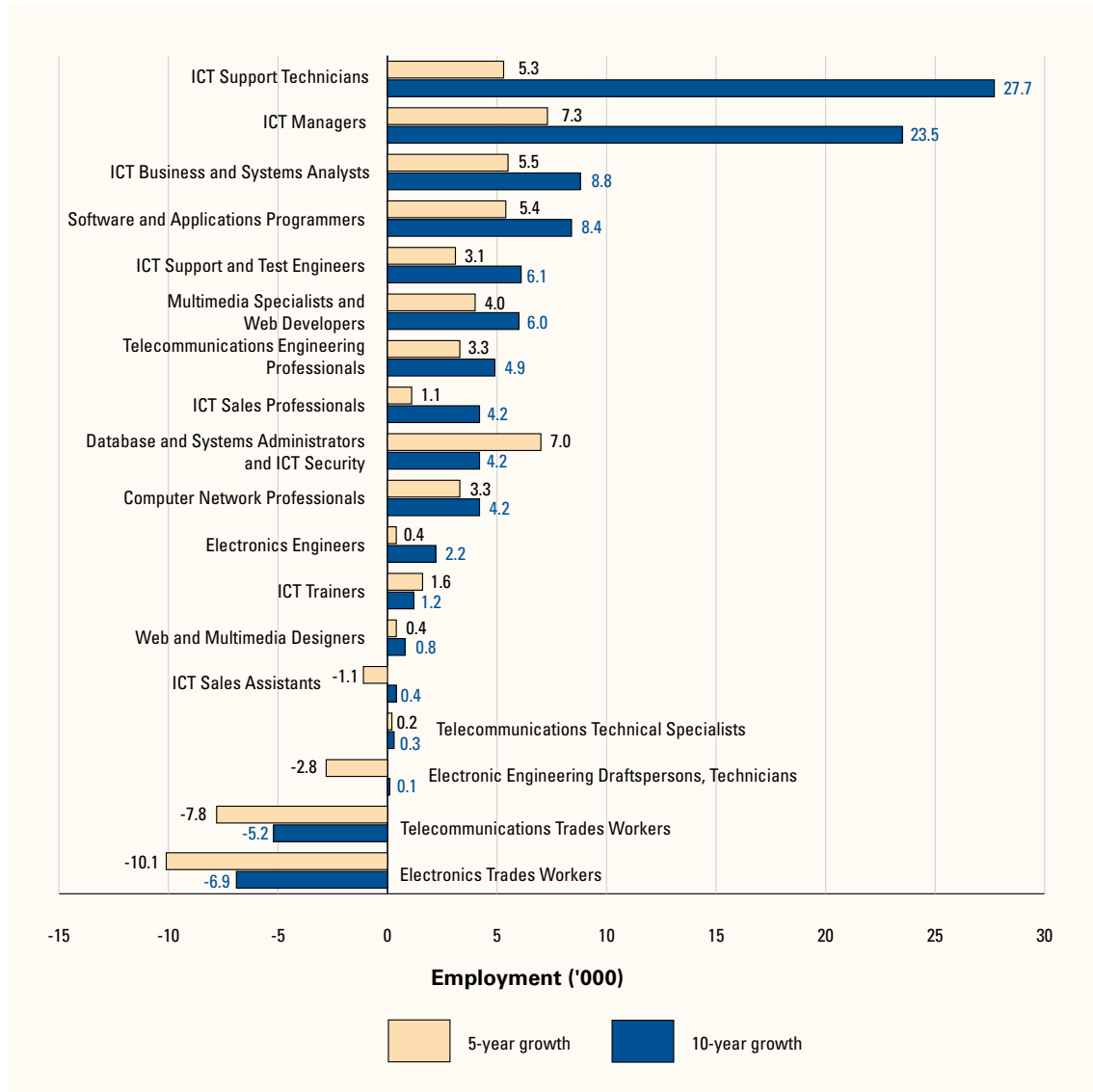
Source: DEEWR, *ICT Labour Market Indicators, February 2013*, www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/
ict_labour_market_february_2013_0.zip.

Figure 6 shows the unemployment rate in the three main ICT occupational groups—ICT
Managers, ICT Professionals and ICT Support Technicians—from 2009 to 2012. The rates are
lower than the overall unemployment rate.[81] The ICT unemployment rate was highest for all
groups in 2009, probably as a result of the global financial crisis. Since then it has declined
each year, except in 2012 when it increased for all groups except for ICT Support Technicians.
In a market with continued growth in demand, a high unemployment rate can be an indication

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81   Ibid., slide 27.

of skills gaps in the workforce.[82] The Australian Computer Society's submission noted that the employment of ICT Support Technicians is more susceptible to the business cycle than other ICT occupations because a large proportion of these jobs are entry-level positions.[83] Stakeholder feedback suggests an apprenticeship/traineeship model for training technically skilled ICT workers could improve entry-level opportunities.

However, there is a high degree of occupational wastage for ICT graduates in the 20 to 29 years age cohort, which suggests that employment prospects for ICT graduates may not be as positive as they appear. In 2011, 51 per cent of all ICT graduates aged 20 to 29 years were not employed in ICT Professional occupations.[84] This may suggest that the market for new ICT graduates is soft, or that working conditions are not as competitive as in other similar professional occupations.

Figure 6:   Unemployment rate for ICT Managers, ICT Professionals and ICT Support Technicians
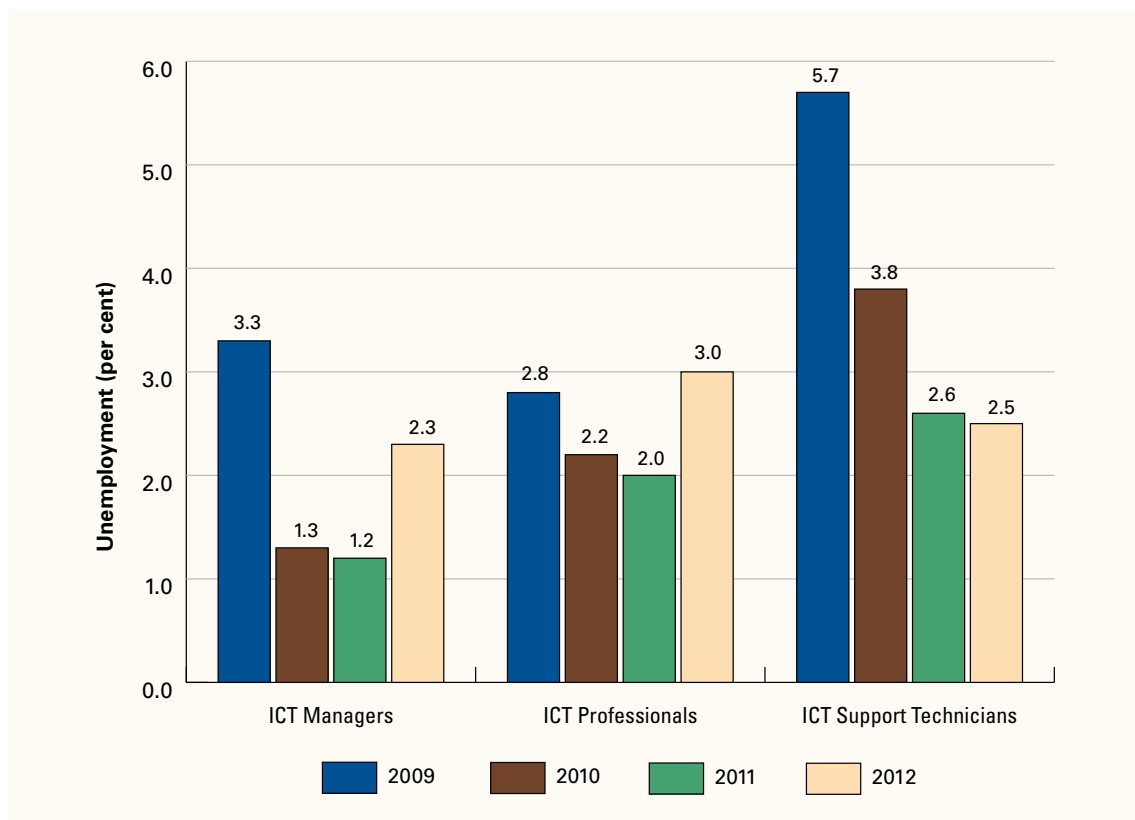
Source: DEEWR, *ICT Labour Market Indicators,* February 2013, <www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/ict_labour_market_february_2013_0.zip.

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82   ACS, 2012, *Australian ICT Statistical Compendium 2012*, p. 39.

83   ACS, 2013, submission to AWPA ICT workforce study.

84   DEEWR, 2013, *ICT Labour Market Indicators,* slide 26.

Age profile

The median age of people in the ICT workforce in 2012 was 38 years, which is only a year lower than the median age of people in the workforce as a whole. However, the age distribution of the ICT workforce, as Figure 7 shows, is much younger.[85] For instance, 67.8 per cent of the ICT workforce is aged 25 to 44 years compared to 45.5 per cent of the workforce as a whole.

Figure 7: ICT Professionals—distribution of employment across selected age groups, 2011
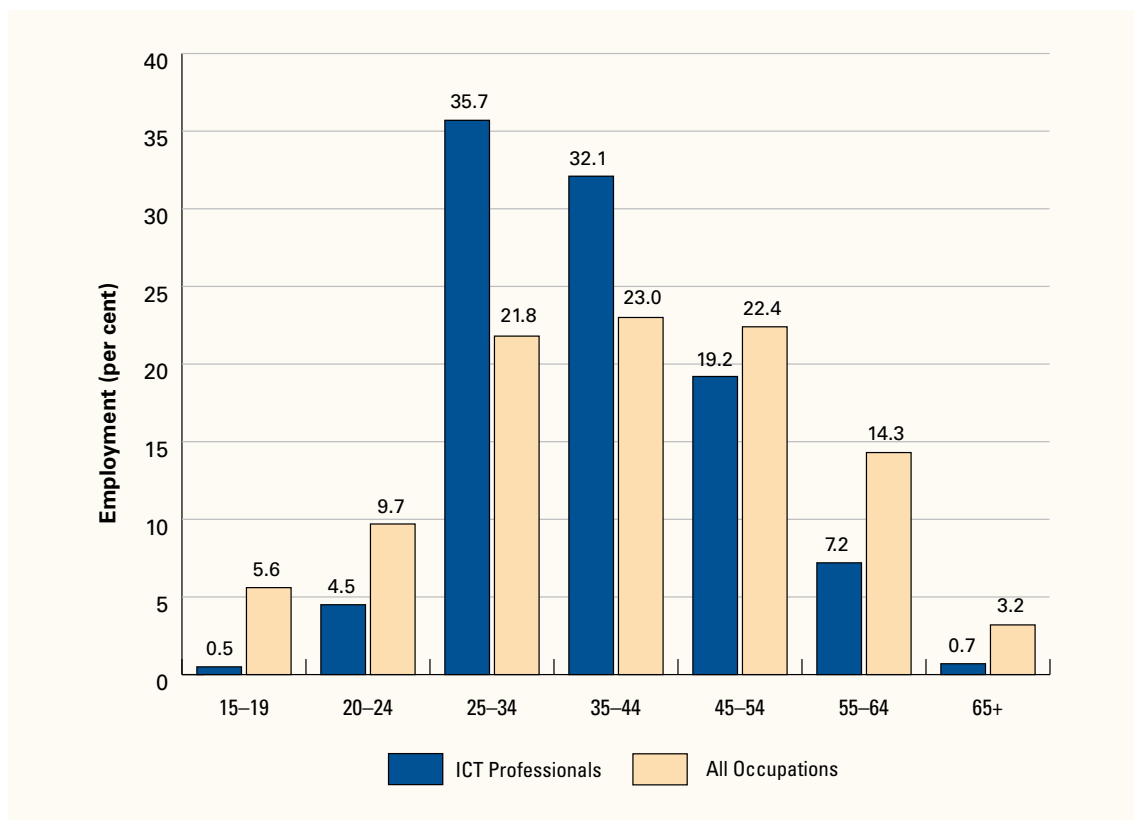
Source: DEEWR, *ICT Labour Market Indicators*, February 2013, www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/ict_labour_market_february_2013_0.zip.

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85   IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 10.

Gender profile

Only about one-quarter of all ICT workers in 2011 were female.[86] Some industries, such as Mining and Agriculture, Forestry and Fishing, have higher proportions of female ICT workers at 40 and 45 per cent respectively, though the absolute numbers of ICT workers employed are relatively small.[87]

2.2 Demand for professional, technical and managerial ICT workers

There are indications that demand for workers in ICT-related occupations will continue to grow in the short to medium term.[88] In some scenarios of the Australian economy reported by AWPA, shortfalls are projected in some key ICT occupations in the longer term. The supply of qualified workers for the ICT sector needs continued monitoring to ensure adequate skills to meet demand.

Recent recruitment data

Recent recruitment data for key ICT occupations indicates that while there are often adequate numbers of applicants for advertised vacancies, employers often considered many applicants unsuitable for the positions. For instance, data from DEEWR's Survey of Employers Who Have Recently Advertised indicates about 10 per cent of applicants in three ICT occupations—ICT Business Analyst, Systems Analyst and Analyst Programmer—were suitable for the positions advertised, and for Developer Programmer and Software Engineer positions only 5 per cent of applicants were suitable. One of the reasons for the mismatch between employer requirements and applicants is that the positions require between 2 and 10 years previous experience, which new entrants cannot meet. DEEWR has recently expanded its survey to capture better data for these five key ICT occupations.

Besides lacking experience, according to employers, applicants often lack soft skills. In some occupations, such as Software Engineer and Developer Programmer, client liaison and 'cultural fit' with the enterprise are considered critical when assessing applicants for positions. DEEWR research identifies the 'very specific nature of employers' requirements' and notes that in some cases positions remained unfilled or were advertised overseas.[89]

Other recruitment data indicates high levels of job turnover and extensive use of contracting arrangements. For example, 77 per cent of respondents to an Information Technology Contract and Recruitment Association (ITCRA) SkillsMatch survey published in January 2013 reported that their employment was contract based. This is the highest figure since the survey began

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86 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013,* p. 9; ACS, 2012, *Australian ICT Statistical Compendium 2012,* p. 25.

87 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013,* p. 9.

88 DEEWR, 'Occupation projections to November 2017', *2013 employment projections*, lmip.gov.au/default. aspx?LMIP/Publications/IndustryEmploymentProjections, accessed 3 April 2013.

89 The discussion related to the Survey of Employers Who Have Recently Advertised is based on data provided to AWPA by DEEWR.

in 2009. The latest ITCRA report has similar figures on contracting—70 per cent of roles are reported to be contract based.[90]

According to ABS data, the Professional, Scientific and Technical Services industry division, which includes the majority of ICT-related occupations, ranks third out of 19 industry divisions in terms of the proportion of contractors employed (15.1 per cent of its total workforce).[91]

ITCRA infers that contracting responds to the current business needs of the ICT industry, 'is market driven and continues to reflect the nature of many of the ICT infrastructure projects coupled with ongoing changes in government tendering arrangements and the business models of those clients partnering with ITCRA Members'.[92]

Changes in government funding have impacted demand for contractors. For example, in Queensland, as a result of some government departments reducing contractor hours, many ICT technicians are having difficulty finding positions at their current skill levels and are consequently taking on lower skilled roles. Technicians with specialist skills, such as .NET and Java development and Systems, Applications and Products (SAP) are, however, still in demand.[93]

The ITCRA ICT sector vacancy data shows the average number of working days to fill a role in ICT declining to 15.4 in the first quarter of 2013 when compared to the 2012 average of 24.7 days.[94] This could indicate some softening of the labour market for ICT personnel.

Overall, the ICT sector is increasingly characterised by contract labour and high turnover of jobs. This is perhaps in response to rapid changes in technology and equally fast uptake of it by consumers and businesses. Contracting out ICT functions may not always be the best solution for all organisations. The Australian Services Union has stated that 'the lack of secure, long term work is a significant contributor to both the lack of diversity in the ICT workforce and to retention issues'.[95] To maintain a strong ICT skill base, the *Review of the Australian Government's use of information and communication technology* recommended the Australian Government develop and implement a whole-of-government strategic ICT workforce plan and develop career pathways to assist agencies to better manage their ICT workforce.[96]

Projections for future employment demand

DEEWR analysis indicates employment for ICT workers is expected to grow considerably over the next five years (Figure 8). The total ICT workforce is projected to grow by 33,200 workers, or 7.1 per cent, from 2012 to 2017. The employment of ICT Professionals is projected to grow by 9.5 per cent, or by 21,400 workers, during this period.

90   ITCRA, 2013, *ITCRA Trends report and SkillsMatch Dashboard Snapshot, April 2013,* www.itcra.com/documents/item/553, accessed 23 April 2013.

91   ABS, 2013, 'Forms of Employment, Australia, November 2012' (cat. no. 6359.0), www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/6359.0Main+Features1November%202012?OpenDocument, accessed 23 May 2013.

92   ITCRA, 2013, *ITCRA Trends report and SkillsMatch Dashboard Snapshot, January 2013,* p. 4, www.itcra.com/documents/item/1108, accessed 3 April 2013.

93   IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 7.

94   ITCRA, 2013, *ITCRA Trends report and SkillsMatch Dashboard Snapshot, January 2013*, p. 4.

95   Australian Services Union, 2013, Submission to AWPA ICT workforce study.

96   Gershon, P, 2008, *Review of the Australian Government's use of information and communication technology,* Department of Finance and Deregulation, Canberra.

Figure 8 captures the five-year employment growth projections for the period 2012 to 2017 for six of the highest employing ICT occupations. The projected increase in the numbers of workers over the five-year period to 2017 for each of these occupations is set out below:

➢ 3,600 (4.4 per cent) for Software and Applications Programmers

➢ 3,000 (5.5 per cent) for ICT Support Technicians

➢ 3,400 (6.5 per cent) for ICT Managers

➢ 4,400 (12.8 per cent) for Electronics Trades Workers[97]

➢ 3,900 (11.5 per cent) for Database and Systems Administrators and ICT Security

➢ 3,300 (9.6 per cent) for ICT Business and Systems Analysts.

Figure 8: Employment projections for six of the highest employing ICT occupations, 2012 to 2017
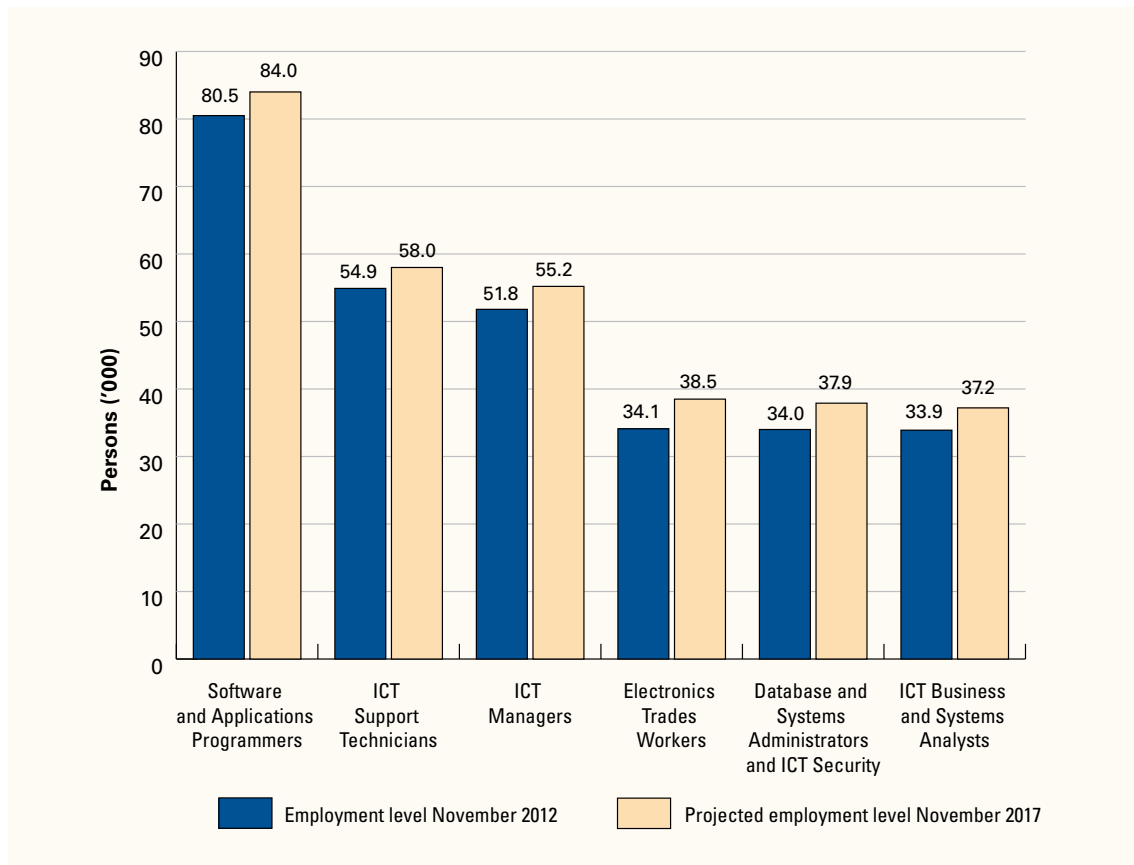
Source: DEEWR, 'Occupation projections to November 2017', *2013 employment projections,* lmip.gov.au/default.aspx?LMIP/ Publications/IndustryEmploymentProjections.

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97   Electronics Trades Workers are employed across a variety of industry sectors including construction; retail trade; and professional, scientific and technical services. The predicted strong growth may reflect the increasing demand for Electronics Trades Workers in a number of areas including in the NBN rollout and in mining automation.

In the four scenarios in AWPA's *Future focus: 2013 National Workforce Development Strategy*,[98] the long-term outlook (to 2025) is for a potential undersupply of qualifications for key ICT occupations. In all scenarios, technological changes will be the key driver for demand for ICT workers, with employment in ICT occupations projected to grow between 64 and 72 per cent faster than overall employment growth in the three high-growth scenarios and account for around 5 per cent of all employment in 2025 (the figure for 2011 is 4.3 per cent). Software and Application Programmers, and Multimedia Specialists and Web Developers are expected to be the largest growing occupations. ICT occupations expected to grow the fastest include ICT Support and Test Engineers, and ICT Business and Systems Analysts. More information about the AWPA scenarios is provided at Appendix 1.

Projected replacement demand

New jobs from growth in an occupation account for only a portion of all jobs that are expected to be available during the forecast period. Many workers will leave jobs for a variety of reasons, such as death, ill health, retirement or transfer to another occupation. These departures will create additional opportunities for workers to enter each occupation. In many occupations, the number of workers retiring will rise in coming years due to the ageing of Australia's baby boomers. This is, however, less likely in ICT occupations because workers are generally younger.[99]

These replacement needs, when added to new jobs, create a more complete picture of job openings. While projections of job growth and decline provide the best picture of how occupational employment is expected to change, job openings provide a better description of the labour market that new entrants will face. The measure of replacement needs for this purpose is net replacement, which, when combined with growth in an occupation, best represents the job openings for new entrants to the occupation.

AWPA's analysis of replacement demand for the ICT workforce indicates low replacement rates for the majority of ICT occupations. This means that job openings for new entrants in these occupations will be due more to employment growth than to turnover.

Figure 9 shows that the net replacement rate for most ICT occupations is below the average for all occupations. The relatively high net replacement rate for ICT Trainers may reflect the low pay compared to other ICT occupations, which makes it more challenging to attract workers to the occupation.

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98   AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, www.awpa.gov.au/our-work/
     national-workforce-development-strategy/Pages/default.aspx, accessed 3 April 2013.

99   Shah, C, and Long, M, 2013, *Forecasts of skill and labour in the transport and logistics industries 2013–17*,
     Report to the Transport and Logistics Industry Skills Council.

Figure 9:   ICT Professionals—net replacement demand rates to 2017
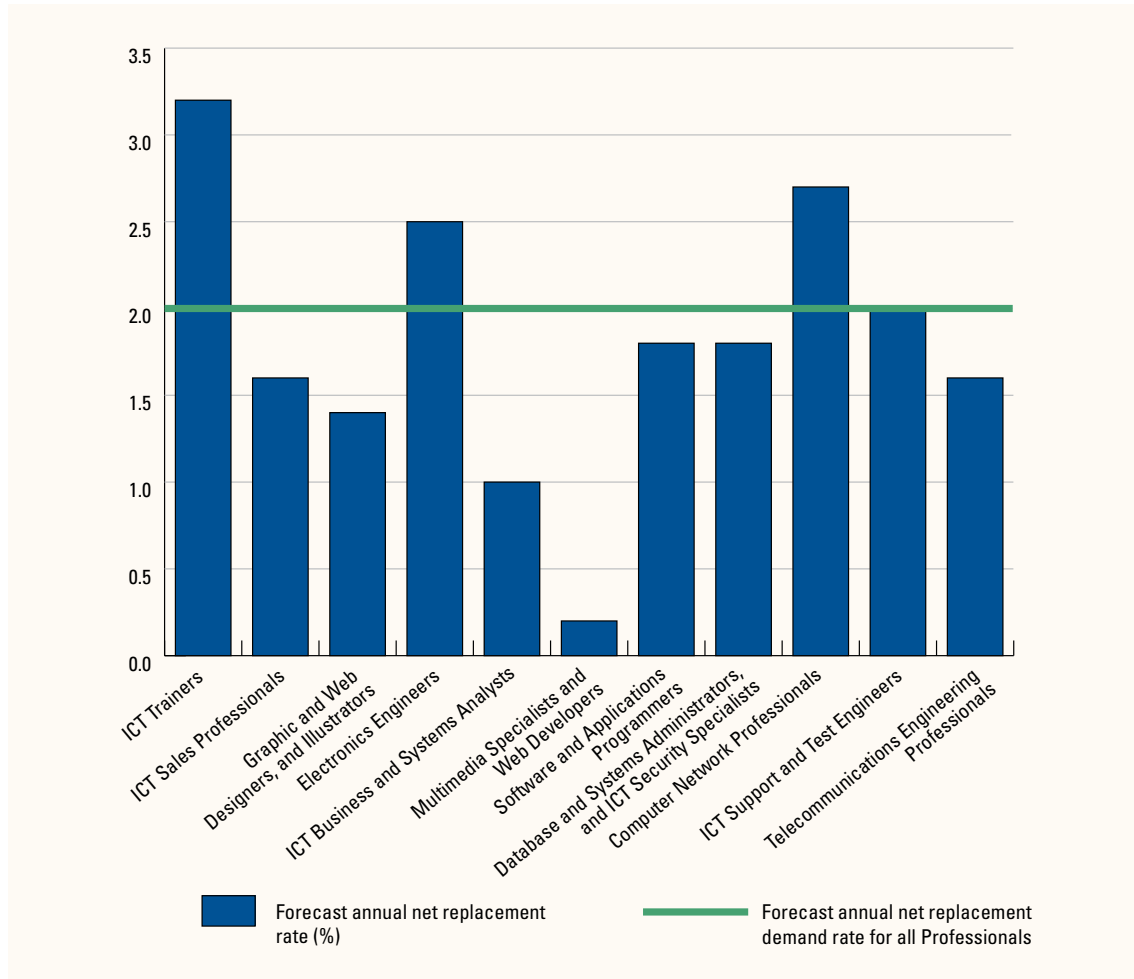
Source: AWPA analysis of ABS, 'Census of Population and Housing 2006' and 'Census of Population and Housing 2011'
(cat. no. 2008.0); ABS, 'Labour Force 2001–11' (cat. no. 6202.0).

2.3   Supply of skills for the ICT workforce

Recent improvements in enrolments in and completions of ICT courses in both higher
education and VET have been marginal. The outcomes for graduates are not always clear,
with data from student outcome surveys indicating graduates are having difficulty securing jobs
relevant to the courses completed.

Skills from higher education

With increasing specialisation in the ICT sector and a corresponding increase in the demand
for higher-level qualifications and skills, higher education continues to be the critical source of

ICT skills supply. Between 50 and 77 per cent of workers in key ICT occupations hold higher education qualifications.[100]

As noted in figures 10 and 11, domestic higher education completions in information technology courses marginally improved in 2011, when domestic completions accounted for 35 per cent of all completions in these courses. According to DEEWR analysis, the peaking of higher education completions coincided with the dot-com crash of 2000. Poor employment outcomes during this period led to a decline in enrolments.

Commencements in ICT-related higher education courses by domestic students show signs of recovery following close to a decade of contraction from 2001 to 2008. The number of commencing students in such courses increased by 11 per cent in the two years to 2011 to 9,235, and course completions increased by 4 per cent over the same period.[101] As a result, the supply of domestic graduates is expected to further improve in the future. While commencements for overseas students in ICT courses have tended to fluctuate in recent years and declined by about 18 per cent from 2009 to 2011, completions remain strong and have been close to double the completion rate of domestic students.[102]

Figure 10: ICT Professionals—higher education commencements in the field of information technology, 2001 to 2011
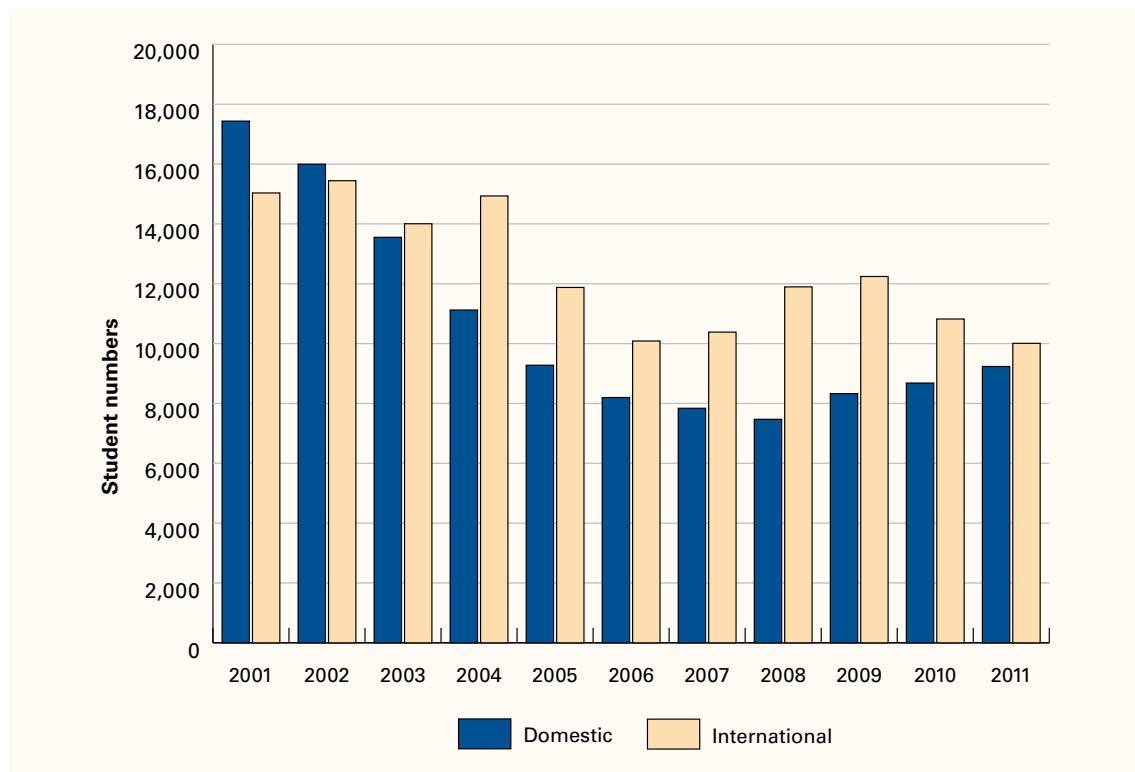
Source: DEEWR, *ICT Labour Market Indicators, February 2013,* www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/ ict_labour_market_february_2013_0.zip.

100 DEEWR, 2013, *ICT Labour Market Indicators,* slide 14.
101 Ibid., slides 18 and 19.
102 Ibid.

Figure 11: ICT Professionals—higher education completions in the field of information technology, 2001 to 2011
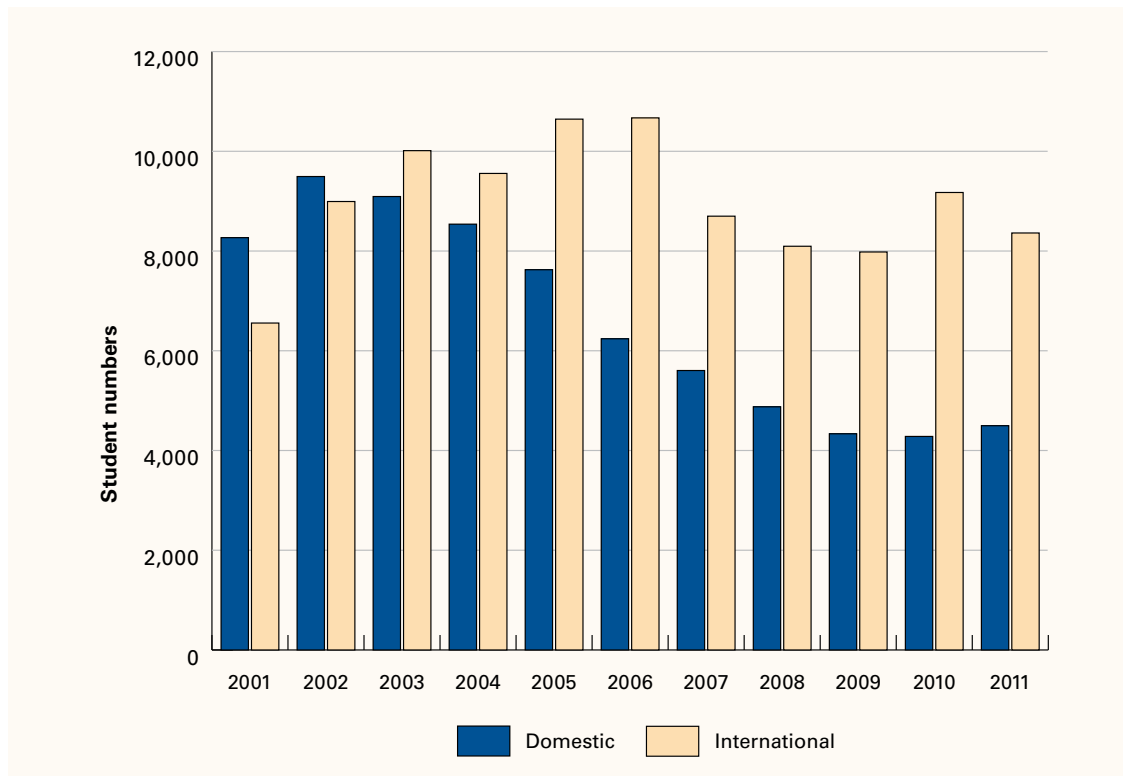
The Australian Government introduced a demand-driven funding model for undergraduate places at universities from 2012. While it is too early to draw conclusions on the impact of this policy on student demand for ICT courses, preliminary data indicates an increase in commencements in ICT courses, with an increase of about 2.3 per cent in 2012.[103]

Skills from vocational education and training

The VET sector plays a critical role in the supply of ICT-related skills. Its role extends to upskilling and providing access to specific skill sets for those already in work, which is more important in a sector like ICT where technology changes are faster than in other sectors. The VET sector's role is also substantial in meeting the demand generated through the rollout of the NBN. In addition, there is a trend for graduates from higher education courses to use VET qualifications for reskilling and upskilling purposes.[104]

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103 Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education, 2013, *Higher Education Statistics 2013,* www.innovation.gov.au/highereducation/HigherEducationStatistics/ StatisticsPublications/Pages/default.aspx, accessed 3 April 2013.

104 IBSA, 2013, submission to AWPA ICT workforce study.

The key training packages for ICT qualifications in the VET sector are the Information and Communications Technology training package, and the Integrated Telecommunications training package.

The Information and Communications Technology training package includes qualifications and units of competency for a range of areas including digital media technologies, cloud computing, mobile devices, network security and interactive and digital games. The Integrated Telecommunications training package covers areas in broadband and wireless technology, digital reception technology, rigging installation, NBN infrastructure and NBN maintenance. The qualifications in this training package were updated to respond to the needs of the NBN rollout and to ensure that the package 'continues to meet the high demands of industry and maintains relevance to the industry's developing needs'.[105]

To ensure a supply of appropriately trained technicians, NBN Co and Innovation and Business Skills Australia have worked with industry to identify the most appropriate streams and electives within these qualifications, and have developed two new qualifications (NBN Construction Certificate II and III) and Certificate III–level skill sets to meet these needs.[106]

Figure 12 indicates that the number of students commencing in VET ICT-related qualifications declined by 40 per cent from 2008 to 2011. Completions also declined during this period by 19 per cent. However, outcomes for the higher level qualifications (Certificate III and above) for Information and Communications Technology increased by 26 per cent between 2010 and 2011 and completions also increased by 3.2 per cent in the same period.[107]

105 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 18.

106 NBN Co, 2013, submission to AWPA ICT workforce study.

107 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 25. Commencement and completion data has to be used with caution as over- and under-reporting are likely due to the diverse benchmarks employed by the providers.

Figure 12: All VET commencements and completions for Information and Communications Technology and Integrated Telecommunications qualifications, 2008–11
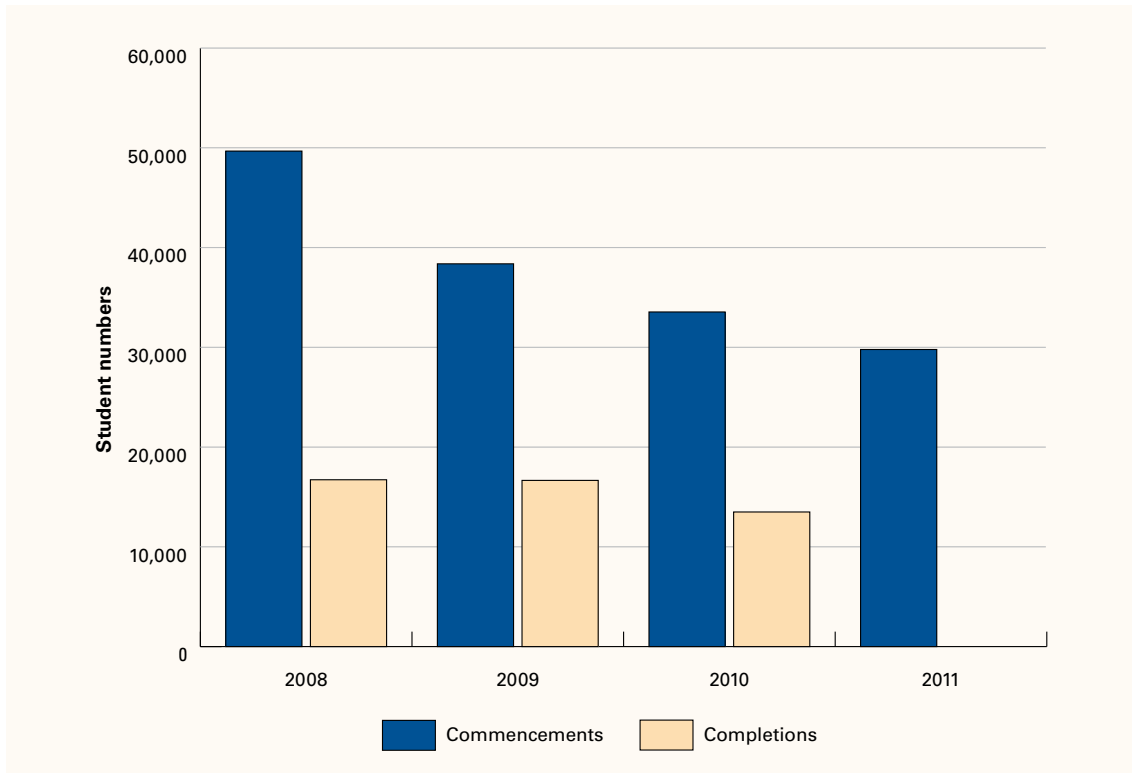
Source: National Centre for Vocational Education Research VOCSTATS, *Students and Courses*, accessed 12 June 2013.

In 2011, the top five qualifications with the highest enrolments (representing 74.5 per cent of total enrolments in the training package) in Information and Communications Technology were:

1. Certificate II in Information Technology (13,978)

2. Certificate I in Information Technology (10,875)

3. Certificate III in Information Technology (10,692)

4. Certificate IV in Information Technology (3,404)

5. Diploma of Information Technology (Networking) (2,290).[108]

About 37 per cent of students enrolled in 2011 had not completed Year 12. While most did not have a prior post-school qualification, about one-quarter held a Certificate III or higher level qualification. Most students were aged 19 years or younger and almost all were male. Female numbers continue to decline.[109]

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108 Ibid., p. 21.
109 Ibid.

Enrolments in the Integrated Telecommunications qualifications increased slightly between 2010 and 2011. The decline in recent years is attributed to the relocation of the Customer Contact qualifications to a different training package. Commencements in these qualifications declined between 2008 and 2010 but increased sharply in 2011, though the numbers remain small at 852 in 2011.[110] Completions are expected to show improvement in 2012.

Enrolments in the Integrated Telecommunications qualifications are dominated by males, and female enrolments continue to decline. The modal age of students enrolled is 20–24 years, which is higher than the modal age of students enrolled in the Information and Communications Technology qualifications.[111]

DEEWR analysis notes that 'apprenticeships are not well-established pathways for entry to ICT careers'.[112] The training rate[113] for ICT Support Technicians in 2010 was 1.5 per cent, which is much lower than the average of 2.7 per cent from 1986 to 2009 for all trades. Chapter Four examines the potential benefits of establishing a national apprenticeship/traineeship pathway for ICT Technicians and Trades Workers.

Skilled migration

Skilled migration, including both permanent skilled migration and temporary skilled migration (primary subclass 457 visas), forms an important source of labour supply for the ICT sector. Nine of the 18 ICT-related occupations are on the 2013 Specialised Occupation List developed by AWPA. The list identifies occupational areas where the risk of shortages, or indeed oversupply, needs to be better identified and addressed. A wide range of data and information is examined each year to generate a new Specialised Occupation List and includes occupations which satisfy the criterion of high information, as well as two of the following three criteria: long lead-time, high use and high risk. It is published at the Australian and New Zealand Standard Classification of Occupations (ANZSCO) unit group (four-digit) level. Recommendations to the Minister for Immigration and Citizenship about which occupations from the Specialised Occupation List should be included in the Skilled Occupation List for permanent skilled migration assessments are based on a number of factors. These include analyses of the labour market, education and training, migration, and general economic and demographic data to assess longer term skills and workforce development needs for a particular occupation. The Skilled Occupation List is at the ANZSCO unit group (six-digit) level. There are six ICT-related occupations at this level included in the 2013 Skilled Occupation List: Electronics Engineer, ICT Business Analyst, Systems Analyst, Analyst Programmer, Developer Programmer and Software Engineer.

Permanent skilled migration accounts for 3 per cent of total employment of ICT Professionals and 1.4 per cent of total employment for ICT Managers.[114] In 2010–11, permanent skilled migration visas related to ICT occupations showed that the largest numbers were for the ICT

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110 Ibid., p. 25.

111 Ibid.

112 DEEWR, 2013, *ICT Labour Market Indicators,* slide 15.

113 The training rate is defined as the number of completed qualifications at Certificate III/IV as a percentage of the employment in the occupation.

114 DEEWR, 2013, *ICT Labour Market Indicators*, slide 16.

Professionals group, which is similar to the trends in primary subclass 457 visa application numbers for the same year. The breakdown from the three main occupational groupings for permanent skilled migration numbers for 2010–11 are as follows:

➢ ICT Managers—112

➢ ICT Professionals—10,897

➢ ICT Technicians and Trades Workers—464.[115]

In 2011–12, temporary skilled migration (primary subclass 457 visas) accounted for approximately 4.2 per cent of total employment for ICT Professionals and 1.5 per cent of total employment for ICT Managers.

According to the Australian Computer Society, some ICT occupations have a high percentage of subclass 457 visa workers. In May 2012:

➢ 5.2 per cent of Software and Applications Programmers were primary subclass 457 visa holders

➢ 4 per cent of ICT Business and Systems Analysts were subclass 457 visa holders.[116]

Figure 13 shows the number of primary subclass 457 visas holders in ICT occupations from 2010 to 2012. The number of Computer Professionals increased by 18 per cent from 2010 to 2012. The number of primary subclass 457 visa applications granted in the Computer Professionals grouping in 2011–12 was more than twice the number of higher education completions in the field of information technology for 2011. Some of these primary subclass 457 visa holders, such as ICT Security Specialists, may be part of the globally mobile ICT workforce whose skills are sought after in many countries. Others may be filling positions which cannot be filled locally at a particular time and place.[117] In addition, domestic completions, as noted previously, have been trending upwards in recent years, suggesting potential improvements in the domestic supply of graduates for the ICT sector.

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115 Department of Immigration and Citizenship (DIAC), customised data request.

116 ACS, 2012, *Australian ICT Statistical Compendium 2012,* p. 21. The ACS does not specify whether these figures relate to primary or secondary subclass 457 visa holders.

117 Subclass 457 workers may enter Australia as part of the international labour market for specific projects. Thus, while they may appear as a subclass 457 visa holder in DIAC statistics, they are not long-term additions to the workforce.

Figure 13: Number of primary subclass 457 visa applications granted for selected ICT workers
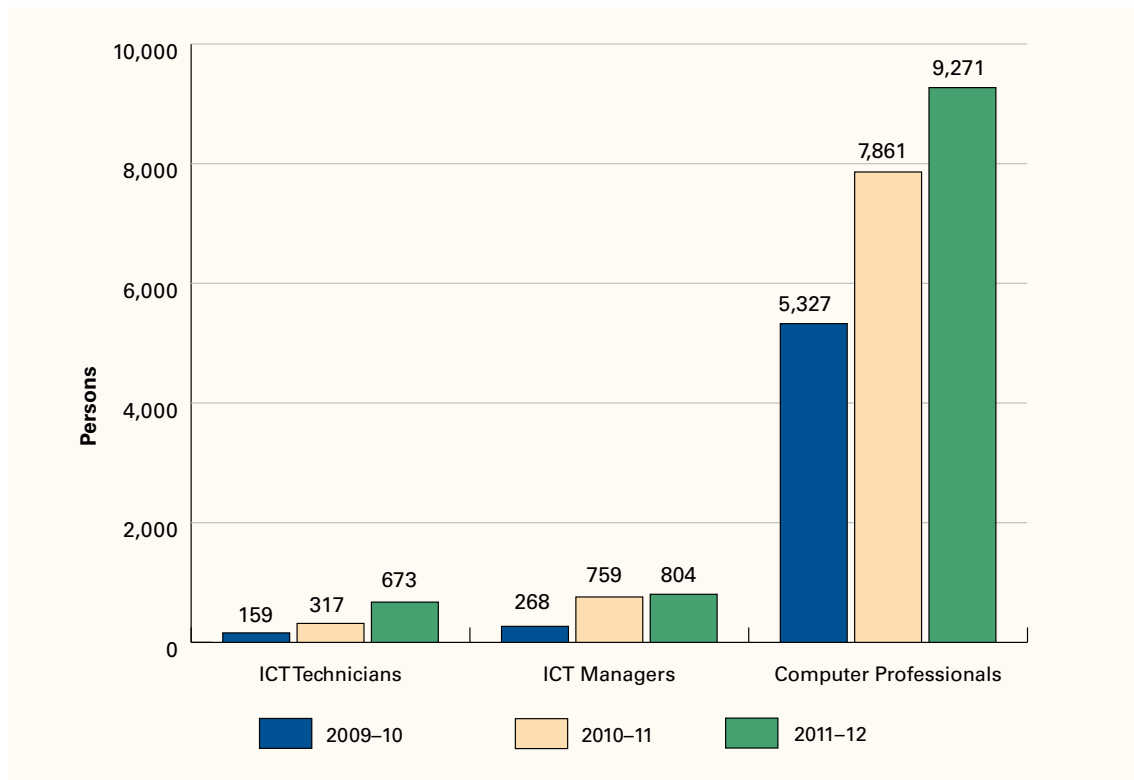
Source: DEEWR, *ICT Labour Market Indicators, February 2013*, www.skillsinfo.gov.au/sites/skillsinfo.gov.au/files/documents/ict_labour_market_february_2013_0.zip.

2.4 Pathways into ICT occupations

Pathways from qualifications to employment

Figure 14 shows the level of concordance between ICT-related qualifications and occupations using data from the ABS 2011 Census for the 20 to 29 years age cohort. The figure captures the numbers of workers in specific ICT occupations drawn from the top three modal qualifications. Overall, the data indicates that some ICT occupations such as Electronics Engineers and Web and Multimedia Designers are dependent on particular streams of qualifications, while others such as ICT Sales Assistants employ individuals from a broad range of qualification pathways. The growing emphasis by employers on soft skills and business skills and the proliferation of ICT in all industry sectors provides opportunities for sourcing skills from non-ICT-related qualifications, especially where prospective employees can draw on ICT skills through experience rather than through qualifications.

Only five of the 18 primary ICT occupations engage more than one-third of individuals from a particular degree or qualification. In other words, the majority of ICT occupations employ individuals with a range of tertiary qualifications. The highest concordance between occupation and qualification is among Electronics Engineers aged 20 to 29 years, with 70 per cent holding at least a bachelor degree–level qualification in engineering and related technologies, electronic engineering or electrical engineering. Similarly, about the same percentage of Web and Multimedia Designers held a qualification in graphic arts and design studies, communication and media studies, or graphic arts and design studies. At the other end of the spectrum, only 16 per cent of ICT Sales Assistants are drawn from the three most common educational pathways. This indicates that ICT Sales Assistants gain employment from a range of educational backgrounds.

This data suggests that some ICT qualifications do not lead to employment in ICT-related occupations. This is also borne out by the Graduate Surveys Australia data included in the next section. For example, only 15 per cent of students with diplomas or certificates in information technology are employed as ICT Support Technicians, which is the primary ICT occupation for students with VET qualifications. In addition, only 18 per cent of students with a bachelor degree or higher qualification in information technology gain employment as Software and Applications Programmers, which is the largest of the 18 primary ICT occupations.

Figure 14: Proportion of ICT occupations holding the top three modal qualifications, 20- to 29-year-olds, 2011
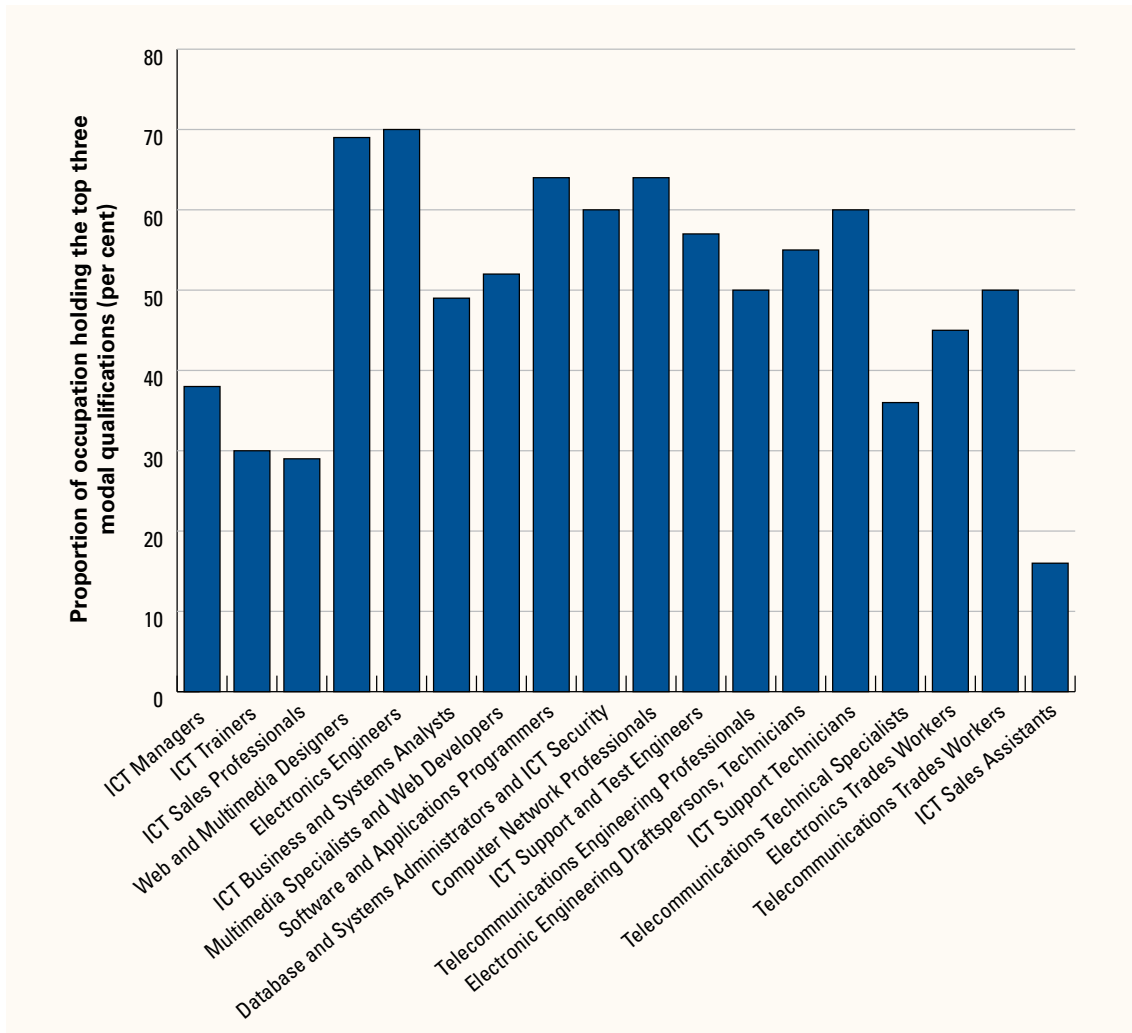
Source: AWPA analysis of ABS, 'Census of Population and Housing 2006' and 'Census of Population and Housing 2011' (cat. no. 2008.0).

Employment prospects for graduates

Employment outcomes for graduates from ICT-related courses are positive, with 74.7 per cent of computer science graduates, and 79.5 per cent of electronic and computer engineering graduates, securing full-time employment upon completion of their courses, although not all of them may have secured jobs in ICT occupations. The median starting salary for ICT graduates in 2012 was $52,500, which was the eighth-highest figure when compared with other courses.[118] However, recent data has supported the findings of the concordance data discussed in the previous section and indicates that the percentage of information technology graduates in jobs shortly after their course completion, where their qualifications are not directly relevant, increased from 58.7 per cent in 2009 to 70.2 per cent in 2012.[119]

The 2011–12 outcomes for VET graduates indicate that, six months after their training in information and communications technology, only 11.2 per cent of graduates were in an occupation typically matched to their training course. However, 21.3 per cent of those in a different occupation to their training course reported that the training was relevant to their current job. The top three occupations of those employed after training were Technicians and Trades Workers (28.7 per cent), Professionals (21.9 per cent) and Sales Workers (17.7 per cent). A high proportion of graduates (85.6 per cent) indicated that they were satisfied with the training, with 64.5 per cent indicating that they received 'job-related benefits' from the training.[120]

118 Graduate Careers Australia, 2012, *Grad Stats, Employment and Salary Outcomes of Recent Higher Education Graduates,* p. 6, www.graduatecareers.com.au/wp-content/uploads/2011/12/GCA-GradStats-2012_FINAL1.pdf, accessed 4 April 2013.

119 Graduate Careers Australia, 2013, *Beyond Graduation 2012: The report of the Beyond Graduation Survey,* p. 5, graduatecareers.com.au/wp-content/uploads/2013/04/Beyond%20Graduation%202012.pdf, accessed 8 April 2013.

120 National Centre for Vocational Education Research, 'VET students by industry: Training Package, Table 8: Outcomes of graduates six months after completing their training in Information and Communications Technology (ICA), 2011–12', www.ncver.edu.au/resources/vsi/vsi_table. html?table_list_class_type_id=1&table_list_table_nr=8&table_list_filter_id=26%2B0&filter_ name=Information+and+Communications+Technology+%28ICA%29&classification_name=Training+Package, accessed 4 April 2013.

Conclusion

Overall, the data on skills supply and demand for the Australian ICT workforce suggests a growing demand for specialist ICT skills, and emerging issues in relation to mismatches between the qualifications demanded by industry and those available in the current ICT labour market. Many graduates of ICT-related courses find themselves in occupations that are not directly relevant to their fields of study. While this is not an indication that they are in unrewarding jobs, it does signal an outflow of skills at a time when the demand for ICT skills is on the rise. The trend of increased demand is projected to continue into the future, particularly as growth becomes increasingly technology driven.

The demographics of the workforce indicate the potential to target particular groups and increase labour supply, and this will be discussed in more detail later in the report. Improving the data on skills supply and demand could improve coverage of the workforce and assist planning processes to address skills demand issues for the sector.

Part Two: Attraction, retention, development and utilisation of ICT skills—what's working and what can be improved

Chapter Three: ICT skills pipeline and the status of ICT careers

Introduction

As set out in the previous chapter, tertiary enrolments in ICT-related disciplines have declined over the past decade. As Australia competes with emerging economies for this skilled labour, and as the demand for ICT workers across a range of professional, technical and trade occupations increases in coming years, a substantial increase in the domestic supply of ICT specialists will be required.

A key challenge is to develop strategies to encourage more young people to consider a career in ICT and to enrol in tertiary ICT courses. In particular, we need to encourage the 'best and brightest' science, technology, engineering and mathematics (STEM) students to consider studying ICT at university, and to encourage a greater proportion of ICT graduates to consider teaching as a profession, thereby helping to encourage and inspire the next generation of ICT professionals.

The ICT industry and profession has an image problem. Persistent and long-held negative perceptions of predominantly male ICT professionals engaged in desk-bound, repetitive, isolating jobs have implications for the pipeline of ICT skills from schools to tertiary education, limiting both the number and quality of domestic graduates. In addition, the ICT sector is almost universally critical of the quality of both the ICT curriculum and its delivery in schools (as well as in VET and higher education), and of the inadequate and out-of-date advice provided by career advisers regarding the wide range of ICT occupations.

It is important to remember that these issues are not confined to Australia, and it is useful to see what other countries have done, and are doing, to improve the supply of domestic ICT students, graduates and employees.

This chapter outlines a range of strategies to encourage more Australian school students to consider a career in ICT and to enrol in tertiary ICT courses. AWPA recommends that industry, the education and training sector and government work together to ensure that secondary school students are effectively engaged in technology and STEM subjects through the delivery of high-quality schooling programs, and to develop positive, assertive and inclusive promotional vehicles for ICT careers.

3.1   Perceptions of ICT and the status of ICT careers

Poor perceptions of the ICT industry, ICT careers and ICT professionals are having a negative impact on the quality and quantity of people attracted to ICT study and ICT professional careers. A 2012 survey of ICT industry professionals and academics reinforced 'the need for improving perceptions of ICT professions and raising the professional profile of ICT', and identified the need for 'greater co-ordinated industry-oriented profile-raising' and collaboration between industry, academe and government.[121]

These calls for change were echoed in the consultations undertaken by AWPA with representatives from industry, professional organisations, the education sector and government agencies. There is a general consensus that ICT has an image problem, and that there is a lack of awareness of the wide range of career possibilities in ICT. There were calls for a sustained, high-profile campaign to educate society about the opportunities provided by an ICT education in a digital economy, and strategies to better coordinate career information and advice. It was acknowledged that while ICT career pathways are often difficult to define given the high rate of change and innovation that occurs within technology, what needs to be emphasised are the persistent and common skills, and the need for agility and adaptability.

Central to this issue is the status of ICT as a career. Why do the negative perceptions persist? As set out in Part One of this report, ICT remains a male-dominated profession (and is arguably becoming more so), it is difficult for domestic graduates to find entry-level jobs within the industry, and the working conditions associated with ICT jobs appear to remain unchanged (or in some cases appear to be deteriorating). For many people, ICT continues to be considered as a technical rather than a professional occupation, and this has implications in terms of the status of ICT occupations, on the career choices made by students and their parents, and on the way the subject is regarded—and taught—within the school system.

The ICT sector can play a lead role in better defining and promoting ICT careers, and in taking steps to address the negative perceptions of the industry. More can be done to highlight and promote the changing and expanding range and opportunities of ICT professions, emphasising the positive aspects such as its dynamic, creative, flexible, interdisciplinary nature, and that many ICT projects involve working with people and using new technologies to solve problems and create new ways of doing things. Strategies for developing positive, assertive and inclusive promotional vehicles for ICT careers are discussed below, but these can only be successful if the ICT industry is itself prepared to change perceptions of ICT careers.

Australian Computer Society chief executive Alan Patterson, for example, has said that the sector needs to tell its story better: 'Australian students do not see ICT as an attractive course of study leading to a rewarding career, which is in fact the opposite of what it is.' Similarly, Simon Kaplan, Director of NICTA's Queensland Research Laboratory, has said that young people perceived ICT positions to be poorly paid, dull and offering few opportunities to advance.[122]

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121 Koppi, T, Ogunbona, P, Armarego, J, Bailes, P, Hyland, P, McGill, T, Naghdy, F, Naghdy, G, Pilgrim, C, and Roberts, M, 2012, *Addressing ICT curriculum recommendations from surveys of academics, workplace graduates and employers*, Australian Learning and Teaching Council, p 10, www.acdict.edu.au/documents/ALTCReportEditedfinal3_000.pdf, accessed 5 March 2013.

122 Pennington, S, 2012, 'A brilliant career—but not in ICT', *Sydney Morning Herald* (13 November), www.smh.com.au/it-pro/business-it/a-brilliant-career--but-not-in-ict-20121112-29866.html, accessed 20 March 2013.

It appears that these perceptions are reinforced by the experiences of students in schools. A 2009 survey undertaken by the Victorian Government found there had been an increase in the percentage of young people *interested* in working in the ICT industry (from 25 per cent in 2007 to 35 per cent in 2009). Thirteen per cent of secondary students reported a *strong interest* in an ICT career (up from 10 per cent in 2007), with male students (23 per cent) being much more likely than female students (3 per cent) to report a strong interest.[123] While more students knew what the term 'ICT' meant (but still only 35 per cent), this did not translate into better understanding of ICT careers or the ICT industry, with students tending to associate ICT with traditional IT-related occupations such as programmers and IT managers, which many students considered to be 'boring'.[124] It was also found that exposure to ICT in school may actually limit students' perceptions of ICT beyond the education system, with the qualitative research suggesting that 'because ICT is taught as a discrete subject in schools, some students believe that ICT encompasses only those topics taught in their "ICT" classes (such as computer programming or IT)'.

The survey report found that 'many students are still unclear about what ICT is, how it differs from IT, and what career opportunities the industry can offer'. While students acknowledged that the use of ICT would be a feature of any future career, they felt that specialising in ICT would limit their career opportunities. There was also a failure to associate careers in games development, visual arts and graphic design—all seen as appealing careers—with the ICT industry.[125] Male students were more positive about a career in ICT, as were those students with family members in the industry, those who had studied ICT at Year 9 or above, and those intending to go on to university rather than TAFE.[126] Female students were significantly more likely to highlight the negative perceptions of ICT careers in their responses.[127] For all students, there was a significant gap between what students identified as important to future career choice (such as a job that matches their areas of interest or jobs they would be good at) and what students saw ICT careers offering.[128]

ICT career outcomes

Not only is there a greater opportunity for industry to work with school students (and their teachers, career advisers and parents) to improve the image of the industry and stimulate interest in ICT careers, there is an opportunity for industry to raise both the *profile* and *transparency* of ICT careers.

The fast-changing nature of technological development has immediate implications for the ICT workforce, as existing job titles and their attendant skill sets are disrupted, transformed or replaced. This makes it difficult to accurately map a generic potential ICT career, and requires cooperation and communication between the ICT industry, schools and career advisers to provide up-to-date and relevant information for students and their parents. There is also the

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123 Department of Innovation, Industry and Regional Development, Victoria, 2009, *Attitudes to ICT careers and study among 14 to 19 year old Victorians*, p. 26, www.business.vic.gov.au/industries/information-and-communication-technology/skills-and-careers/career-awareness, accessed 20 March 2013.

124 Ibid., p. 7.

125 Ibid., p. 20.

126 Ibid., p. 22.

127 Ibid., p. 23.

128 Ibid., p. 24.

related issue of ensuring that the range of ICT job titles and occupations offered to students matches the wide and ever-expanding reality of actual ICT jobs.

Recent criticism of the way in which ICT careers are promoted has pointed to the confusion of the occupations listed in existing ICT career promotional material, including occupations that may no longer exist.[129] This level of confusion and, in many cases, duplication was also made apparent in a prototype ICT Skills app—developed by NICTA and showcased at Techfest 2013—that aims to match students' interests with tertiary and TAFE ICT courses and, potentially, careers in ICT. The large range of possible job titles, together with the wide range of pathways through differently labelled ICT courses, confirmed the need for streamlining and clarifying the pathways into an ICT career.

The challenge, therefore, is to make relevant, up-to-date, accurate information about ICT career paths readily available to students and their parents. This information should be accessible in a range of formats and utilise the potential of social media, computer games, apps (such as the one being developed by NICTA), and other online resources such as YouTube, taking into account the increasing number of teenagers accessing the web on smartphones and tablets rather than on computers.[130] When used alongside new, engaging, positive strategies to encourage students to pursue further study and a career in ICT, these resources will help students decide the pathway to an ICT career that is the best fit for them.

AWPA received a number of suggestions on how the ICT industry can work with schools to promote careers in ICT. A joint submission from NICTA and the Australian Information Industry Association (AIIA) noted that '[c]urrently there are few opportunities—formal or informal— for one-on-one engagement between prospective students and industry'. The submission recommended that:

> Programs that specifically target the showcasing of ICT as a career with input and involvement of industry participants (business owners, ICT entrepreneurs, representatives from the various ICT fields) should be formalised as part of a targeted growth program.[131]

NICTA and the AIIA further recommended the introduction or expansion of formal industry mentoring programs, as 'critical to linking interested/prospective students with industry and, in particular, the specific area of the industry that aligns to their interest'. However, NICTA and the AIIA warned that as the ICT industry is diverse and fast changing, a 'one size fits all' program that simply links students with an 'ICT worker' would be too generic 'and risks dampening interest if the mentoring relationship is not akin to what "excites" prospective students'. Both also reinforce the critical need for a specific focus on women mentoring female students.[132]

129 Barrie, M, 2013, 'The Australian Computer Society should be disbanded', LinkedIn (31 January), www.linkedin.com/today/post/article/20130131000939-921366-the-australian-computer-society-should-be-disbanded, accessed 20 March 2013; Healy, T, 2013, 'IT profession deserves better than the ACS', *Sydney Morning Herald* (5 February), www.smh.com.au/it-pro/business-it/it-profession-deserves-better-than-the-acs-20130205-2dw2y.html, accessed 23 April 2013. These issues were also canvassed at an ICT skills panel held as part of NICTA's Techfest 2013, Parliament House, Canberra, 13 February 2013, overview notes, www.nicta.com.au/__data/assets/pdf_file/0007/37834/Overview_ICT_Skills_Panel_web.pdf, accessed 20 March 2013.

130 See, for example, Pew Research Center, 2013, 'Teens and Technology 2013', Washington DC (13 March), www.pewinternet.org/Reports/2013/Teens-and-Tech.aspx, accessed 20 March 2013.

131 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

132 Ibid.

A number of web resources provide some information about ICT careers. These include the Australian Computer Society's I Choose Technology website, which gives an overview of the ICT industry, ICT jobs and information about ICT salaries.[133] Others include the ACS Foundation's Careers Foundation portal, which includes a range of 'Careers in ICT' videos,[134] as well as commercial sites such as CareerSpot's ICTCareer website.[135] There is an opportunity for industry groups to expand or develop a centralised industry-led portal for students, parents, teachers and career advisers to access up-to-date, relevant ICT career information.

3.2 The skills pipeline—the role of the schooling system

Participants at AWPA's ICT workforce roundtable, held in February 2013, expressed concern about both the content and delivery of existing ICT curriculums in Australian schools. There was general concern about the shortage of subject-qualified ICT teachers and that not enough of a distinction is made between the teaching of digital literacy and the teaching of ICT as a discrete subject, or subjects. There was also agreement that industry needs to be encouraged to become more engaged in both the development of the ICT curriculum and in programs that develop and support teaching practice.

A 2012 UK study found the delivery of computing education in many UK schools to be 'highly unsatisfactory'. While the existing ICT curriculum was broad enough 'to allow scope for teachers to inspire pupils and help them develop interests in Computing', the study found that 'many pupils are not inspired by what they are taught and gain nothing beyond basic digital literacy skills such as how to use a word-processor or a database'.[136] An area of particular concern was the shortage of teachers with specific and current ICT subject knowledge. This often led to ICT lessons being delivered by non-specialists, and a blurring between the teaching of ICT as a subject and ICT being taught as digital literacy. This led to a negative, self-perpetuating perception of ICT, with few students deciding to pursue further study in the computer sciences,[137] as shown in Figure 15. The report recommended that '[t]he term ICT as a brand should be reviewed and the possibility considered of disaggregating this into clearly defined areas such as digital literacy, Information Technology and Computer Science'. It argued that the term 'ICT' should no longer be used as it has attracted too many negative connotations.[138] AWPA suggests that, while mindful of the challenges involved, consideration be given to a similar 'rebranding' of ICT in Australia and a clear distinction made between the teaching of digital literacy to all students and the teaching of computer science and information technology as a discrete discipline.

In September 2012, the UK ICT national curriculum was suspended by the Education Secretary, Michael Gove, who had described it as 'demotivating and dull', and schools were allowed to decide what to teach. Mirroring the concerns that have been raised in Australia, Gove stated: 'In short, just at the time when technology is bursting with potential, teachers, professionals,

133 I Choose Technology, www.ichoosetechnology.com.au, accessed 20 March 2013.

134 ACS Foundation, *Careers Foundation,* www.careersfoundation.com.au, accessed 20 March 2013.

135 ICTCareer, www.ictcareer.com.au, accessed 20 March 2013.

136 Royal Society, 2012, *Shut down or restart? The way forward for computing in UK schools,* p. 5, royalsociety.org/education/policy/computing-in-schools/report, accessed 5 March 2013.

137 Ibid., p. 7.

138 Ibid., p. 8.

employers, universities, parents and pupils are all telling us the same thing. ICT in schools is a mess.'[139] In August 2012, a survey of 1,000 young people for the *Guardian* revealed that only a quarter had learned any computer coding at school—33 per cent of boys and just 17 per cent of girls.[140] A new ICT curriculum is not expected to be released until September 2014.[141]

Figure 15: Vicious cycle of student perceptions of ICT education
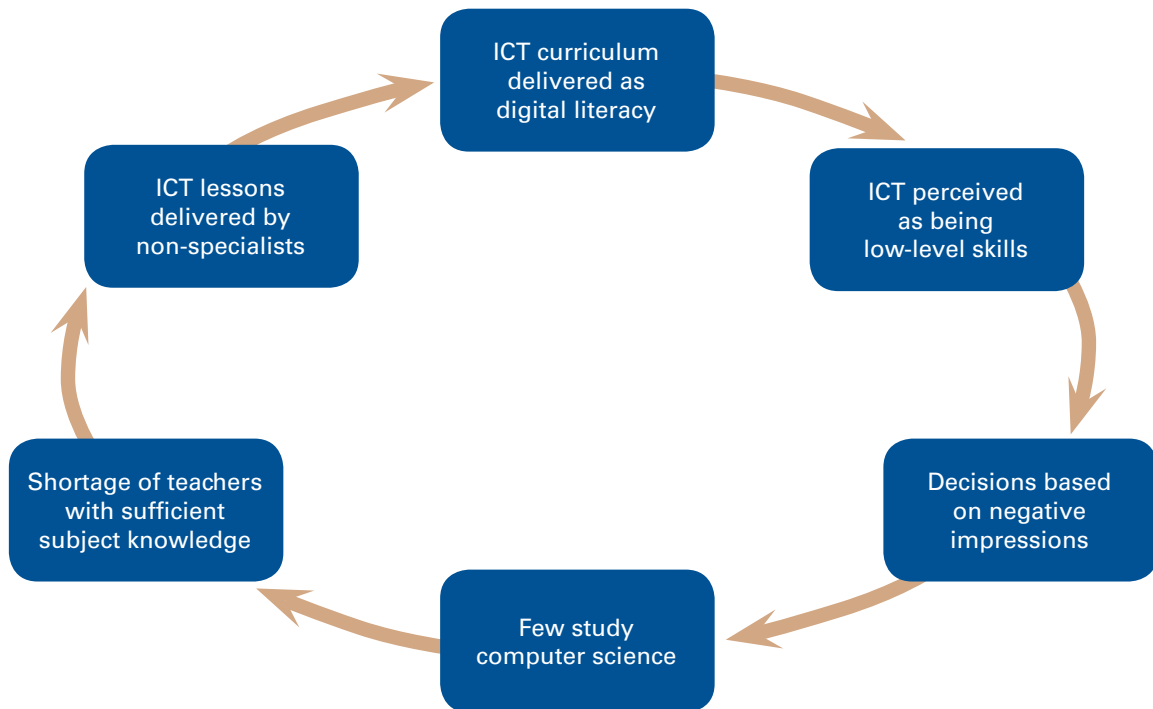
Source: Adapted from Royal Society (UK), 2012, *Shut down or restart? The way forward for computing in UK schools,* p. 7.

In Australia, Matt Barrie, founder of freelancer.com, has been outspoken in his criticism of the way ICT is taught in Australian schools and universities, describing the existing secondary school curriculum as 'old fashioned, irrelevant and bland':

> The kids would like to go out there and learn but the curriculum is so stagnant. It's all bureaucracy and the teachers don't want to look like dummies … I don't think the problem is teaching the students, it's teaching the teachers.[142]

139 Press Association, 2012,'Gove brands ICT curriculum "a mess"', *The Guardian*, 11 January 2012, www.guardian. co.uk/uk/feedarticle/10036637, accessed 9 April 2013.

140 Tickle, I, 2012, 'ICT teaching upgrade expected … in 2014', *The Guardian,* 20 August 2012, www.guardian.co.uk/ education/2012/aug/20/ict-teaching-programming-no-guidance, accessed 9 April 2013.

141 Ibid.

142 Pennington, S, 2012, 'Schools urged to get with the program', *Sydney Morning Herald* (19 November), www.smh.com.au/it-pro/business-it/schools-urged-to-get-with-the-program-20121119-29lvm.html, accessed 18 March 2013.

Barrie has stated that 'the most important thing Australia absolutely has to do is build a world-class technology curriculum in our K–12 [kindergarten to Year 12] system', but 'instead we lump in a couple of horrendous subjects about technology with woodwork and home economics'. He points to Estonia, which has transformed itself into a leading 'e-society',[143] and where, he claims, '100 per cent of publicly educated students will learn how to code starting at age 7 or 8 in first grade, and continue all the way to age 16 in their final year of school'.[144]

NICTA's Simon Kaplan agrees:

> One of the key problems with the school ICT curriculum is that it is taught badly by people who don't really understand what ICT is about so they employ a kind of shallow, rote teaching that doesn't take them outside their limited comfort zone.[145]

Referring to survey-based research on why students chose to study ICT at university, Carolyn Toleman, manager of the Western Australian chapter of the ACS Foundation, reported that the standard of ICT courses in secondary schools contributed to the decline in university ICT enrolments: '[L]ocal high school students I spoke with were being taught secretarial studies (MS Office, Word, Excel, PowerPoint) under the title of "ICT", in years 11 & 12 … They thought this was boring as they had already learned this in primary school.' The problem, she said, was a lack of ICT-qualified teachers in secondary schools.[146]

The ICT curriculum

The Australian Curriculum, Assessment and Reporting Authority is currently developing the Draft Australian Curriculum: Technologies (from Foundation to Year 10) in consultation with industry and educators. The curriculum is due to be finalised in late 2013 and implemented from February 2014.[147] Development of the curriculum has been identified by the Australian Government as important to ensuring that Australia has a workforce with the digital skills required to make our economy competitive.[148] While some concerns have been raised that the curriculum has been 'watered down' to focus more on digital literacy than computer science,[149] AWPA has been advised that having a national curriculum will at least 'provide a consistent national view of the critical role of ICT in society and the essential core ICT literacy skills for young people to learn and live in the contemporary world'.[150] It will also provide a vehicle for connecting learning in technology with learning in all other areas of the national school curriculum, not only in STEM subjects but also in English, with regard to literacy skills, the arts

143 E-Estonia, *The Digital Society*, e-estonia.com, accessed 9 April 2013.

144 Foo, F, 2013, 'Need to sow seeds of success with start-ups', *The Australian* (9 April), www.theaustralian.com.au/australian-it/it-business/need-to-sow-seeds-of-success-with-start-ups/story-e6frganx-1226615241297, accessed 9 April 2013.

145 Pennington, S, 2012, 'Schools urged to get with the program'.

146 LinkedIn, 'Why do students choose to study ICT at University? Interview with Carolyn Toleman, WA Manager of ACS Foundation, concerning her research into declining numbers', www.linkedin.com/groups/Why-do-students-choose-study-4319303.S.185911449, accessed 21 March 2013.

147 ACARA, *Curriculum, Technologies*, www.acara.edu.au/curriculum_1/learning_areas/technologies.html, accessed 9 April 2013.

148 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 14.

149 NICTA, 2013, 'ICT skills panel', overview notes.

150 Swinburne University of Technology, 2013, submission to AWPA ICT workforce study.

and social sciences.[151] However, as the curriculum is currently being developed, it is difficult to foresee or comment on the final outcome at this stage.

The integration of ICT learning into other areas of the curriculum not only reflects the increased use of technology in all aspects of our lives, it also taps into the widespread use of technology by school students outside of school. There is also a call for a broader approach to the content as well as delivery of ICT and STEM curriculums, 'that place[s] more emphasis on generic innovation and problem-solving skills and cross-disciplinary learning opportunities'.[152] The ICT industry has an opportunity to work with schools and government to support ICT curriculum development and its implementation, and to support professional development for teachers.

However, during the consultations conducted for this report, a range of stakeholders suggested to AWPA that ICT education in schools does not currently prepare students adequately for tertiary study in ICT, and that it may take many years to improve the quality of teaching in ICT schooling programs. In the interim, it may be necessary to introduce alternative approaches to educational delivery that embrace the online learning environment and are targeted to students with a particular interest in ICT. Matt Barrie has advocated the introduction of a government-funded semester-long ICT module that can be delivered and assessed online, based on the annual University of Sydney National Computer Science School Challenge. Participation in the challenge has increased from 150 in 2005 to 4,200 in 2013.[153]

The module would teach basic programming, encourage students to create apps, and augment the existing secondary school ICT curriculums.[154] It would function as an extension subject for interested students, and could ensure that 'students with an existing predisposition towards computer science' are 'taught extremely well and remain engaged with computing'.[155] Barrie suggests that the provision of high-quality support staff, available to students remotely, would be vital to the success of the module.[156] AWPA recommends that the Australian Council of Deans of ICT and NICTA work with Education Services Australia to develop and pilot such a module, which could function as a pathway for students to relevant tertiary study in ICT. Consideration could be given to involving local teachers in coordinating delivery of the module. While delivery of the module would be online, local teacher engagement in the module provides a mechanism for interested teachers to increase and practise their own ICT skills.

151 ACARA, 2013, *Draft Australian Curriculum: Technologies,* pp. 18–20, consultation.australiancurriculum.edu.au/Static/docs/Technologies/Draft%20Australian%20Curriculum%20Technologies%20-%20February%202013.pdf, accessed 9 April 2013. See also the National Digital Learning Resources Network (NDLRN) initiative, which comprises a resource collection, delivery infrastructure and metadata standards for digital resources for all areas of the national curriculum, and is collaboratively developed and jointly owned by all Australian school education jurisdictions, www.ndlrn.edu.au, accessed 9 April 2013.

152 Ai Group, 2013, 'National ICT Forum', presentation to B-HERT Business /Higher Education Roundtable, National ICT Forum, Swinburne University of Technology, 13 March.

153 Pennington, S, 2012, 'Schools urged to get with the program'.

154 Ibid.

155 Ibid.

156 Ibid.

Recommendation 1

That the Australian Council of Deans of ICT, National ICT Australia and Education Services Australia develop and pilot a semester-long ICT module for secondary students that can be delivered online, administered centrally and assessed via an automated marking system to augment existing and future secondary school technology curriculums.

Industry and school partnerships

There are a number of ways the ICT industry can enter into partnerships with schools, either through a dedicated, structured program such as the Queensland-based Group X program[157] (see case study on page 72), or through individual companies, industry bodies or professional groups establishing 'ICT Ambassador' or other mentoring programs within their own structures. Several of the large international ICT companies offer 'academy' programs, providing schools with up-to-date industry-relevant and cost-effective academic programs supported by teaching material, equipment, online resources and licences. Examples include Cisco Academy, Microsoft IT Academy, Google's CS4HS program, the IBM Academic Initiative and HP Institute.[158] In some cases, these programs can lead to industry certification and are largely delivered through VET in Schools programs. A recent Australian Industry Group (Ai Group) survey of companies found that about two-thirds of respondents did not have any links with schools, suggesting considerable opportunity for the expansion of school–industry partnerships.[159]

The Group X program provides a framework for industry engagement with school children, and there are a range of other programs that appear to engage effectively with schools. These include the ACS Foundation's school visits program and *Big Day In* ICT careers events organised, run and hosted by students for students, held this year in Sydney, Melbourne, Perth and Newcastle,[160] and SAP's Young ICT Explorers competition which encourages students to apply what they learn in their ICT classes to develop technology-related projects.[161]

In Victoria, the Department of State Development, Business and Innovation and Ai Group have worked together to create the ICT 'Start Here, Go Anywhere' initiative, which has run for six years and established better links between industry and school students. The initiative supports information events and expos across Victoria targeting students in Years 9 to 12, with ICT industry speakers discussing their experiences within the industry and answering questions.[162]

However, while pockets of good practice exist, current ICT industry involvement in school programs tends not to be formalised or systematic. AWPA welcomes the Australian Government's recent announcement of funding for the Digital Careers initiative based on the Group X program. There is therefore an opportunity for industry groups to work with the

157 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

158 Other examples include CompTIA Career Paths, ITIL from the British Computer Society, Oracle University, Adobe Education Leaders, and Autodesk Education.

159 Ai Group, 2013, submission to AWPA ICT workforce study.

160 ACS Foundation, *The Big Day In,* www.acsfoundation.com.au/bdi, accessed 20 March 2013.

161 SAP Young ICT Explorers, www.youngictexplorers.net.au, accessed 20 March 2013.

162 Ai Group, 2013, submission to AWPA ICT workforce study.

education sector in similar ways to develop a more systematic approach.[163] It was also suggested to AWPA that contributions made by ICT professionals to school programs, especially contributions from SMEs, need to be recognised, 'and incentives created to assist in workplace contacts e.g. time allowed for on job mentoring or buddies to coach students and teachers, allowing in work time skills building and site visits; these arrangements may need in work commitment from student mentors'.[164]

In addition to providing guest speakers and trainers, industry visits and work placements, there is an opportunity for industry to play a role in assisting schools (particularly those with limited resources) through providing access to computers and other ICT equipment—either donated, loaned or heavily discounted—and access to educational resources, including documentation, websites and software.

It is important to note that the success of any such existing or future school–industry partnership depends not only on the availability of suitable industry professionals, but also on the interest and participation of individual schools and teachers.

Case study: Group X—a partnership approach to increasing interest in ICT study

To increase the number of students studying ICT and considering a career in ICT, there needs to be a centralised, coordinated and targeted approach to promoting ICT careers to school students, their teachers and parents, before they have made their career choices. Based in Queensland, Group X is a consortium of universities, industry, research organisations and government dedicated to increasing interest in tertiary ICT study by debunking misperceptions of ICT careers, and supporting engagement activities intended to build and maintain interest in ICT.[165] Group X concentrates on the start of the ICT pipeline by targeting secondary school students, parents and teachers.

Group X promotes ICT careers through a range of activities that highlight the breadth, depth, and variety of opportunities. Activities include:

➢ involvement in career fairs, university open days and tech fairs

➢ developing promotional materials that highlight the positive aspects of ICT careers and profiling young ICT graduates

➢ a web presence with relevant and accessible materials, including information on career prospects and skills requirements (www.groupx.edu.au and www.ichoosetechnology.com.au)

➢ supporting other activities that stimulate interest in ICT such as SAP Young ICT Explorers, RoboCup, and First Lego League.

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163 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

164 IBSA, 2013, submission to AWPA ICT workforce study.

165 Group X members include the Queensland Government, NICTA, University of Queensland, Queensland University of Technology, Griffith University, University of Southern Queensland, Central Queensland University, James Cook University, AIIA, ACS, ACS Foundation, and industry.

In particular Group X seeks to support activities that reach out to students who do not have a pre-existing interest in ICT and might shy away from traditional 'ICT camps'.

Since the establishment of Group X in 2007, there has been an increase in ICT student numbers in Queensland. Group X is now oversubscribed as awareness of the project has grown among schools across the state, and many more requests for school engagement and activity support are being received than can be satisfied with current resourcing.

In Queensland the universities, industry and state government have cooperated by pooling funding and working together, and it is this willingness to work together coming from players in other jurisdictions that is at the root of making Group X effective on a national scale. Once the principle of sharing resources and collaborating is established, the remainder of the expansion process would be fairly straightforward.

The Australian Government recently announced that NICTA 'will be funded to lead a consortium that will develop programs to promote careers in ICT skills to school students'. The Australian Government will provide $6.5 million over four years for the Digital Careers initiative, which is a national rollout of the Group X program. The program will work with industry to complement the Australian Curriculum with peer tutoring, school-based traineeships and professional development for teachers. NICTA will also develop an app to provide ICT-specific information about education and careers in late 2013.[166]

Professional development for ICT teachers

All teachers of technology subjects need to have ready access to, and the incentive to undertake, ongoing, relevant professional development. According to Deakin University, for example, while there are many partnerships between the ICT industry and schools involving technical support and hardware provision, 'what is really required is more emphasis on Professional Learning, which is more frequently the province of partnerships between schools and universities'.[167]

Teacher associations and other stakeholders have stated that professional development for teachers is essential if the new technology curriculum is to be successfully implemented.[168] There is an opportunity for ICT industry associations to actively engage with both state and national agencies to support curriculum development and its implementation, and professional development. This is already happening in some jurisdictions. The Victorian Information Technology Teachers Association, for example, with the assistance of small government grants (through the Victorian Department of State Development, Business and Innovation), coordinates activities between schools and industry and organises industry visits for teachers to improve their appreciation and understanding of the industry and ICT careers. There are also a number of programs aimed at increasing and improving teachers' use of ICT in all aspects of

166 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 17.

167 Deakin University, 2013, submission to AWPA ICT workforce study.

168 Swinburne University of Technology, 2013, submission to AWPA ICT workforce study.

education. These include the now completed Teaching Teachers for the Future project, funded by DEEWR and the Australian Council of Deans of Education, which aimed to build the ICT teaching capacity of pre-service teachers in Australian universities.[169]

Teaching as a means of engaging secondary school students effectively in technology and STEM subjects

In May 2012, Australia's Chief Scientist, Professor Ian Chubb AC, delivered his report *Mathematics, Engineering and Science in the National Interest* to the Prime Minister. The report stressed the contribution of STEM skills to future productivity and prosperity and confirmed that in Australia, 'the proportion of mathematics and science students in schools still goes down; and in universities (as with engineering) it is virtually flat'. The report identified the efforts being made internationally to boost participation in STEM subjects at schools and in higher education, and called for Australia to follow suit, or be left behind. 'Something different has to be done demanding a paradigm shift.'[170]

The report found that while the international average for the ratio of STEM to non-STEM degrees was 26.4 per cent in 2002, in Australia the ratio in 2002 was 22.2 per cent, and by 2010 it was 18.8 per cent—'the fall reflecting the halving of graduations in Information Technology over that period'.[171] The Chief Scientist concluded that ensuring inspirational teaching by well-trained teachers is central to both increasing the level of mathematics, science and engineering graduates substantially, and increasing the level of scientific literacy in the community. When students are more engaged, they will learn more and be more inclined to pursue careers in mathematics, science and engineering. The report recommended that:

➢ teachers must be well trained and knowledgeable in their subject area and need to teach their area of specialisation. They need access to good teaching curriculums, inspiring leadership, and professional development and they need to be supported in their classrooms

➢ students, both male and female, need to be aware of and see value in STEM career pathways, including as mathematics and science teachers themselves, and be encouraged to pursue these pathways

➢ university courses should be innovative and of the highest quality and the pool from which mathematics and science teachers are drawn needs to be broadened

➢ the understanding of the importance of STEM to Australia's future needs be promoted and nurtured across the community.[172]

All of these conclusions, recommendations and strategies can be applied to the teaching and promotion of ICT.

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169 Teaching Teachers for the Future, www.ttf.edu.au, accessed 3 April 2013. See *Teaching Teachers for the Future final report*, www.acde.edu.au/pages/images/TTF%20Final%20Report.pdf, accessed 3 April 2013.

170 Office of the Chief Scientist, 2012, *Mathematics, Engineering and Science in the National Interest,* Australian Government, Canberra, p. 6. See also Lyons, T, Quinn, F, Rizk, N, Anderson, N, Hubber, P, Kenny, J, Sparrow, L, West, J, and Sue, S, 2012, *Starting Out in STEM: a study of young men and women in first year science, technology, engineering and mathematics courses,* report from the IRIS project prepared for Australia's Chief Scientist, University of New England, Armidale.

171 Office of the Chief Scientist, 2012, *Mathematics, Engineering and Science in the National Interest,* p. 6.

172 Ibid., p. 28.

In response to recommendations made by the Chief Scientist, the Australian Government announced the allocation of $54 million to support science, mathematics and engineering education, and the establishment of the position of Australian Science and Mathematics Education and Industry Adviser, located within the Office of the Chief Scientist, to promote the role of mathematics, science and statistics across education and industry.[173]

The Ai Group's March 2013 report, *Lifting our Science, Technology, Engineering and Maths (STEM) Skills*, stated that while 'STEM skills are essential to the future economic and social well-being for the nation … Australia's participation in STEM skills at secondary school and university are unacceptably low'.[174] The number of secondary students taking advanced mathematics fell by 27 per cent between 1995 and 2007, and the number of female students opting out of mathematics and science is also rising.[175]

In 2012, Universities Australia raised a number of concerns about the skills levels, and numbers, of first-year students in STEM, including that 'in too many schools STEM is still mostly science and mathematics taught separately with little or no attention to technology and engineering'.[176]

Ai Group has called for 'the establishment of an industry-led working group, in conjunction with the Office of the Chief Scientist, to develop a national framework and strategies to implement "school–industry" STEM skills initiatives and to support increased university and industry participation'. The initiatives would include career advice highlighting the importance of STEM skills for a wide range of occupations.[177]

In March 2013, the Australian Government announced a series of 'new standards for teacher training',[178] and the introduction of the Enhancing the Training of Mathematics and Science Teachers Program, based on the recommendations of the Chief Scientist,[179] to utilise the combined expertise of university mathematics, science and education faculties to assist in training teachers in mathematics and science, currently in short supply. In 2010, of the almost 73,000 students undertaking a graduate diploma in education, only 550 had undertaken previous undergraduate science study.[180]

If the very similar problems and issues facing the promotion and teaching of ICT subjects in schools are to be comprehensively addressed to increase the numbers of students going on to study ICT subjects at tertiary institutions, and consider a career in ICT, a similar paradigm

173 Office of the Chief Scientist, 2012, '$54 Million Commitment to Mathematics, Engineering and Science' (8 May), www.chiefscientist.gov.au/2012/05/54-million-committment-to-mathematics-engineering-and-science, accessed 25 March 2013. Dr Roslyn Prinsley took up this position in February 2013.

174 Ai Group, 2013, *Lifting our Science, Technology, Engineering and Maths (STEM) Skills*, p. 1, www.aigroup. com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/ Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf, accessed 25 March 2013.

175 Ibid.

176 Universities Australia, 2012, *STEM and non-STEM First Year Students,* cited in Ai Group, 2013, *Lifting our STEM Skills,* p. 3; Hoachlander, G, and Yanofsky, D, 2011, 'Making STEM real', *Educational Leadership*, vol. 68, no. 6, p. 60.

177 Ai Group, 2013, *Lifting our STEM Skills*, pp. 12–13; Willox, I, 2013, 'Boosting maths, IT skills adds up for economy', *Herald Sun* (29 March), www.heraldsun.com.au/business/boosting-maths-it-skills-adds-up-for-economy/story-fn7j19iv-1226608738561, accessed 23 April 2013.

178 Garrett, P, and Bowen, C, 2013, 'Higher standards for teacher training courses', joint media release (11 March), ministers.deewr.gov.au/garrett/higher-standards-teacher-training-courses, accessed 25 March 2013.

179 Office of the Chief Scientist, 2012, *Health of Australian Science*, Australian Government, Canberra; Office of the Chief Scientist, 2012, *Mathematics, Engineering and Science in the National Interest, Australian Government, Canberra.*

180 Office of the Chief Scientist, 2012, *Mathematics, Engineering and Science: In the National Interest,* p. 21.

shift is needed. The Australian Council of Deans of ICT (ACDICT) has called for ICT to be given greater recognition as an integral part of STEM, highlighting 'the enabling and central role of ICT throughout STEM disciplines'. ACDICT has called for the Enhancing the Training of Mathematics and Science Teachers Program to be extended to include improving the skills of teachers of ICT. According to ACDICT's President, Professor Leon Sterling:

> Government should address the issue holistically and consider alternatives to improve the teaching of ICT in secondary schools by providing adequate funding, as ICT is vital for the future well-being in Australia. Doing it for maths and science is only addressing part of the solution.[181]

However, since applications for this program closed in April 2013, AWPA recommends that the Australian Government establish a new program for ICT teachers along the lines of the Enhancing the Training of Mathematics and Science Teachers Program.

In addition, AWPA recommends that the Australian and state and territory governments, schools, the tertiary sector and relevant industry bodies work to enhance the quality of ICT teaching in schools through providing additional training and ongoing professional development for pre-service and current ICT teachers. Strategies should include developing and extending existing training programs, and offering scholarships or other financial support or incentives to enable and encourage teachers to undertake training. This should include the nationally accredited Vocational Graduate Certificate in Digital Education, developed by Innovation and Business Skills Australia. AWPA also recommends that the ACS Foundation expand its existing engagement with schools, including its school visit matching service, to develop a national program to provide curriculum materials, increased connections between industry and schools, and other support for ICT teachers and their students.

Recommendation 2

That the Australian Government, state and territory governments, tertiary education institutions and relevant industry bodies enhance the quality of ICT teaching in schools. Strategies should include the following:

a) that scholarships and/or VET FEE-HELP support be introduced to enable teachers and pre-service teachers to acquire additional qualifications and/or skill sets in ICT education, such as the nationally accredited Vocational Graduate Certificate in Digital Education

b) that the ACS Foundation broaden its focus on schools from its school visit matching service to the development of comprehensive support for technology teachers, including through the provision of relevant curriculum materials, the connection of students with relevant tertiary education providers, and the establishment of business mentors for interested students

c) that the Australian Government establish a program dedicated to enhancing the training of ICT teachers based on the existing Enhancing the Training of Mathematics and Science Teachers Program.

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181 Dinham, P, 2013, 'ICT lacking recognition says ACDICT', *iTWire* (18 April), www.itwire.com/it-policy-news/govenrment-tech-policy/59520-ict-lacking-recognition-says-acdict, accessed 18 April 2013.

The role of high-quality promotion and career development advice

Submissions to AWPA from post-secondary education providers and industry groups alike expressed widespread concern that schools (teachers, students and career counsellors) as well as parents do not have a clear idea about the range of possible careers in ICT. It was submitted that early education is the vital target group for instilling a preference for ICT careers, and that industry can play a greater role in promoting ICT careers in schools. Industry can play a major role in providing students, and their parents, with information highlighting the fact that ICT careers involve much more than just working with, or on, a computer. They can do this through involvement in school careers fairs, provision of work-integrated learning opportunities, and serving on advisory boards.[182]

While enhanced career promotion will provide students and their parents with information about the possibilities afforded by a career in ICT, there is also a need for high-quality, coordinated and well-resourced career development advice in all schools. There is an opportunity for industry groups and tertiary providers to work more closely with school career advisers (through existing networks such as the Career Industry Council of Australia, the national peak body for the career industry, and the National Association of Graduate Careers Advisory Services), and DEEWR, to develop a coordinated approach to delivering up-to-date information on the range of choices offered to students contemplating a career in ICT or in ICT-related fields.

The ICT Skills app being developed by NICTA, which matches students' interests with particular occupations and the relevant tertiary and TAFE ICT courses, could provide a useful tool for this purpose, along with information on ICT courses and outcomes offered on DEEWR's Jobguide website,[183] aimed at Year 10 students, and the Myfuture website,[184] a joint initiative of the Australian Government and state and territory governments. This specific ICT career development information could feature courses or programs with particular specialities, targeted programs for women or Indigenous students, and those that incorporate work-integrated learning (WIL) and other value-adding programs.

Students and their parents need to be informed about the value of WIL programs to an ICT course of study, and provided with up-to-date information on the various programs available.[185] It is important that this coordinated approach to ICT career development advice in schools continues into the tertiary environment, enabling students to make informed decisions about course selection. This information—including the benefits of WIL programs—could be featured on the Australian Government's My Skills website,[186] which provides information about VET and registered training organisations, and the Ausralian Government's MyUniversity website.[187]

Research confirms that students respond well to the opportunity to speak to people already engaged in vocations they are considering. Students consider work placements with ICT companies, scholarships and expos to be the most effective means of promoting ICT careers.[188]

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182 Deakin University, 2013, submission to AWPA ICT workforce study.

183 DEEWR, *Job Guide*, www.jobguide.thegoodguides.com.au, accessed 1 May 2013.

184 Myfuture, www.myfuture.edu.au, accessed 1 May 2013.

185 See Chapter 4 for discussion on the value of work-integrated learning.

186 My Skills, www.myskills.gov.au, accessed 1 May 2013.

187 MyUniversity, myuniversity.gov.au, accessed 1 May 2013.

188 Department of Innovation, Industry and Regional Development, Victoria, 2009, *Attitudes to ICT careers and study among 14 to 19 year old Victorians,* pp. 7, 28.

During consultations conducted for this report, a range of strategies were raised for improving the exposure of school students to ICT careers, including developing schemes like the Scientists and Mathematicians in Schools program[189] (funded by DEEWR) to explicitly include ICT professionals, utilising dynamic ICT graduates working in the industry, exposing more students to the ICT industry through work experience opportunities and undertaking ICT projects for real clients, for example website development and prototyping, as part of their assessment.

The Australian Government's National Career Development Strategy, announced on 23 May 2013, includes $800,000 in extra funding for the Scientists and Mathematicians in Schools program to 'focus on partnerships that support real world experiences that showcase ICT careers for students and teachers'.[190] AWPA welcomes this initiative and recommends that the Australian Computer Society, the Australian Information Industry Association, other ICT industry bodies, and all ICT enterprises encourage ICT professionals to utilise this program to actively engage with students and teachers in the classroom and to showcase careers in ICT.

In addition, to build momentum around school visits and open up the opportunities to more schools and students, AWPA recommends that ICT professionals be encouraged to attend school career nights and expos as part of the Australian Computer Society's continuing professional development program. Where appropriate, this industry engagement should extend to innovative engagement strategies such as the use of social media.

Recommendation 3

That strategies be adopted to improve the exposure of school-aged students to ICT professionals. Strategies should include the following:

a) that the Australian Computer Society and the Australian Information Industry Association promote the benefits to ICT professionals of participating in the Australian Government's recently announced extension of the Scientists and Mathematicians in Schools program to showcase ICT careers, and encourage ICT professionals to visit schools to discuss their exciting careers and engage with students and teachers in ongoing discussion through social media, blogs and forums

b) that the Australian Computer Society include visits by ICT professionals and ICT researchers to school career nights and expos—and other innovative engagement strategies such as the use of social media—on the schedule of activities for the continuing professional development of ICT professionals.

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189 Scientists in Schools, www.scientistsinschools.edu.au, accessed 3 April 2013; Mathematicians in Schools, www.mathematiciansinschools.edu.au, accessed 3 April 2013.

190 Garrett, P, 2013, '$6.1 million to kick-start careers', media release (23 May), ministers.deewr.gov.au/garrett/61-million-kick-start-careers, accessed 24 May 2013.

Encouraging more women to study ICT and to consider careers in ICT

Internationally, the decline in numbers and visibility of women in ICT professions is coupled with a growing deficit of skills to fill vacancies across the sector. This has led to renewed interest in attracting more women into the ICT skilled labour force through more targeted programs.[191]

In addition to the benefits of increasing the pool of potential ICT professionals, the literature on ICT and women's levels of participation emphasises the benefits of diversity in strengthening the work environment and increasing productivity. A recent report by the Australian Human Rights Commission echoed these findings, noting that the benefits of increasing gender diversity in male-dominated industries included higher customer satisfaction, greater productivity and higher profitability.[192]

In the United States, according to Girls Who Code—a non-profit organisation launched in 2012 working to close the gender gap in the technology and engineering sectors—women now represent 12 per cent of all computer science graduates, a fall from 37 per cent in 1984.[193] While 74 per cent of girls in middle school express an interest in STEM subjects, when choosing a college major, just 0.3 per cent of female secondary school students select computer science.[194] The founders of Girls Who Code have estimated that 'it will take 4 million girls learning to code to reach gender parity in the computer science field by the end of the decade, and they've committed to doing their part: using the Girls Who Code program to train 1 million girls by 2020'.[195]

Girls Who Code is one of a growing number of recent programs with strong industry support established to close the gender gap in technology through early intervention before young female students have decided what they want to study. Microsoft's DigiGirlz initiative, for example, is a global outreach program aimed at female secondary school students, comprising one-day DigiGirlz events held around the world (including one in North Ryde, Sydney, in April 2012), camps and online classes.[196] A number of similar initiatives have been developed in the United Kingdom.[197]

While these programs target female students, they are part of a wider movement—with strong industry support—to recruit more young people to technology, by making the subject both exciting and relevant. In the United States, Mark Zuckerberg and Bill Gates are among the high-profile supporters of Code.org (discussed later in this chapter). It is worth noting that many

191 International Telecommunication Union, 2012, *A bright future in ICT. Opportunities for a new generation of women*, p. 6, girlsinict.org/trends-analysis-and-profiles/bright-future-icts-opportunities-new-generation-women, accessed 6 March 2013.

192 Australian Human Rights Commission, 2013, *Women in male-dominated industries: A toolkit of strategies*, www.humanrights.gov.au/sites/default/files/WIMDI_Toolkit_2013.pdf, accessed 24 May 2013.

193 Girls Who Code, www.girlswhocode.com, accessed 3 April 2013. See also Cain Miller, C, 2013 'Opening a Gateway for Girls to Enter the Computer Field', *New York Times* (2 April), dealbook.nytimes.com/2013/04/02/opening-a-gateway-for-girls-to-enter-the-computer-field/?ref=technology, accessed 3 April 2013.

194 Girls Who Code, www.girlswhocode.com.

195 Girls Who Code, 2013, 'A million girls coming to a computer science class near you', press release (3 March), www.girlswhocode.com/a-million-girls-coming-to-a-computer-science-class-near-you, accessed 3 April 2013.

196 DigiGirlz, www.microsoft.com/en-us/diversity/programs/digigirlz/default.aspx, accessed 3 April 2013.

197 See, for example, the Little Miss Geek initiative, littlemissgeek.org, accessed 3 April 2013.

of the programs designed to attract more young women to technology careers might also be useful in attracting a wider range of young men to the profession.

In Australia, there have been a number of initiatives established to encourage more young women to consider careers in ICT, including the Digital Divas program, funded by the Australian Research Council from 2009 to 2011. Other initiatives include *Go girl, go for IT*, a career showcase run by the Victorian ICT for Women Network for female students in Years 8 to 11.[198] Programs specifically targeting young women are also offered by a number of universities, including the University of Sydney's National Computer Science School's Girls' Programming Network,[199] and ICT enterprises, including IBM's EXITE (EXploring Interests in Technology and Engineering) camps for female students in Years 8 to 10. IBM has held EXITE camps annually since 2001, and they are now held in collaboration with state departments of education.[200]

Case study: Digital Divas—exciting girls' interest in ICT

Digital Divas was the first program of its kind in Australia, providing curriculum modules designed to excite girls' interest in ICT, written to match learning outcomes for students in Years 8 to 11. The program was initially funded by an Australian Research Council Linkage Grant (2009 to 2011) and run in partnership between Monash University, Swinburne University of Technology and Deakin University, the Victorian Department of Education and Early Childhood Development, the Australian Computer Society, the Victorian ICT for Women Network and Brentwood Secondary College.

The Digital Divas curriculum modules were developed to promote group work and collaboration in the classroom, where teaching was supplemented by placing university ICT students (Expert Divas) in the class to work with teachers to challenge the stereotype that only boys study ICT. Each school was visited by a young female ICT professional to connect the activities completed in the modules with the ICT career path.

The project was run in 10 Victorian schools, eight of which were co-educational, and one Sydney girls' school. Most of the schools were in the government sector. The majority of the schools continue to run the program and the curriculum is now freely available through a website (www.digitaldivasclub.org), and has also been distributed widely through mailing lists to Victorian ICT teachers through the Victorian Information Technology Teachers Association mailing list. The Faculty of ICT at Swinburne University of Technology has made a commitment to support any new school initiating the program by providing Expert Divas from the Women in ICT student group and is supporting one country school starting the program in 2013.

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198 Go girl, go for IT, gogirl.org.au, accessed 8 May 2013.

199 National Computer Science School, *Girls' Programming Network,* www.ncss.edu.au/gpn/index.html, accessed 8 May 2013.

200 IBM, *Diversity in IBM, Advancing Women*, www-07.ibm.com/employment/au/diversity/women.html, accessed 8 May 2013.

Initial analysis of the program indicates that the students enjoyed the curriculum, the stereotype of an ICT professional working alone was significantly decreased, students gained a better understanding of the range of careers in IT, and 61 per cent of the students answered they were more likely to consider a career in ICT. An initial finding is that the classroom teacher had an enormous impact on how successful the program was in particular schools, and this has led Swinburne and Deakin universities to further collaborate and successfully win two other grants to run outreach programs to provide upskilling in aspects of ICT teaching, particularly to challenge the need for teachers to be the repository of knowledge and encourage student-led learning in their classrooms.

The major drawback is that many co-educational schools are not willing to run girls-only classes despite strong evidence that female attitudes to ICT wane considerably during secondary school.

3.3 Developing positive, assertive and inclusive promotional vehicles for ICT careers

It is clear that no single strategy will provide a remedy for the range of skill supply issues outlined in this chapter. Curriculum development, targeted professional development for teachers of STEM and technology, increased industry involvement with students and support of teachers, the promotion of a more positive perspective on ICT careers, and encouraging more female students to consider a career in ICT all require distinct, innovative strategies.

There is an opportunity for the ICT industry to work with creative marketing and advertising professionals to develop an ICT branding and marketing campaign together with a suite of coordinated, targeted ICT career promotion products for different cohorts and audiences (for example, youth, mature-aged workers, women and parents), demonstrating how ICT skills can be an enabler across a range of careers, and make a difference in a range of sectors.

Building on the promotional work already undertaken by industry associations, state and federal government agencies, education providers, technology companies and others, and noting and drawing on creative and successful international campaigns, there is an opportunity for the industry to promote an assertive, positive message about ICT that taps into youth culture and the widespread adoption and interest in technology, gaming, social media and so on, and has a presence across all media and platforms.

As well as emphasising the creative aspects of working in technology and using technology to create solutions to existing, developing and future problems across all industries and all aspects of society, it is important to highlight that much ICT work takes place in teams collaborating on projects, that is, it is not just sitting alone in front of a computer or working on a help desk. In addition, learning computer science builds critical thinking and skills in problem solving that can be applied to other subjects in the classroom and beyond.

The recent launch of Code.org, the US non-profit foundation dedicated to growing computer programming education, suggests one possible model for an Australian ICT industry promotional vehicle. Code.org's slick promotional film 'What Most Schools Don't Teach' has

had more than 10 million views on YouTube alone since its release in February 2013.[201] The Code.org website also serves as a portal where teachers and students can connect to online resources.

In Australia, the ACS Foundation has developed a series of online videos, *Start Here, Go Anywhere* (March 2013), featuring young graduates as well as more experienced ICT professionals describing their work and the possibilities offered by a career in ICT. Other similar promotions include the Victorian Government's *Careers that Inspire* promotional video made in conjunction with NICTA,[202] and the ichoosetechnology.com.au and Group X websites. The Group X website offers a range of resources and has the potential—if Group X can be expanded into a national resource—to become the platform for a web-based national ICT promotion. A focus on computer game design and development, drawing on projects like the 'R U Game?' competition run by the University of Ballarat and University of Tasmania, would also be of value.

It may also be useful to consider how other sectors have successfully rebranded themselves and their products or services, and other effective sector-specific advertising campaigns, such as the campaign created for the mining industry.

AWPA recognises the need for the ICT industry to better promote ICT as a course of study and as an exciting and valued career, and recommends that consideration be given to an industry-wide rebranding of ICT in Australia. AWPA recommends that the ICT industry work with creative marketing and advertising professionals, building on existing resources such as those developed for Group X, and drawing on creative and successful international campaigns such as Code.org, to develop coordinated ICT branding and marketing campaigns aimed at a range of target audiences. Working with these groups (youth, young women, parents, female workers, mature-aged workers), the industry can develop a suite of targeted careers promotion products demonstrating how ICT skills can be an enabler across a range of careers, and make a difference in a range of sectors.

Recommendation 4

That National ICT Australia, the Australian Information Industry Association and the Australian Computer Society develop a suite of targeted careers promotion products for different cohorts and audiences (for example, youth, mature-aged workers, women and parents), to demonstrate how ICT skills can be an enabler across a range of careers, and make a difference in a range of sectors. These products should have a presence across all media and platforms, including widely adopted tablet and smartphone apps, gaming and social media.

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201 Code.org, www.code.org, accessed 27 February 2013.

202 Victorian Government and National ICT Australia, *Careers that Inspire,* video, www.youtube.com/watch?v=naxXti7ZAaU&list=UUipK40A0MfVPt0a6IArthng&index=13, accessed 20 March 2013.

Conclusion

ICT—as a career, a course of study and an industry—is suffering from an image problem at a time when the need for skilled ICT professionals has never been greater. To increase the supply of enthusiastic, skilled ICT graduates, the ICT industry must invest in better promoting ICT as a career, and work with the Australian Government, schools, and the tertiary education sector to develop creative and engaging approaches to ICT education at all levels.

Chapter Four: Ensuring the supply of high-quality ICT skills

Introduction

This chapter provides an overview of ICT tertiary provision in Australia and details a series of recommendations to support the tertiary education system to provide competent, confident, work-ready graduates in collaboration with industry.

Australian tertiary providers deliver an array of programs that prepare individuals for entry into a range of ICT occupations. There is considerable crossover between VET and higher education providers, with several dual-sector institutions developing pathways from higher-level VET qualifications to undergraduate degrees, and a number of registered training organisations providing undergraduate programs. In addition, ICT-intensive skills are now delivered across a range of academic disciplines and areas of study, in response to the increasing influence and importance of ICT across a range of industry sectors.

As stated throughout this report, despite recent positive trends, the work readiness of domestic ICT graduates is not sufficient to meet industry demand for ICT-intensive skills, and the skilled migration program continues to form a key source of supply for ICT skills. Some industry stakeholders also indicate dissatisfaction with the quality of domestic ICT graduates. Employers demanding ICT-intensive skills consistently report that many graduates are not sufficiently work ready and do not possess the combination of technical, business and communication skills required to work at the required level. AWPA suggests that work-ready graduates cannot be produced unless employers work closely with tertiary providers on course content, and participate readily in work-integrated learning (WIL) programs.

Employers and students alike identify the integration of meaningful professional experience into tertiary programs as the best way to address this issue. VET qualifications are heavily industry focused, as they are drawn from training packages that are shaped by extensive, annual industry consultation. In addition, training providers are encouraged to conduct student assessments under workplace conditions. While work placements are not mandatory in demonstrating competence, providers look for opportunities for students to have real work experiences that can also be used to assess performance.[203] A range of innovative and well-supported approaches to WIL are available for ICT students across Australian universities, including final-year work placements, short-term internships and industry-based projects. While substantive evidence on the merits of particular projects is thin on the ground, industry and student feedback indicates that the experience gained through these programs enables students to connect theoretical knowledge to the practical application of skills and significantly enhances the communication and business skills, or soft skills, of students.

A range of strategies are proposed in this chapter to enhance the provision of ICT skills by the Australian tertiary education sector. Issues with the quantity of graduates can be addressed by expanding the provision of digital literacy skills across a range of tertiary programs, and for

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203 IBSA, 2013, Submission to AWPA ICT workforce study.

ICT-intensive skills, creating an intensive conversion program to enable graduates across a range of disciplines to acquire high-level ICT skills quickly. In relation to the quality of graduates, WIL programs can be improved through conducting a detailed evaluation of different approaches to WIL, engaging more small to medium-sized enterprises in these programs, clarifying the link between WIL programs and learning outcomes, and identifying additional sources of program funding. In the VET sector, the creation of an apprenticeship/traineeship pathway for ICT technicians and trades workers would allow domestic VET students to access a valuable employment pathway.

4.1   Overview of tertiary provision

Australian tertiary education providers deliver a range of ICT-related courses, from courses that support the development of ICT-intensive skills in computer programming and software and applications development, to programs focused on the technical skill sets required to support the testing, development and maintenance of ICT infrastructure, to an emerging array of study options that facilitate the development of sector-specific ICT skills in areas ranging from health informatics to the automation of mining operations. As indicated in Chapter Two, demand for professional, technical and managerial ICT workers is expected to increase over the next five years, and the supply of a range of ICT skills will be vital to innovation and productivity gains across a range of industry sectors.

For many ICT occupations, there is no clear concordance to a particular university degree or VET qualification. Rather, there are multiple pathways along which people may enter an ICT Professional occupation. There has been growth in demand for all ICT Professional occupations over the past 10 years (see Figure 5 in Chapter Two), and bachelor degree and higher-level qualifications appear to be an entry requirement for some of these occupations but not for others. However, these qualifications are not always specific to ICT. In fact, the fields of education (at degree level or higher) of ICT Professionals are diverse, including information technology (approximately 67 per cent), engineering and related technologies (21.3 per cent) and management and commerce (12 per cent).[204]

Higher-level qualifications (undertaken after completion of a bachelor degree) play an important role in facilitating entry to particular ICT professions. For instance, 30 per cent of Telecommunications Engineering Professionals have postgraduate degrees or graduate diplomas or certificates, compared to 17 per cent of ICT Professionals overall.[205]

Alongside formal qualifications, vendor certifications are key requirements for many ICT workers. These certifications are often delivered through academies hosted by particular tertiary education providers. There are a range of academies that support emerging technologies, including Microsoft, Cisco, VMware, Citrix and EMC academies. All of these programs ensure that students are taught key industry skills, and provide an additional certification which is a key differentiator for students entering the job market and establishing ICT careers.[206] These certifications are essential for employees working with particular ICT programs, products and services. Vendor certifications are often integrated with, and mapped

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204 DEEWR, 2013, *ICT Labour Market Indicators*, slide 14.
205 Ibid., slide 13.
206 Boxhill Institute of TAFE, 2013, submission to AWPA ICT workforce study.

to, VET qualifications, but they are not as commonly provided with university degrees. Some stakeholders argue for a greater focus on vendor certifications in ICT degrees to prepare students to work with particular products; others suggest that universities should direct attention to transferable skills that can be applied across a range of settings and to a range of products.[207]

Of course, skills development does not stop with the completion of a university degree, VET qualification or industry certification. The skills profile of the typical ICT worker is constantly evolving due to skills obsolescence and the emerging demand for different combinations of skills. This means that the maintenance and upgrading of skills and competencies in specific, technical areas is a constant process for ICT workers. These issues are explored further in Chapter Five.

Provision of ICT education by higher education providers

The majority of Australia's 39 public universities provide ICT-related courses. These courses are found both within specialised ICT or IT faculties, and in related disciplines including business, health, engineering and the arts.[208] A range of types of universities deliver these courses, including dual-sector institutions that offer pathways and articulation arrangements to allow students to progress from VET qualifications to higher degrees.[209] There are also graduate certificate and graduate diploma qualifications available to enable students in other fields to gain specialist ICT skills.[210]

As indicated in Chapter Two, enrolments in ICT higher education degrees have marginally but steadily increased in recent years. This trend is encouraging, especially if these enrolments translate into higher completion figures over the next three to four years.

The Australian Computer Society (ACS) is responsible for the professional accreditation of ICT degrees. The ACS has accredited more than 950 education programs at a range of Australian universities and a number of registered training organisations that provide higher education degrees in ICT.[211] The ACS works closely with the Tertiary Education Quality Standards Agency to align its certifications with national standards. Completion of an accredited ACS university degree also enables graduates to achieve ACS professional certification status.[212] Accordingly, the ACS maintains that the key objective of its accreditation processes is to assist educational institutions to provide 'students [with] the appropriate preparation for professional practice in ICT'.[213]

207 Pennington, S, 2012, 'This lecture proudly brought to you by ...', *Sydney Morning Herald* (6 December), www.smh.com.au/it-pro/cloud/this-lecture-proudly-brought-to-you-by--20121206-2awwp.html, accessed 10 March 2013.

208 Graduate Careers Australia, 2010, *Careers in Information & Communications Technology (ICT)*, p. 8, www.graduatecareers.com.au/wp-content/uploads/2011/12/careers_in_information_and_co.pdf, accessed 13 March 2013.

209 Ibid.

210 Ibid.

211 ACS, *Accredited Courses,* www.acs.org.au/careers-and-employment/accredited-courses, accessed 13 March 2013.

212 Ibid.

213 ACS, 2013, 'ACS Accreditation and TESQA', presentation, B-HERT Business/Higher Education Roundtable, National ICT Forum, Swinburne University of Technology, 13 March, www.acdict.edu.au/documents/Accreditation-ALTA-April2013.pdf, accessed 14 March 2013.

In relation to professional development for ICT academics, the Australian Council of Deans of ICT plays a major role. In particular, the council's Learning and Teaching Academy supports professional development through networking, collaboration and cooperation. The academy convenes learning and teaching forums and provides annual grants to support both learning and teaching and engagement between institutions.

Provision of ICT education by VET providers

ICT-relevant qualifications are delivered by public and private registered training organisations across Australia. These qualifications are drawn from two training packages:

➢ The Information and Communications Technology training package includes qualifications and units of competency across a range of aspects of the ICT industry.

➢ The Integrated Telecommunications training package includes qualifications and units of competency across a range of aspects of the telecommunications industry.

Innovation and Business Skills Australia (IBSA) engages in the continuous improvement of training packages to ensure that the qualifications and units of competency within them are meeting industry skills needs. This review process often results in the development of new units of competency. For example, in 2012 IBSA commenced a project to identify and update existing units of competency and to develop new units related to cloud computing in the Information and Communications Technology training package.[214]

Both of these training packages include qualifications that are integrated with particular industry certifications. IBSA notes that 'it is advantageous that the workforce achieves both the Training Package qualification and the IT vendor qualification', and that the integration of IT vendors and training package units of competency is continuing.[215] Box Hill Institute of TAFE notes in its submission to AWPA that 'many industry certifications have direct employment benefits'. For example:

> If a Diploma in Computer Systems student completes the Cisco Certified Network Administrator (CCNA) as part of its program, and then sits and passes the industry certifications exams to become certified, it dramatically increases their employability, as these certifications are often mandatory requirements to many entry level jobs. The certifications are also internationally recognised, providing a greater opportunity of employment mobility.[216]

A range of submissions provided to AWPA highlight the impact of state and federal reforms in VET funding models on ICT qualifications. For example, the submission provided to AWPA by the Australian Council for Private Education and Training notes that the rate of funding provided by the Victorian Government per student contact hour for the Certificate IV in Information Technology

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214 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 18.
215 Ibid., p. 26.
216 Box Hill Institute of TAFE, 2013, submission to AWPA ICT workforce study.

was reduced in May 2012, which has increased the cost for students seeking to undertake this important qualification.[217]

The quality of VET teaching is also a key issue. IBSA identifies the attraction of suitably qualified VET practitioners as 'a perennial challenge' due to the comparative wage benefits of positions in industry, and the attractiveness of work compared to VET teaching.[218] The recently endorsed Vocational Graduate Certificate in ICT Education is a valuable resource for the professional development of the ICT teaching workforce.

4.2   Perceptions and experiences of ICT tertiary education

Industry expectations of ICT graduate competencies have changed considerably in recent years. The evolution of ICT into mainstream business operations across a range of industry sectors has expanded the range of skills required of ICT workers. Many businesses demand flexible generalists rather than narrow specialists—so-called 'T-shaped' professionals with deep expertise across a broad range of skill sets.

The ability of ICT workers across a range of occupations to promote, explain and support particular ICT programs, products and services to businesses has emerged as a key requirement. The focus has changed from asking businesses to articulate what they want in relation to ICT goods and services, to the development of a business relationship that leads to the development of a sophisticated response to specific industry needs. Working in this way requires ICT workers to display an array of business and communication skills.

Many industry stakeholders identify a gap between these skills requirements and the capabilities of ICT graduates. Claims that Australian ICT graduates are not work ready are frequently cited. Researcher Chris Pilgrim identifies widespread views of 'common deficiencies in the workplace readiness of new graduates particularly regarding the development of essential generic skills such as interpersonal and professional communications, business awareness and problem-solving abilities'.[219] Some stakeholders have formed the view that business and management competencies should form part of all degrees and qualifications, since 'the days of an IT career spent sitting in a back office are over, at least in the commercial sector'.[220]

In its submission to AWPA, Deakin University argues that the most successful ICT courses at Australian universities are double degrees that include both technical and soft skills, including programs that combine business and ICT qualifications, and single degrees that involve particularly extensive work-integrated learning components.[221] While there are many successful

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217 Australian Council for Private Education and Training, 2013, submission to AWPA ICT workforce study. Funding was reduced in 2012 for the majority of VET courses in Victoria with exceptions for apprenticeships and foundation courses (Department of Education and Early Childhood Development, 2012, *Refocusing vocational training—course subsidy list*, p. 1. www.education.vic.gov.au/Documents/about/department/coursesubsidylist. pdf, accessed 12 June 2013).

218 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*.

219 Pilgrim, C, 2012, 'Industry and university perspectives of work integrated learning Programs in ICT Degrees', *ACIS 2012: Location, location, location: Proceedings of the 23rd Australasian Conference on Information Systems 2012,* ACIS, Geelong, p. 1.

220 Withers, S, 2012, 'Fixing the ICT skills shortage in Australia and New Zealand', *Voice + Data* (13 March), www.voiceanddata.com.au/articles/51791-Fixing-the-ICT-skills-shortage-in-Au, accessed 29 October 2012.

221 Deakin University, 2013, submission to AWPA ICT workforce study.

examples of the former, several universities inform AWPA of difficulty sustaining sufficient enrolment levels in these courses. Work-integrated learning is considered in detail later in this chapter.

ICT continues to rate poorly on the list of preferred university courses for students applying for university places. In both 2011 and 2012, the broad field of information technology yielded the second-lowest number of highest preference applications out of 10 fields of education.[222] As outlined in Chapter Three, part of the reason for these low numbers is likely to relate to the poor status of ICT careers. However, there is some evidence that the degrees themselves, and the pathways they lead to, are less than satisfactory for many students. In 2011, only 68.4 per cent of information technology graduates believed that their qualifications were important to their main paid job, the second-lowest figure out of the 10 broad fields of education.

Like employers, the majority of students appreciate the value of integrating meaningful professional experience into degree programs. In responses to a recent survey, students requested 'greater industry involvement in learning and teaching, up-to-date practical and relevant industry-based technologies and practices, real-life examples, and business knowledge to industry'.[223]

Given the universal benefits of professional experience outlined above, the onus is on employers to work with tertiary providers to provide these opportunities to students, including the provision of funding and in-kind support where required, and thus develop a pool of competent, confident, work-ready graduates.

4.3   The role of temporary and skilled migration

Alongside the supply of skills from tertiary education, skilled migration is currently a vital source of skills for the Australian ICT industry. While this report is primarily focused on maximising the supply of ICT skills through the domestic Australian tertiary sector, it is worth touching on the important contribution of migrants to the Australian ICT sector.

As indicated in Chapter Two, the contribution of temporary skilled migrants to meeting demand for ICT Professionals has increased significantly in recent years (Figure 13). The number of primary subclass 457 visas granted for ICT Professionals increased by 74 per cent from 2009–10 (5,327 granted) to 2011–12 (9,271 granted). In 2011–12, ICT Professionals represented 13.5 per cent of total primary subclass 457 visa applications granted, including three of the top 12 nominated occupations. Net migration also grew by 14 per cent from 2009–10 (5,955 workers) to 2011–12 (6,761 workers). Growth is much slower for domestic completions for ICT Professionals over this period—a 4 per cent increase from 2009 (4,335) to 2011 (4,497).

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222 Department of Industry, Innovation, Science, Research and Tertiary Education, 2012, *The demand driven system: Undergraduate Applications and Offers, February 2012,* p. 11, www.innovation.gov.au/HigherEducation/ResourcesAndPublications/Documents/HEReports/UndergradAppandOffers_Feb2012.pdf, accessed 13 March 2013.

223 Koppi, T, Edwards, S, Sheard, J, Naghdy, F, and Brookes, W, 2010, 'The case for ICT work-integrated learning from graduates in the workplace', *Proceedings of the Twelfth Australasian Computing Education Conference,* Australian Computer Society, Brisbane, p. 114, dl.acm.org/citation.cfm?id=1862235&dl=ACM&coll=DL&CFID=155510618&CFTOKEN=85907580, accessed 12 March 2013.

The low numbers of domestic students engaged in ICT education is not the only reason for this increase in demand for overseas workers. As indicated in the previous section, many employers claim that domestic ICT graduates do not always satisfy business skills requirements. In its submission to AWPA, the Australian Computer Society outlines its support for skilled migration 'where there are domestic skill shortages exacerbated by a lack of students studying ICT, work-readiness issues regarding graduates and barriers to retraining for older workers'.[224]

In addition, the global marketplace for ICT skills means that, in some cases, very specific skills requirements can more easily be met by specialists from overseas. For example, businesses working with particular programming languages may encounter difficulty finding specialists in the Australian job market.

It is likely that temporary and permanent skilled migration (see Chapter Two) will continue to play a significant role in meeting demand for ICT Professionals in coming years. In this context, efforts to improve the work readiness and ongoing employment prospects of domestic ICT workers will be particularly important. In its submission to AWPA, the Association of Professional Engineers, Scientists and Managers, Australia states that:

> skilled and temporary migration in ICT should occur in the context of interventions which assist with reducing attrition rates from tertiary ICT courses, adequate professional development for Australian-based ICT professionals and enterprise-based strategies to ensure optimal retention of ICT specialists in the profession.[225]

Employers drawing labour from the temporary migration program must demonstrate to the Department of Immigration and Citizenship that they fulfil training requirements. The employer must show that it has made a contribution to training Australian workers, usually through the payment of a percentage of the payroll to an industry training fund or other training provider and a commitment to maintain this training expenditure.[226] In addition, employers must employ subclass 457 visa holders in accordance with applicable Australian workplace law and pay the market salary, which must be at least the temporary skilled migration income threshold (currently $51,400, with an annual update expected on 1 July 2013). Improving the commitment of ICT multinational companies to building domestic supply is worth aspiring to. The Australian Computer Society, which conducts ICT skills assessments for prospective migrants, also has a key role to play here. It could work with relevant organisations to support workforce development strategies to build the commitment of multinational companies to domestic skills supply, and thus reduce reliance on temporary overseas skilled labour over time.

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224 ACS, 2013, submission to AWPA ICT workforce study.

225 APESMA, 2013, submission to AWPA ICT workforce study.

226 Department of Immigration and Citizenship, *Employer sponsored workers: Temporary Work (Skilled)—Standard Business Sponsorship (Subclass 457),* www.immi.gov.au/skilled/skilled-workers/sbs/eligibility-employer.htm, accessed 5 June 2013.

4.4 Improving the delivery and enhancing the contribution of work-integrated and industry-based learning

There is broad consensus among students, academics and industry on the value of professional experience, in relation to both the quality of the student experience and students' subsequent employment prospects. This section proposes strategies to enhance the scope, reach and efficacy of professional experience programs in tertiary ICT programs.

Professional experience is a central component of many VET ICT programs. Such programs are industry focused and directed, and the qualifications are reviewed annually following a national industry consultation process. Innovation and Business Skills Australia acknowledges that 'while work placements are not mandatory in demonstrating competence, providers are increasingly looking for opportunities for students to have real work experience that can also be used to assess performance'.[227] Providers must also incorporate soft skills, technical skills and a range of employability skills into all courses.[228]

As noted in Chapter Two, apprenticeships and traineeships—the VET qualifications that are most geared towards industry experience—have achieved poor traction in the ICT sector. The following section proposes strategies that are aimed at building an ICT apprenticeship/ traineeship pathway.

Universities, which deliver the majority of higher education degrees, are highly autonomous institutions and not subject to the same process of centralised regulation as VET courses. However, higher education institutions are subject to the registration guidelines of the Tertiary Education Quality Standards Agency. In addition, the majority of higher education institutions submit their degree programs to the Australian Computer Society, which is the recognised accrediting body for ICT courses in Australia. Although the ACS guidelines do not mandate professional experience as an essential component of programs, the ICT Profession Body of Knowledge framework, a key supporting document for the accreditation process, lists the following as an underlying principle:

> practical work, as in project work or industry placements, is required at some point in programs of study so that learning of applied skills and knowledge can be fully developed.[229]

Professional experience in ICT higher education degrees (and across many fields of education) is typically delivered through various forms of work-integrated learning (WIL). WIL is defined in a 2009 report as 'an umbrella term for a range of approaches and strategies that integrate theory with the practice of work within a purposefully designed curriculum'.[230] WIL 'includes industry placements, internships, industry projects and other methods and approaches that aim to enhance the professional practice capabilities of students'.[231] This array of approaches

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227 IBSA, 2013, submission to AWPA ICT workforce study.

228 Ibid.

229 ACS, 2012, *The ICT Profession Core Body of Knowledge*, p. 7, www.acs.org.au/__data/assets/pdf_ file/0007/7792/The-ICT-Profession-Body-of-Knowledge.pdf, accessed 10 April 2013.

230 Patrick, C, Peach, D, Pocknee, C, Webb, F, Fletcher, M, and Pretto, G, 2008, *The WIL (Work Integrated Learning) report: A national scoping study,* final report, Queensland University of Technology, Brisbane, p. iv.

231 Pilgrim, C, 2012, 'Industry and university perspectives of work integrated learning Programs in ICT Degrees', p. 1.

reflects 'the diversity of students' capabilities, motivations and interests as well as different university resourcing models and priorities'.[232]

AWPA highlights the value of WIL in the 2013 National Workforce Development Strategy.[233] WIL enables students to put university learning into practice, and to consider the connections between different aspects of their university studies.[234] WIL is also beneficial for the development of soft skills in communication, teamwork and leadership.[235] A recent survey demonstrated that graduates with professional experience value and demonstrate skills in 'communication, problem solving and teamwork more so than graduates without work experience'.[236] And businesses stand to benefit as well:

> Workplaces get an injection of new talent and new ideas and employers develop links with education institutions and other providers. This gives industry the opportunity to contribute to curricula and pedagogy. Firms may also benefit by establishing networks of experienced potential recruits, from student feedback on workplace practices, and through opportunities for existing staff to gain supervisory and mentoring experience.[237]

A range of WIL programs are available to students enrolled in ICT courses at Australian universities. WIL is not just about work placements in the final year of study. The research points to the importance of introducing WIL early in the curriculum, rather than just the capstone units at the end of a degree.[238] Many degree programs incorporate professional experience units that simulate industry experience, often by engaging students in team projects based on real-world contexts. The high numbers of international students in ICT degrees make well-structured team projects particularly important, as the cross-cultural exchange, communication and knowledge sharing assists students to prepare for work in a global industry. Short-term mobility projects also have considerable utility, but classroom exchange is usually cheaper and may be just as valuable in many cases. In its submission to AWPA, the Australian Council of Deans of ICT notes that 'students exposed to real team-based projects in industry become far more aware of the "soft" skills that are needed for successful projects'.[239]

Students should also be supported to consider the contribution of WIL to prospective career paths. Research undertaken by the National Association of Graduate Careers Advisory Services (NAGCAS) noted a lack of clarity on the integration of career development learning and work-related learning. To make WIL more careers-focused, NAGCAS recommended that within institutions, faculties work with career services divisions to include elements of career

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232 Ibid., p. 5.

233 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 107, www.awpa.gov.au/ our-work/national-workforce-development-strategy/2013-workforce-development-strategy/Documents/ FutureFocus2013NWDS.pdf, accessed 3 April 2013.

234 Koppi, T, et al., 2010, 'The case for ICT work-integrated learning from graduates in the workplace', p. 114.

235 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 107.

236 Koppi, T, et al., 2010, 'The case for ICT work-integrated learning from graduates in the workplace', p. 114.

237 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 107.

238 Pilgrim, C, 2011, 'Work Integrated Learning in ICT Degrees', *Proceedings of the 13th Australasian Computing Education Conference (ACE 2011)*, Perth, 17–20 January 2011, vol. 114, p. 122.

239 ACDICT, 2013, submission to AWPA ICT workforce study.

development learning in WIL, and that students be involved in the process of planning their learning experiences, including in the selection and management of their WIL.[240]

A range of different approaches to WIL are featured in the following case study.

Case study: Work-integrated learning—variations on a successful theme

Across Australia's 39 universities, a range of approaches to work-integrated learning (WIL) in ICT courses are in place. The information below outlines a selection of these approaches. The intention is not to exclude other worthy examples of WIL, but to feature examples that demonstrate positive outcomes for both individuals and the ICT industry.

Deakin University's WIL program presents a strong case for the value of experiential learning for students. Students are offered the option of a 3- to 12-month stint of industry-based learning, or a 100-hour internship with a host organisation. This flexibility creates a range of options for a diverse student population. Host organisations can be either nominated by students or chosen from a list of organisations that have registered with Deakin University.

One of the key aspects of Deakin University's WIL program is the Real World Modules Series workshops. These workshops comprise a series of online and face-to-face sessions that are 'designed to improve their [students'] professional capacity during placement and to increase their employability skills before, during and after the placement opportunity'. A range of subject areas are covered in these workshops including global citizenship, digital literacy, effective workplace communication, problem solving, critical reflection and teamwork.

Evidence suggests that participating students get work quicker after graduating, sometimes through their placement, and the career progression for these students is better over the long term, compared to students who have not undertaken WIL as part of their coursework.

Swinburne University of Technology offers a diverse approach to WIL that incorporates industry scholarships, industry placements, shorter-term internships, capstone projects that engage students in short-term, project-based placements with organisations, and a social impact project that connects students with non-government organisations. Each of these programs includes mentorship from the university and (with the exception of capstone projects) ICT professionals. International placements are also offered.

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240 Smith, M, Brooks, S, Lichtenberg, A, McIlveen, P, Torjul, P, and Tyler, J [on behalf of the National Association of Graduate Careers Advisory Services], 2009, *Career Development Learning: maximising the contribution of work-integrated learning to the student experience*, Australian Learning and Teaching Council, Final Project Report, University of Wollongong Careers Central Academic Services Division, mams.rmit.edu.au/egbr8k4fi796.pdf, accessed 8 May 2013.

The **University of Ballarat** supports a very different approach to WIL. The university's Mt Helen campus annexes the University of Ballarat Technology Park, where IBM is located. In partnership with IBM, the university delivers the Bachelor of Information Technology (Professional Practice) degree. This four-year degree, which has a higher Australian Tertiary Admission Rank score and eligibility requirements than the mainstream, three-year Bachelor of Information Technology, involves annual work placements in IBM. At the end of the placement, many graduates of the program are successful in obtaining employment with IBM.

The first year of the program consists of full-time study, and many students undertake part-time work at IBM. The second and third years are split between study and work placements at IBM (entitling students to an $8,000 scholarship), and the final year is evenly split between coursework and a semester-long IBM placement. Therefore, the course enables students to develop a cumulative working experience of professional contexts, and also provides some financial support that can be very useful in helping students fund their studies.

Barriers to the provision of professional experience in tertiary degrees

The programs listed above, and programs like them, are not available to all ICT students.[241] Students with poor grades are often not considered for industry placements on the grounds that they 'might place an unreasonable burden on the industry partners'.[242] In addition, it may be more difficult for students based in regional locations to access WIL programs. While visa arrangements for international students permit students to support themselves during their studies, restrictions precluding full-time paid work imposed under student visas can limit the scope of work placements for international students.[243] Finally, placements may also be difficult for students to undertake successfully if they have extensive part-time work obligations, particularly if the placements are unpaid.[244]

There are a range of competing views on what constitutes effective WIL. Swinburne University of Technology notes 'significant differences of opinions regarding implementation, recognition, funding and responsibilities' across the range of stakeholders involved in WIL.[245] In particular, there are often tensions between organisational needs for tangible benefits from student placements, and expectations for students to 'achieve an appropriate learning experience with intentional learning outcomes'.[246] Swinburne and many other universities seek to counteract this by being particularly selective about the organisations they partner with for student placements, to ensure that enterprises 'respect students and treat the exercise as a learning experience'.[247]

241 Pilgrim, C, 2011, 'Work Integrated Learning in ICT Degrees', p. 120.

242 Ibid., p. 121.

243 Ibid., p. 120; Australian Education International, 2012, *Student Voices: Enhancing the Experience of International Students in Australia,* pp. 23–4, aei.gov.au/research/Publications/Documents/Enhancing%20the%20 International%20Student %20Experience.pdf, accessed 31 May 2013.

244 Pilgrim, C, 2011, 'Work Integrated Learning in ICT Degrees', p. 121.

245 Swinburne University of Technology, 2013, submission to AWPA ICT workforce study.

246 Pilgrim, C, 2012, 'Industry and university perspectives of work integrated learning Programs in ICT Degrees', p. 2.

247 Withers, S, 2012, 'Fixing the ICT skills shortage in Australia and New Zealand'.

AWPA supports the proposal by Professor Chris Pilgrim for the formation of a shared understanding of WIL that contributes to both industry requirements and student outcomes. Pilgrim asserts that:

> a shared understanding regarding the authenticity of the range of learning experiences for WIL is required in order to achieve industry acceptance and recognition of innovative internal and virtual models of WIL. This approach also needs to address the balance that is needed between employability skills and lifelong learning.[248]

In particular, Pilgrim asserts a requirement for 'the development of clear learning objectives for WIL' in collaboration with all stakeholders.[249] Maintained by the Australian Computer Society, these objectives would bring industry, students and universities together in determining the goals of WIL across the diverse activities that constitute it, and thus 'ensure the balance between employability skills and lifelong learning'.[250] These objectives could be integrated into the ACS accreditation process.

The Australian Government's Office for Learning and Teaching is funding a project to enhance WIL outcomes across academic disciplines. This project is led by Griffith University in partnership with four other universities across Queensland, New South Wales and Victoria. The objectives are to identify the key challenges faced by WIL leaders in both universities and enterprises and to establish a framework and criteria to assess effective WIL leadership practices and the policies that support practice.[251] Another Office for Learning and Teaching project, 'Addressing ICT curriculum recommendations from surveys of academics, workplace graduates and employers', has recently finished.[252] The project was led by the University of Wollongong, with partners including the Australian Council of Deans of ICT. The outcomes from both projects will provide a useful resource to guide ICT faculties in universities.

A number of submissions received by AWPA suggest that additional funding support for WIL is required to increase opportunities for students to engage in WIL. The introduction of WIL and professional experience programs incurs significant costs for institutions, host businesses and students. Institutions are tasked with arranging, tracking and assuring the quality of placements. Businesses incur staff costs in supervising and training students, and liaising with the institution. And students are reluctant to take on WIL or other professional experience activities unless remunerated sufficiently to compensate for the loss of income associated with the disruption of their availability for part-time work.[253]

As discussed previously, AWPA's 2013 National Workforce Development Strategy recommends that governments, industry bodies and VET and higher education providers work together to increase opportunities for WIL and professional cadetships. AWPA finds that, given views from a range of stakeholders on the costs of effective WIL programs, governments, industry and

248 Pilgrim, C, 2012, 'Industry and university perspectives of work integrated learning Programs in ICT Degrees', p. 8.

249 Ibid.

250 Ibid.

251 Office for Learning and Teaching, *Leading WIL: Distributed leadership approach to enhance work integrated learning outcomes,* www.olt.gov.au/project-leading-wil-distributed-leadership-approach-enhance-work-integrated-learning-outcomes-2011, accessed 3 October 2012.

252 Koppi, T, et al., 2012, *Addressing ICT curriculum recommendations from surveys of academics, workplace graduates and employers.*

253 Deakin University, 2013, submission to AWPA ICT workforce study.

tertiary education providers may need to investigate models and funding options to make WIL placements attractive to employers.[254]

Improving WIL will also require substantial additional commitment and a unified approach from employers. Collaboration is vital here. At the November 2012 ICT Skills Forum at Parliament House, a number of industry stakeholders noted that the intensive competition to source ICT skills has been counterproductive, as businesses too often focus on immediate skills needs allied to particular technological demands, and forgo the potential benefits of a long-term, collaborative approach to building a pool of ICT skills. WIL is an ideal focal point for improved industry collaboration. The creation of additional student places, and support for a consistent approach to working with universities on the strategic framework for WIL programs, would transform WIL from a disparate range of programs of varying quality available to some students, to a central component of every student's course of learning.

AWPA also supports the view that better evidence of the value of WIL is required to determine the relative benefits of different approaches.[255] Analysis of the longitudinal impacts of WIL is required to determine how students benefit from these experiences in the medium to long term.

Engaging with SMEs to provide professional experience

In its submission to AWPA, Deakin University notes 'the costs associated with the WIL program could be viewed as a barrier to entry especially for small to medium sized enterprises'.[256] The university estimates that a three-month placement costs businesses $8,100 plus goods and services tax.[257]

The engagement of more small to medium-sized enterprises (SMEs) in WIL programs could provide considerable benefits to students. First, a high proportion of ICT enterprises are SMEs, and more placements in SMEs may increase the proportion of students who are ready to work in these organisations, or may wish to work in them at a later point in their careers. Second, students could potentially draw inspiration from placements with enterprising, innovative and entrepreneurial start-up companies. The benefits to the SMEs themselves, however, may be more difficult to ascertain, especially for organisations that combine minimal resourcing for supervision and support with a highly technical operational profile and skills base.

The Victorian Government is delivering a program that matches ICT SMEs with students and provides potentially mutual benefits. The Technology Student Accelerator Voucher program is outlined in the case study on page 98.

254 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 110.

255 Pilgrim, C, 2012, 'Industry and university perspectives of work integrated learning Programs in ICT Degrees', p. 4.

256 Deakin University, 2013, submission to AWPA ICT workforce study.

257 Deakin University Information Technology, Science, Engineering, Architecture and Built Environment WIL Program, *Information for Employer/Host Organisation,* www.deakin.edu.au/sebe/students/wil/employer.php, 10 April 2013.

Case study: Technology Student Accelerator Voucher program

As part of the Victorian Government's Technology Student Accelerator Voucher program, vouchers worth up to $10,000 are available to small to medium-sized enterprises (SMEs) to develop ICT solutions that use newly developed technology or apply existing technology in new ways.

Under the program, SMEs partner with a Victorian university to engage one or more high-performing students to work on projects, accompanied by an academic supervisor. The project must run for a minimum of 10 weeks.

In early 2013, the Victorian Government funded nine projects involving RMIT University, Swinburne University of Technology, the University of Ballarat and the University of Melbourne. The projects range from the development of real-time digital content delivery mechanisms for mass communication to testing of frequencies for bulk reading of radio frequency identification tags.

While this program is in its early stages, its integration of enterprise innovation with professional experience for students, and its use of collaboration between universities and SMEs, provide a useful model for other jurisdictions to consider.

Recommendation 5

That the Australian Government, tertiary education providers and industry expand and improve work-integrated learning and other professional experience programs by:

a) increasing funding support for work-integrated learning and facilitating the expansion of these programs to a greater proportion of the student population

b) improving the integration between various forms of work-integrated learning and course learning objectives to ensure a balance between employability skills and lifelong learning, building on the work-integrated learning outcomes project funded by the Office for Learning and Teaching

c) engaging more small to medium-sized enterprises in work-integrated learning programs by promoting the mutual benefits of these programs

d) supporting a thorough, longitudinal evaluation of the various models of work-integrated learning and professional experience, with a focus on the contribution of these programs to employment outcomes and career progression.

4.5 Improving pathways to entry-level positions—establishing an ICT apprenticeship/traineeship model

As outlined in Chapter Three, graduating students often experience difficulty in securing entry-level positions. For higher education students, the various forms of work-integrated learning described in the previous section provide students with opportunities to improve their employability skills and subsequent employment prospects. For students engaged in vocational education and training, professional experience is also vital and, in many cases, is already embedded into units of competency. However, Australian Apprenticeships, which are identified as 'the best way to combine training and employment' for Australian vocational students, are not a well-established pathway for entry to ICT careers.[258]

ICT apprenticeships and traineeships would offer students three distinct benefits. First, students would complete a portable, nationally accredited qualification. Second, extensive, relevant work experience would be undertaken throughout the apprenticeship/traineeship. Third, and of particular importance for ICT workers, industry certifications could be integrated with the course of study.

The National Centre for Vocational Education Research reports positive employment outcomes for students who complete ICT apprenticeships and traineeships. VET ICT graduates completing their qualification as an apprentice or trainee are 1.5 times more likely to be working in their occupation than their non-apprentice/non-trainee peers.[259] In addition, a high proportion of students who train with the intention of being an ICT Support Technician (and who subsequently find employment) are employed in an occupation where the training is relevant, whether they find employment in the same occupation or a slightly different one. All apprentices and trainees report that their training is relevant to their current job, whereas the figure for the non-apprentice/non-trainee group is 82.2 per cent.[260]

In its 2013 *Environmental Scan*, IBSA notes a small increase in apprenticeship, traineeship and cadetship enrolments across the two key VET training packages.[261] However, many of these positions are traineeships at Australian Qualifications Framework levels 2 and 3, and arguably do not provide the long-term employment pathways for graduates that higher-level apprenticeships do. Qualifications at the Certificate IV and diploma levels provided in the form of apprenticeships could provide much stronger employment pathways for graduates.[262]

Recognising the value of the apprenticeship model for employment pathways and career prospects, and the paucity of apprenticeship positions available for ICT workers, the Australian Information Industry Association is working with the Victorian Government and industry to scope an ICT apprenticeship pathway.

The ICT-VET Pathways project, which has received funding from the Victorian Department of State Development, Business and Innovation, comprises analysis and research into the possible structure of an ICT VET apprenticeship model, a proof-of-concept pilot at Melbourne TAFE

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258 Australian Apprenticeships, www.australianapprenticeships.gov.au, accessed 19 April 2013.

259 DEEWR, 2013, *ICT Labour Market Indicators 2013,* slide 22.

260 Ibid.

261 IBSA, 2013, *Information and Communications Technology Industry Environmental Scan—2013*, p. 16.

262 Box Hill Institute of TAFE, 2013, submission to AWPA ICT workforce study.

campuses to test the approach, and an evaluation of the impact and outcomes of the initiative, with a view to expansion of the project into other states and territories.

There are successful ICT apprenticeship programs already in place including, for example, the Australian Government ICT Apprenticeship Program. The program, which is part of a broader suite of ICT entry-level programs administered by the Australian Government Information Management Office, targets students who are currently completing their Year 12 certificate, and existing workers looking for a career change.[263] Twenty-three of the 110 Australian Government departments and agencies—employing almost 90 per cent of the total Australian Public Service ICT workforce—have recruited apprentices and cadets through the Australian Government ICT entry-level programs in 2013.[264]

Apprentices engaged with the Australian Government ICT Apprenticeship Program complete a Certificate IV (two years) or diploma (three years) in one of a range of fields including IT general, IT testing, IT networking, IT programming, software development, and systems analysis and design.[265] In 2013, the seventh apprenticeship cohort commenced the program. To date, approximately 186 ICT apprentices and cadets have completed the program.[266]

Other countries have also demonstrated that an apprenticeship/traineeship pathway to ICT is an effective way to simultaneously secure work experience, qualifications and industry certification. For example, the UK National Skills Academy, in collaboration with the National IT Partnership for IT apprenticeships, delivers the Grow Your Own IT Talent Project. The project engages or 'plants' young apprentices in IT project teams and supports them to undertake training while working. Apprentices are trained for one of three occupations: software developer, IT technician or database analyst. The National IT Partnership monitors companies to ensure that they are providing adequate supervision, support and mentoring for apprentices. The National Skills Academy reports a high level of employer satisfaction with the initiative, stating that 'more than 90 per cent of employers who grow their own IT talent through apprenticeships recommend them as a way of recruiting'.[267]

AWPA identifies substantial potential in an expanded apprenticeship/traineeship model for ICT technicians and trades occupations, and recommends that, if successful, the Victorian pilot approach should be considered by other jurisdictions. The Australian Government ICT Apprenticeship Program and the UK model also offer examples with proven outcomes for consideration.

Recommendation 6

That the Australian Government and industry associations monitor the outcomes of the Australian Government ICT Apprenticeship Program and the Australian Information Industry Association and Victorian Government's ICT-VET Pathways project, and if successful, develop and pilot a national apprenticeship/traineeship model for ICT technicians and trades workers.

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263 AGIMO, 2013, submission to AWPA ICT workforce study.

264 Ibid.

265 Ibid.

266 Ibid.

267 National Skills Academy for IT, *Grow your own IT talent*, www.itskillsacademy.ac.uk/apprenticeships/growyourownit, accessed 1 May 2013.

4.6 Broadening the pool of ICT skills

Integrating generic ICT skills into existing tertiary education programs across a range of sectors

The strategies outlined above are aimed at maximising the employability and career outcomes of students in mainstream ICT degrees and courses. However, efforts are also required to support ICT skills development for students in other disciplines.

In many disciplines, ICT-intensive skills are becoming more evident. For example, as technology becomes increasingly pervasive in both the provision of health and aged care services, and the storage and processing of medical data, there is a growing need for embedded health informatics training for health professionals, health service managers and ICT professionals working in the health sector. E-health and health informatics modules are now incorporated into nursing training programs, and the Australian Government Department of Health and Ageing offers online and additional training in the use of the personally controlled electronic health (eHealth) record system.[268] In July 2013, the Health Informatics Society of Australia, the Australasian College of Health Informatics and the Health Information Management Association of Australia will launch a new certification program for health informaticians.[269]

This type of innovation is currently limited to particular disciplines where there are specific requirements for ICT-intensive skills. There is a critical need to expand the scope of ICT education across the spectrum of university courses to facilitate a broader engagement in ICT across the economy, and to pick up the productivity and innovation opportunities outlined in Chapter One.

In the consultations conducted for this report, several stakeholders have advocated the integration of a baseline level of ICT education into all undergraduate degrees. A potential approach to the provision of this education is the development of a short learning module that introduces fundamental concepts of ICT.

AWPA recommends that the Australian Council of Deans of ICT work with national deans' councils representing other disciplines to scope the development of a cross-disciplinary module on digital literacy, including teaching resources and learning materials. The ability to customise the module for particular disciplines would be essential to the success of the module. The Foundation Skills Training Package developed by Innovation and Business Skills Australia (IBSA) for the VET sector, and discussed in Chapter Five, could provide a model.

Recommendation 7

That the Australian Council of Deans of ICT and other deans' councils promote the incorporation of digital literacy into all undergraduate degrees by developing and piloting a cross-disciplinary unit that could be customised for particular disciplines.

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268 Department of Health and Ageing, *Using the eHealth record system*, publiclearning.ehealth.gov.au/hcp/how-do-we-use-it/using-the-ehealth-record-system, accessed 8 May 2013.

269 McDonald, K, 2013, 'Certification program for health informaticians to launch at HIC', *Pulse+ IT* (3 May), www.pulseitmagazine.com.au/index.php?option=com_content&view=article&id=1410:certification-program-for-health-informaticians-to-launch-at-hic&catid=16:australian-ehealth&Itemid=327, accessed 8 May 2013.

Broader coverage of ICT skills is also required across the VET sector. Each of the 11 national Industry Skills Councils considers the relevance of ICT skills in its annual environmental scans, and these considerations also inform the national consultation processes that the councils conduct annually. IBSA has also recently published a report, *Digital literacy and e-skills: participation in the digital economy*, which aims to 'confirm and validate, through consultation with experts, existing and new skill sets and competencies that are fundamental to digital literacy'.[270]

The report examines and reviews the range of skill sets and units of competency currently provided in the training packages that IBSA is responsible for and creates a taxonomy of 'e-skills' from generalist foundation-level skills, to extension-level skills that apply to particular occupational contexts, to the strategic level that comprises high-end, ICT-intensive skills. Regional Australians and at-risk groups are identified as primary targets for foundational skills, and extension and strategic-level ICT skills are tagged as essential for the adoption and deployment of ICT services. The report recommends the addition of 17 new and 25 enhanced units of competency in the Information and Communications Technology and/or the Business Services training packages to meet these skills requirements. The report is a useful document for all Industry Skills Councils to consider as they conduct industry consultations for the continuous improvement of training packages. There is the potential for some of the 17 new or 25 enhanced units of competency to be mapped against existing units of competency and, if appropriate, transported into other training packages. Three of the units relate to training and education competencies that IBSA suggests should be held by those delivering ICT training.[271]

The delivery of ICT-intensive skills to non-ICT graduates

A generic digital literacy unit or unit of competency may help learners to contextualise ICT in a particular discipline and learn many of the foundational concepts related to ICT. However, these offerings are unlikely to be specific or detailed enough to facilitate the development of what IBSA calls strategic-level ICT skills. For individuals seeking to develop these skills and position themselves for employment in Australia's growing ICT sector, the provision of postgraduate or higher level VET conversion programs may enable students from a range of disciplines to develop strategic, ICT-intensive skills.

The Irish Government is currently delivering an ICT graduate conversion program. From March 2012, it rolled out 800 places in intensive ICT skills conversion programs, run by a range of higher education providers in partnership with industry.[272] In February 2013, a further 760 conversion places were announced in 15 individual programs across 10 higher education institutions. The additional placements were announced following 'very positive initial evaluation and strong industry endorsement' of the 2012 program.[273] Each of the conversion courses funded by the Irish Government features collaboration with an extensive group of ICT enterprises. The enterprises inform course design and offer three- to six-month student placements. Places in the conversion courses are fully funded and available to students with

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270 IBSA, 2013, *Digital literacy and e-skills,* p. 3.

271 Ibid., p. 6.

272 Irish Government, Higher Education Authority, *Launch of the ICT Action Plan and ICT Skills Programme 2013,* www.hea.ie/ictskills, accessed 10 May 2013.

273 ICT Skills Conversion Courses, www.ictskills.ie, accessed 14 May 2013.

a Level 8 or equivalent qualification, which is equivalent to a bachelor degree with honours or above. The courses lead to an honours-level degree in computer science.[274]

The Irish context is very different to the Australian context, and this program reflects the status of ICT as a high-performing industry in an otherwise poorly performing economy, and the high unemployment rate among young Irish people. However, given continuing low levels of engagement in mainstream ICT courses, set against the projected increase in demand for ICT-intensive skills in the medium to long term, a comparable approach may be worth pursuing in Australia.

AWPA recommends that the Australian Council of Deans of ICT work with the Australian Computer Society, the Australian Information Industry Association and other industry associations to consider the design of a pilot conversion program in Australia. To facilitate the delivery of ICT-intensive skills, the program would need to be at Australian Qualifications Framework Level 9 (master degree by coursework), and would take up to two years for a graduate from another discipline to complete. As is the case with the Irish model, the pilot must garner extensive industry engagement to ensure that the program is relevant to the needs of industry and, therefore, likely to lead to strong employment outcomes for participants.

Recommendation 8

That the Australian Council of Deans of ICT, the Australian Computer Society, the Australian Information Industry Association and other industry associations develop a pilot ICT-intensive skills conversion program aimed at recent graduates from other disciplines. This program could be delivered at Australian Qualifications Framework Level 9 (master degree by coursework).

Conclusion

This chapter has highlighted considerable innovation and diversity in Australian ICT tertiary provision. The development of a range of approaches to professional experience in VET programs and higher education qualifications is particularly significant, as is the level of support provided for students undertaking industry placements and internships. The continuing evolution of work-integrated learning will expand these benefits. The development of an apprenticeship/traineeship pathway will also provide benefits for both individuals and businesses across the economy.

This chapter is concerned with the development of entry-level ICT workers. The next chapter examines the ongoing skills requirements for these workers. In a dynamic industry, every ICT professional, technician and trades worker will need to consistently add to his or her skills to retain a foothold in the ICT workforce. Therefore, the attainment of a VET qualification or a higher education degree is but one step in a process of lifelong learning.

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274 Merrion Street Irish Government News Service, 'Ministers Quinn & Cannon announce 760 new places on ICT graduate skills conversion programmes', www.merrionstreet.ie/index.php/2013/02/ministers-quinn-cannon-announce-760-new-places-on-ict-graduate-skills-conversion-programmes, accessed 10 May 2013.

Chapter Five: Developing, retaining and effectively using ICT skills in the workforce

Introduction

In this chapter, we shift our attention from the issues of supply of high-quality ICT skills through the school and tertiary sectors, to the development, retention and effective utilisation of the existing ICT workforce. In its submission to AWPA, the Association of Professional Engineers, Scientists and Managers, Australia (APESMA) suggests that 'investment in education, training and skills development at the workplace level in line with business objectives will critically underpin ICT workforce development over the next decade'.[275]

The ICT workforce has changed as technology has changed and become increasingly widespread across all sectors of the economy. The adoption of new technologies has required new skill sets, and the need for an increasingly adaptable ICT workforce, often requiring increasingly higher level specialist skills. AWPA encourages industry to invest in its workforce as well as in new technologies, and we present a range of strategies that seek to promote high-performing workplaces that facilitate workforce development, encourage investments in skills development for both early-career workers and the established workforce, and highlight the National Workforce Development Fund as a source of funding for upskilling and reskilling existing workers.

5.1 The importance of continuing skills development for ICT workers at all levels

A recent survey of more than 900 Australian IT professionals revealed that 57 per cent of respondents believe their company does not invest enough in training and development; 65 per cent believe they cannot progress to the next level in their current company; 50 per cent would be willing to forgo career progression to work flexible hours; and just 30 per cent indicated that morale in their business is high. The five main reasons given by respondents who had recently resigned from positions in ICT were no career progression, dissatisfaction with salary, poor relationship with manager, company culture misfit, and limited flexible working hours.[276]

The development and implementation of strategies aimed at improving ongoing skills development for ICT workers will require collaboration across the ICT sector and the leadership

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275 APESMA, 2013, submission to AWPA ICT workforce study.

276 Ambition, 2013, *Market Trends Report 1H 2013 Australia*, www.ambition.com.au/File.ashx?path=Root/ Documents/Market-Trends/AU-Market-Trends-Report-2013-1H-1.pdf, accessed 10 April 2013; Dinham, P, 2013, 'Company culture rises in importance for IT workers', *iTWire*, www.itwire.com/it-people-news/ people/59404-company-culture-rises-in-importance-for-it-workers?utm_source=iTWire+Update&utm_ campaign=0dc80eae8b-2012100810_8_2012&utm_medium=email, accessed 10 April 2013.

of peak bodies and professional organisations. To ensure the currency, development and retention of generic and specialist ICT skills, employers and employees need to develop the 'adaptive capacity' required to flexibly and creatively adapt to changing circumstances.

Building peer learning initiatives and specialist communities of practice will be critical in ongoing skill development in ICT. Peer learning networks can be developed and supported at all levels of skill development, from school students through to experienced professionals. Specialist communities of practice, based on both online and physical networks, are important in developing and maintaining world-class expertise in specific ICT domains in Australia.[277] Another innovative model for informal peer-to-peer learning in an area with rapid changes in knowledge needs is the 'mashup', where ICT and related professionals come together to share and expand their collective knowledge to meet a particular challenge. ICT professionals and employers should be encouraged to explore innovative models of learning (both formal and informal) to help meet current and future skill demands.

AWPA believes the ICT industry has capacity to improve its investment in ongoing skills development for the ICT workforce, and encourages enterprises to develop forward-looking workplace development plans. This will provide opportunities for ICT workers and employers alike to adapt to changing technologies and skills needs, assist in the engagement, motivation, retention, satisfaction and effective utilisation of all staff, and provide quality careers in the ICT industry for the existing and emerging workforce.

5.2   High-performing workplaces investing in workforce and skills development

Despite the increasing complexity of ICT services, driven by the increasing and accelerating use of cloud services and mobile devices, expenditure on education within the sector remains low. According to research by consultants IDC, industry spending on ICT education lags behind the market average, and falls well behind spending on software. ICT training in Australia in 2012 represented just 0.57 per cent of total ICT expenditure (US$408 million of US$71,830 million), and IDC forecasts that training expenditure will drop to 0.55 per cent of ICT spending by 2015 (US$435 million of US$79,601 million).[278] IDC research shows that training is important, and that with a sufficient percentage of team members certified, IT organisational performance can increase by up to an average of 11 percentage points.[279]

Despite this reluctance to invest in training, IDC found that increased spending on training had a direct impact on the success of ICT projects, with projects allocating more than 6 per cent of the project budget to training being significantly more successful than projects where 3 per cent or less of the budget went on training.[280] Surveying the impact of certification on performance in ICT, IDC found that two-thirds of managers believed that certifications improve

277 Dawson, R, input provided to the AWPA ICT workforce study report, May 2013.

278 ICT spending covers expenditure on IT training and education together with packaged software.

279 IDC, 2012, *ICT Skills in the Workplace Forum: Market Overview,* p. 33.

280 Ibid., p. 32.

the overall level of service and support offered to ICT end users and customers, while three-quarters responded that certifications are important to team performance:

> Certifications add value by increasing project success rates, improving service to users and improving the [return on investment] of the software investment. Expensive software needs skilled people to extract maximum value.[281]

The rapidly changing nature of technology ensures that specific (as opposed to generic) ICT skills have a limited lifespan. ICT professionals must therefore update their skills to meet the ongoing and future skill demands of their employers. The evidence suggests that the ICT workforce takes professional development seriously. Seventy-five per cent of respondents to a recent APESMA survey indicated they were very, moderately or somewhat concerned about training and professional development, and 77 per cent indicated that the lack of training opportunities in their workplace was demotivating.[282] These figures point to the rapidly changing nature of ICT skills requirements, and the resulting requirements for workers to consistently update their skills base.

Updating skills through training or other forms of learning enables individuals to access opportunities for career advancement, remain challenged and satisfied with their work, develop the confidence to contribute to the achievement of organisational goals, support innovation by using up-to-date versions of key software and applications, and become proficient in niche areas of current or forecast skills shortage.[283] The Australian Computer Society's Professional Partner program provides employers with an opportunity to work with the ACS to tailor professional development programs for their staff.

Innovation and Business Skills Australia (IBSA) notes that a majority of businesses are not well prepared for the ICT challenges and opportunities ahead. While they may have short-term workforce plans to fill immediate gaps, few have a longer term workforce plan.[284] While large enterprises often outsource their requirements for specialised skills, in the future they will need to grow their in-house skills in a range of areas. New approaches will need to be developed to recognise the different requirements and operating models of the wide range of ICT skills across all industries. IBSA stresses that:

> workforce planning is much more than staff planning; it should strongly align with strategic objectives and reach beyond forecasting staffing needs to include the management of talent, outsourcing and job redesign. An agile and mobile workforce needs to be planned and developed to support innovation and productivity.[285]

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281 Ibid., p. 33.

282 APESMA, 2011, 'At the crossroads: barriers to rebuilding ICT capability following the 2009/10 global financial crisis', p. 12, www.apesma.com.au/groups/information-technology/Reports/At-the-crossroads-report.pdf, accessed 23 April 2013.

283 APESMA, 2011, 'Recruitment and Development and Retention (RADAR) Report—An APESMA report on strategies for addressing skills gaps and shortages at the enterprise level', p. 8, www.awpa.gov.au/our-work/labour-market-information/skilled-occupation-list/documents/APESMAITGroupAttachment1.pdf, accessed 22 April 2013.

284 IBSA, *2013 Information and Communications Technology Industry Environmental Scan—2013*, p. 16.

285 Ibid.

Workforce development is often misunderstood. It is not just about staff planning; nor is it just about training. AWPA states:

> It is about integrating business strategy, work organisation and job design.
> The workplace needs to be designed to ensure that:
>
> ➢ existing skills are used effectively
>
> ➢ skills are constantly developed on and off the job
>
> ➢ skills, techniques and improvements are shared across the organisation along with new techniques and other improvements.[286]

At an enterprise level, workforce development 'entails recognising that people in workplaces are our most important natural resource'. Taking a workforce development approach means that:

> business strategy drives organisational development as well as skills development and use. Training is relevant to business needs and work is organised to maximise employee capabilities. Strategies to achieve change include job redesign, increased employee participation and autonomy, mentoring and applying new learning.[287]

The benefits to enterprises of improved skills utilisation include improved profitability, innovation, productivity and retention.[288] AWPA provides a guide to developing workforce development plans in its 2013 National Workforce Development Strategy. The guide includes identifying the workforce development needs of the organisation, for example leadership and management capability, retention, job design and career paths, maximising staff capabilities, and training.[289]

APESMA, together with its ICT interest group the Information Technology Professionals Association (ITPA), has identified a series of workplace factors that reduce the currency and availability of ICT skills, including:

➢ the ICT sector is often perceived as 'churning and burning' professionals and encouraging migration to other sectors

➢ ICT skills learned have a limited lifespan due to the rapidly changing nature of technology—employees need to constantly update their skills to those the market is going to need

➢ employers are not doing sufficient skills foresighting or developing rolling three to five year skills forecasts that will allow them to re-train or upskill their workforce in areas of future skills needs.[290]

APESMA suggests a focus on addressing ICT skills issues at the enterprise level to address these issues. Key among the range of solutions suggested by APESMA are adopting work practices which will attract, develop and retain quality ICT staff; a commitment to skills

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286 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 52.

287 Ibid., p. 53.

288 Ibid.

289 Ibid., Appendix 3: Workforce development plan, pp. 167–9.

290 APESMA, 2011, *Recruitment and Development and Retention (RADAR) Report,* p. 5.

development due to rapidly evolving and updated hardware and software; addressing the under-representation of key demographics in the ICT workforce; and maximising the contribution of both the flexible and permanent workforce.[291]

Management capability is a key issue in the ICT sector which impacts on the capacity of organisations to implement work practices for skills development. APESMA calls for better management capability in the following key areas to improve productivity in ICT workplaces, which may improve work satisfaction and the retention of skilled workers: managing innovation, managing workplace culture (including employee involvement and participation in decision-making, staff engagement and motivation, flexibility, workload and work–life balance), managing training and skills development, and fair reward and recognition.[292] APESMA notes in its submission to AWPA that, 'in order to effect *sustainable* change leaders and managers need to develop an understanding of the factors which influence the shared values, beliefs and assumptions which develop over time in workplaces'. Influencing factors include 'management and leadership styles, organisation structure, control systems, communication processes and "organisational folklore"—the myths and stories which develop in workplaces and often take on "a life of their own"'.[293] AWPA has found that:

> Studies suggest that firms with sound management are better able to: match skills to jobs; develop productive networks; make better decisions through engagement with employees (for example); and, are better able to respond to changes in the market place, including changes resulting from the introduction of new technologies. The studies also indicate that simply having good management policies is not sufficient. They must also be effectively implemented into the firm's culture.[294]

One of the recommendations of AWPA's 2013 National Workforce Development Strategy was that the Australian Government commission a comprehensive review of leadership and management, including front-line management.[295]

The Australian Government established the centre for Workplace Leadership in recognition of the importance of developing leadership and management practices. There are opportunities for existing industry networks to collaborate with the new centre. AWPA has suggested that SMEs should be a key focus for the centre, 'given the importance of SMEs to the Australian economy' and the resource challenges that they face when compared with the larger enterprises.[296]

Submissions received by AWPA indicate that the attraction, retention and utilisation of ICT skills are more challenging and quite different for SMEs, but that addressing skills issues is critical for these organisations, who face becoming uncompetitive in an increasingly digital economy, whether they are ICT producers or consumers.[297]

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291 Ibid., p. 7.

292 APESMA, 2013, submission to AWPA ICT workforce study.

293 Ibid.

294 AWPA, 2013, *Human capital and productivity,* p. 39, www.awpa.gov.au/our-work/Documents/Human%20 capital%20and%20productivity%20literature%20review%20March%202013.pdf, accessed 3 April 2013; see also AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy,* pp. 57–60.

295 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 60.

296 Ibid.

297 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

A number of Australian Government programs are in place to improve the competitiveness and capability of ICT SMEs. Enterprise Connect is an Australian Government initiative that 'offers comprehensive, confidential advice and support to eligible Australian small and medium businesses to help them transform and reach their full potential'.[298] It offers tailored advice and support that enables strategic planning for businesses in relation to their current and future skills needs. While the program is not specifically targeted to support training, it is focused on building capability in organisations to match unmet business needs with solutions that may include adoption of new technology, access to networks and support to articulate their skills needs to providers and to funding bodies. The programs offered by Enterprise Connect include business reviews delivered at no charge to businesses, grant assistance to implement recommendations flowing from a business review, and a range of tailored innovation services to meet individual business needs.

The growing proportion of contract work in some areas of ICT poses additional challenges to the development of workplace culture, and the ICT industry and enterprises—both large and small to medium-sized—need to establish strategies to maximise the contribution of the flexible as well as permanent ICT workforce. APESMA argues that, as it is expected that ICT contracting professionals will continue to play a significant role in both the private and public sectors in Australia over the next decade, 'strategies for attracting and retaining the best contracting professionals alongside those aimed at attracting quality permanent staff should be an important part of an organisation's toolbox of recruitment and people management strategies'.[299]

APESMA and the ITPA therefore propose that ICT workforce plans 'should also identify strategic measures to address capacity and capability gaps beyond those which can be addressed by the permanent workforce'. APESMA and the ITPA suggest that, where appropriate, enterprises should ensure that contracting and consulting professionals are engaged under fair terms, 'utilise induction to embed more inclusive practices and behaviour toward contractors, and engage them more actively in organisational and project goals', and 'show leadership by using learning and development as incentives to attract quality contracting and consulting professionals'.[300]

Through consultation with representatives from ICT enterprises, peak bodies and professional associations, AWPA has identified a number of examples of ICT organisations that demonstrate an enduring, organisation-wide commitment to staff development. In particular, many large multinational organisations with operations in Australia have put in place sophisticated workforce development plans that facilitate high levels of worker satisfaction and productivity. Several of these are featured in the case study on page 111.

AWPA recommends that APESMA feature the successes of these companies through the development of a series of promotional tools that assert the value of workforce development for ICT companies.

298 Enterprise Connect, www.enterpriseconnect.gov.au/about/Pages/default.aspx, accessed 9 May 2013.
299 APESMA, 2013, submission to AWPA ICT workforce study, p. 16.
300 Ibid.

Case study: High-performing workplaces facilitating workforce development

Microsoft

Microsoft is identified as an employer of choice and devotes considerable resources to identifying, developing and retaining high-calibre talent. Employees can access a range of professional development opportunities and Microsoft has a comprehensive curriculum delivered both face-to-face and via online portals. Microsoft enjoys very high employee engagement which serves as an important counter to unexpected attrition, and received AON Hewitt's 'Best of the Best Employer' award for 2010 and 2012. Microsoft offers personal development and leadership programs at local, regional and global levels with opportunities for self-improvement given to all employees. Employees are offered a range of opt-in technical training in addition to specific training and are given great flexibility in the delivery mechanisms for this training to fit their work–life balance needs. Special financial support and additional study leave are available to pursue further tertiary studies where it aligns with role and career goals.

Westpac

Westpac is addressing the challenge of reskilling and developing its existing workforce through a combination of structured formal training, leadership development and the development of soft skills. Initiatives include online and personal courses through its Skillsoft program, opportunities for secondments with third-party partners both onshore and offshore, and female mentoring both in and outside the organisation.

Westpac is increasing its ICT graduate places and introducing a cadetship program hiring five students directly from Year 12 (beginning in 2014). Westpac sponsors and participates in mentoring for women through a partnership with the University of Technology Sydney, and has established a new research partnership with the University of Wollongong that will allow students to gain an insight into technology in the context of financial services.

IBM

IBM provides comprehensive targeted development for employees under the CareerSmart umbrella.

In 2013 each employee is encouraged to dedicate a minimum of 40 hours to their professional development by learning new skills or strengthening those they already have. The Professions program helps develop and maintain a pool of highly skilled and experienced practitioners with consistent standards and best practice throughout IBM.

Employees are encouraged to develop as T-shaped professionals, defined as those who have deep technical skills and broad business, communication and project management skills.

> **Recommendation 9**
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> That the Association of Professional Engineers, Scientists and Managers, Australia, the Australian Information Industry Association and the Australian Computer Society develop a pilot cross-sector program highlighting high-performing workplaces using ICT-intensive skills by featuring case studies, testimonials and instructional guides for other organisations.

5.3 Enhancing skills development for early-career ICT workers

As discussed in Chapter Four, many employers form the view that ICT graduates are often not work ready and require a number of years of experience to work effectively in the profession. To counter this, most degree-level ICT programs offer extensive professional experience to students.

However, even students who have undertaken extensive, well-supported professional experience face a steep learning curve in the early part of their careers. The rapidly changing nature of ICT skills requirements means that university curriculums may not always equip graduates with the very latest skill sets, and the highly specific, client-focused nature of contemporary ICT enterprises means that many graduates will take some time to adjust to the workforce.

Many academics suggest that undergraduate programs are not intended to produce graduates suited for particular, specialist roles in industry. As Swinburne University of Technology points out in its submission to AWPA, 'undergraduate ICT degrees are generally structured to produce graduates with broad ICT skills and knowledge, and the necessary generic skills, required for graduates to enter the ICT workforce in graduate roles'.[301] In most cases, even graduates who emerge with 'advanced skills and knowledge in a particular area ... enter the ICT workforce in non-specialist roles'.[302] In this way, the purpose of a university education is not solely vocational. National ICT Australia (NICTA) states that the purpose of undergraduate degrees is to 'prepare students for lifelong learning, and sometimes too much effort is focused on the "first job" rather than properly preparing students for a career'.[303]

The VET sector is a little different, given the industry-focused orientation of training package qualifications. In its submission to AWPA, the Box Hill Institute of TAFE in Victoria states that the foundation of the continuous improvement of training packages in industry consultation should result in work-ready graduates, and suggests that 'in the main this is the case'.[304] However, IBSA concedes that 'the prevalence of contract based work and the rapid rate of change in the industry present challenges for skill development'.[305] Therefore, like higher

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301 Swinburne University of Technology, 2013, submission to AWPA ICT workforce study.

302 Ibid.

303 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

304 Box Hill Institute of TAFE, 2013, submission to AWPA ICT workforce study.

305 IBSA, 2013, *Training Packages—Information and Communications Technologies,* www.ibsa.org.au/training-packages/by-industry/information-and-communications-technology.aspx, accessed 22 April 2013.

education degrees, it is impossible for VET qualifications to respond to each and every change in the skills required for a range of increasingly specialised ICT occupations.

In any case, employers must bear some of the responsibility for the development of graduates. Mentoring, support from peers and exposure to experienced ICT workers are all good practice here. Of course, in many cases it is easier for multinational companies and other large ICT organisations to invest in this type of support. SMEs often face the dual challenge of limited resources and a highly specialised, client-focused product offering that demands a level of experience in a small cadre of specialist ICT staff.

Several submissions provided to AWPA highlight the differences between expectations of the capability of ICT graduates, and expectations of graduates in other disciplines. NICTA points out that:

> In other professions—medicine, engineering, architecture or law, for example—there is no expectation that students are 100% 'work ready' on graduation. In these professions there is an expectation of 'graduate traineeship' for a period of 1–2 years.[306]

To boost the capability of graduates, a one-year graduate traineeship requirement for entry-level ICT professionals may be worth pursuing.

This form of graduate traineeship is already provided to international students who finish degrees at Australian higher education institutions and seek permanent residency. The ACS Professional Year (PYear) Program in Computing/ICT runs for 44 to 52 weeks and aims to equip students 'with the professional skills needed for a successful career in the Australian workforce'.[307] The program includes courses on business and communication skills and workplace culture, a 12-week internship with a host organisation, and a concurrent online module on professionalism in ICT. AWPA recommends extending this program to domestic graduates.

Recommendation 10

That the Australian Computer Society and the Australian Information Industry Association introduce a one-year professional experience program for entry-level ICT professionals. This experience is already available to international students seeking employment in Australia, and could be extended to domestic students.

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306 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

307 ACS, *Professional Year (PYear) Program*, www.acs.org.au/migration-skills-assessment/professional-year-program, accessed 22 April 2013.

5.4 Ongoing professional development for the ICT workforce

Recommendation 10 in this report would keep newly qualified graduates on the pathway to lifelong learning. However, the provision of upskilling and reskilling opportunities for ongoing ICT employees is also crucial to the ongoing productivity of the Australian ICT workforce. APESMA suggests in its submission to AWPA that 'the failure to address knowledge and skills gaps will inevitably impact productivity and innovative capability at the industry level'.[308]

The Australian Computer Society (ACS) maintains a continuing professional development program for ICT professionals that promotes engagement in formal learning programs, informal and self-directed learning, industry events such as conferences, and professional contributions to the ICT profession. Encouragingly, the ACS acknowledges:

> a growing recognition amongst corporates that a commitment to professional development of ICT staff has a number of significant benefits—greater staff satisfaction, loyalty and commitment; being seen as a professional and committed employer and therefore an attractive place to work; and of course helping maintain ICT skills set within organisation which are relevant to prevailing needs.[309]

It is vital that at least some aspects of professional development are accredited or assessed in some way, so that the attainment of additional skills is formally recognised and can contribute to career development. Employers are encouraged to ensure that ICT employees have the opportunity to seek accreditation as certified professionals and to undertake the requisite annual professional development. Universities provide a range of 'specialist postgraduate degrees that are designed to provide advanced skills and knowledge to current ICT professionals to support career advancement into specialist and/or managerial roles'.[310] However, Swinburne University of Technology contends that 'many companies are now disengaging from universities and are setting up their own proprietary skilling programs, or are placing the responsibility and costs for upskilling entirely onto the employee'.[311]

Several submissions to AWPA have suggested that this shift points to the requirement for greater flexibility among universities with their offerings. In particular, Deakin University suggests in its submission to AWPA that:

> Higher education providers need to improve the accessibility of off-campus/on-line/part-time courses. Higher education providers also need to develop greater modularisation of what they offer. University subjects, let alone entire courses, are frequently too long and too structured for those in full-time work. Short modules, with a clear work-related focus, could be done on-line at the student's own pace (as with massive open online courses). The credit gained upon completion of each module could subsequently be counted, if the student chooses, toward a subject and, eventually, a formal qualification.[312]

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308 APESMA, 2013, submission to AWPA ICT workforce study.
309 ACS, *Professional Experience,* www.acs.org.au/professional-development, accessed 22 April 2013.
310 Swinburne University of Technology, 2013, submission to AWPA ICT workforce study.
311 Ibid.
312 Deakin University, 2013, submission to AWPA ICT workforce study.

The VET sector also has a key role to play in continuing skills development for a range of occupations across the ICT workforce. In some cases, VET providers are able to provide greater modularisation than higher education providers, including, for example, the provision of skill sets that contain one or more units of competency for the purposes of upskilling. As mentioned earlier in this report, many VET courses are integrated with industry certifications, which are essential for employers and employees working with particular programs, products and services.

The Centre of Excellence in Cloud Computing established by Box Hill Institute of TAFE, featured in the following case study, is a good example of a VET provider delivering a flexible, accessible training module for the existing ICT workforce.

Case study: Centre of Excellence in Cloud Computing

In 2011, after considerable industry consultation and discussion, Box Hill Institute of TAFE established a Centre of Excellence in Cloud Computing to deliver training to meet the emerging skills gap in this critical technology area.

In its role as a leader in network training, stemming from a long partnership with Cisco through its academy program, Box Hill Institute identified growing frustration across industry with the access to a suitably trained workforce and the lack of flexible training options in cloud and virtualisation technologies. To meet this demand, Box Hill Institute engaged leading virtualisation and cloud computing vendors, including VMware, Citrix, EMC and NetApp, to establish a group of academies to partner in the development of the Centre of Excellence in Cloud Computing. Box Hill Institute is now the leading Australian vocational training provider for virtualisation and cloud computing technologies.

Courses are delivered using virtual machines to support the delivery of training through personalised practical laboratories. This training environment supports over 20 courses with more than 400 students enrolled in the centre.

The environment has also increased learning flexibility for students by delivering access to dedicated laboratory equipment in the classroom, at students' homes, or anywhere where they can access the internet. This has enabled Box Hill Institute to deliver training to IT professionals in remote mining sites in the Pilbara, and to international students in Mongolia, Indonesia and Malaysia.

Students and ICT professionals participating in these courses receive nationally recognised qualifications, and have the opportunity to gain leading virtualisation industry certification. With the demand for cloud computing skills rapidly escalating, Box Hill Institute is assisting Australians to become qualified in this exciting technology, and assisting industry by filling this emerging skill gap.

Alongside formal training options, it should be noted that massive open online courses complement formal learning within traditional education institutions. The ACS notes that while such courses do not provide credits towards qualifications or certifications, 'they do offer the

opportunities for learning, and in relatively short timeframes, at no cost'.[313] This form of learning could become particularly valuable for ICT workers, subject as they are to skills obsolescence and expectations of continuing skills development. It may be worthwhile for the ACS to consider the contribution of this form of learning to continuing professional development, though not at the expense of formal, accredited programs that enable workers to build a portfolio of transportable skills and qualifications.

5.5 The National Workforce Development Fund

Investment in upskilling and reskilling existing workforce is an ongoing expense, and for SMEs in particular, such investment may prove to be out of reach, and may even act as a disincentive. Funding to assist enterprises in their workforce development, including the upskilling and reskilling of staff, is available through the National Workforce Development Fund (NWDF).

The NWDF forms part of the Australian Government's Skills Connect initiative, which is designed to link employers and industries to funding for whole-of-workforce (including language, literacy and numeracy training and mentoring of Australian Apprenticeships) planning and development. The NWDF is an industry-driven model that enables businesses to co-invest with the Australian Government to train, reskill and upskill workers in areas of skills need. Industry contributions operate on a sliding scale, with large enterprises contributing up to 66 per cent of training costs, and small and medium-sized businesses contributing between 33 and 50 per cent.

IBSA facilitates the skilling of ICT industry workers and business functions through the NWDF, working with organisations to develop and train staff to increase their performance and contribution to the productivity and profitability of the enterprise. Organisations eligible to participate in the NWDF program include enterprises, professional associations and industry bodies. These bodies can submit applications to coordinate training initiatives on behalf of smaller enterprises seeking to participate in the program.

While not compulsory, when applying for funding through the NWDF, enterprises are encouraged to prepare and submit workforce development plans. These can be developed in collaboration with the Industry Skills Councils. Among their functions, the councils provide advice to the Australian and state and territory governments on the training that is required by industry, and prepare annual environmental scans. Many of these environmental scans, including, for example, AgriFood Skills Australia and the Community Services and Health Industry Skills Council's e-scans, note the need for increased digital literacy to enable all workers to better engage with technological change in all sectors.

The following case study features an innovative upskilling program for the ICT workforce funded though the NWDF. In particular, the case study demonstrates the benefits of the fund for SMEs.

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313 ACS, 2013, submission to AWPA ICT workforce study.

Case study: Delivering vital upskilling training through the National Workforce Development Fund

There is increasing demand for qualified skilled telecommunications workers, able to deliver and maintain the infrastructure essential to the nation's future, including the National Broadband Network. Many telecommunications workers do not have formal technical qualifications and are part of a mobile and transient workforce, which makes it difficult for them to undertake training.

Through a partnership between the Australian Government and Communications and Information Technology Training (CITT), a not-for-profit company, some 833 workers from six communications and technical services enterprises in the ICT industry have been given the opportunity to reskill and upskill.

This joint NWDF project of more than $2 million is making it possible for them to gain Certificate III qualifications as telecommunications cablers, cable jointers, linesworkers, digital reception technicians and broadband technicians.

Through Innovation and Business Skills Australia (the Industry Skills Council responsible for the ICT and Telecommunications industries, in addition to Business and Financial Services, Creative Industries, Printing and Graphic Arts and Training and Education), one company, Network Neighborhood, partnered with CITT to access customised, NWDF-funded training to increase its employees' skills and knowledge. Seven technicians from the company completed the Advanced Diploma of Information Technology (Project Management).[314]

Recommendation 11

That the Australian Computer Society, the Australian Information Industry Association and Innovation and Business Skills Australia work with industry bodies and ICT organisations, particularly ICT small to medium-sized enterprises, to promote the National Workforce Development Fund as a key enabler for organisations to identify and address their workforce development needs, including in relation to the National Broadband Network.

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314 Department of Industry, Innovation, Science, Research and Tertiary Education, 2012, *National Workforce Development Fund: Skilling Your Business,* p. 14, www.innovation.gov.au/Skills/ SkillsTrainingAndWorkforceDevelopment/NationalWorkforceDevelopmentFund/Documents/ SkillingYourBusiness.pdf, accessed 26 April 2013; IBSA, *Skilling Australians: Workforce Development Case Study—Network Neighborhood supporting ICT in Education*, ibsa.us2.list-manage1.com/track/ click?u=84aa4f6b4fbf30236b8b413ca&id=5ce7ca7fc7&e=1a63d54f6c, accessed 26 April 2013.

5.6 Improving the digital literacy of the broader workforce

In order to fully engage with, contribute to, and benefit from the digital economy, and as jobs across all industries are redesigned, it is essential that all Australian workers are supported in accessing training in digital skills. Digital literacy needs to be included as a core component of school education both in terms of content and delivery, as distinct from the teaching of specialised ICT, technology and computer science subjects. Post-school, the teaching of digital literacy skills must continue into tertiary education, and be a core component of ongoing workplace skills development. In its submission to AWPA, the Australian Industry Group (Ai Group) stated:

> Improving foundation skills, such as literacy, numeracy and problem-solving, is an important element of a workforce skills strategy for the digital economy. These skills are essential building blocks for digital capabilities in a technology rich environment and are the first step in the challenge of lifting the digital capabilities of the workforce … Ongoing monitoring of the digital literacy capabilities of the Australian workforce will be important to identify and act on any gaps in skills or training needs.[315]

Ai Group called for 'the development of a single statement or strategy setting out the critical areas of workforce development needs in a digital economy context'.[316] Similarly, IBSA has urged national decision-makers to 'form a digital literacy workforce development plan and skills strategy to enable industry to engage in the global economy and also to support the Australian Government's National Digital Economy Strategy'.[317] AWPA recognises that universal digital literacy is a significant national issue, and recognises the value in developing a single statement or strategy for preparing the broader workforce for the digital economy.

In its recent survey of existing and new skill sets and competencies underpinning digital literacy, IBSA has found that with increasing access to affordable information technology and high-speed broadband, the 'digital divide' is widening as efforts to improve ICT skills (or 'e-skills') struggle to keep pace with demand.[318] IBSA argues that:

> Compared with urban Australians who have had prior access to high-speed broadband and the requisite skills to use ICT, individuals and small businesses in NBN early-release rural and regional sites and those groups with historically low digital literacy apparently lack the e-skills required to more rapidly leverage the NBN.[319]

AWPA received a number of submissions providing examples of existing initiatives designed to improve digital literacy capabilities throughout the workforce. IBSA's Foundation Skills Training Package for the VET sector provides a pre-vocational pathway to employment and vocational training. The package covers reading, writing, numeracy, oral communication and learning skills, as well as entry-level digital technology and employability skills. Digital technology skills are taught at different levels, from basic to more routine digital skills for the workplace.[320]

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315 Ai Group, 2013, submission to AWPA ICT workforce study.

316 Ibid.

317 IBSA, 2013, *Digital literacy and e-skills,* p. 4.

318 Ibid., p. 1.

319 Ibid., p. 4.

320 training.gov.au, training.gov.au/Training/Details/FSK, accessed 30 April 2013.

The Australian Government's National Foundation Skills Strategy for Adults and Workplace English Language and Literacy programs likewise recognise digital literacy as a core skill for employment.[321] AWPA notes that it would be useful to audit government and private sector programs to improve digital literacy capabilities to identify and expand the most successful programs and methods.

Establishing a robust and respected certification program to recognise standards of capability and competence in both general and specialised areas of digital literacy would serve as an incentive to both workers and employers.

Conclusion

This chapter has examined the importance of ongoing skills development for the ICT workforce, highlighting high-performing workplaces that facilitate workforce development, and recognising the need for the ICT industry—as a whole, and at an enterprise level—to invest in developing the skills of its workforce. AWPA recommends the introduction of a one-year professional experience requirement for entry-level ICT professionals, and recognises the benefits of continued investment by enterprises across all sectors in the upskilling and reskilling of their ICT workforce to meet changing technological demands. This chapter has also discussed the importance of enhancing digital literacy skills development across all sectors of the Australian workforce.

The next chapter explores strategies to improve the supply of ICT skills through increasing the diversity of ICT employment by attracting and retaining women, mature-aged workers, Indigenous Australians and people with disability.

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321 Department of Industry, Innovation, Science, Research and Tertiary Education, *National Foundation Skills Strategy for Adults*, www.innovation.gov.au/Skills/About/Policy/NationalFoundationSkillsStrategyForAdults/Pages/default.aspx, accessed 30 April 2013; Department of Industry, Innovation, Science, Research and Tertiary Education, *Workplace English Language and Literacy (WELL) Program,* www.innovation.gov.au/Skills/LiteracyAndNumeracy/WorkplaceEnglishLanguageAndLiteracy/Pages/default.aspx, accessed 30 April 2013.

Chapter Six: Increasing the diversity of ICT employment

Introduction

One of the best ways to improve the supply of critical ICT skills is to expand the ICT industry's workforce beyond its current profile, which is largely male and aged between 25 and 44 years. Women, mature-aged workers, Indigenous Australians and people with disability are under-represented in the ICT workforce when compared to other industry sectors. This chapter examines the importance of workforce diversity, considers the reasons for the low levels of participation for particular groups in the ICT workforce, and presents some strategies to increase participation.

There are some general issues which impact on the workforce diversity of the ICT sector. These include workplace culture, job designs that are prescriptive and inflexible, and demands for lifelong learning, reskilling and upskilling. The high skills requirements of the sector and its technological focus have the potential to exacerbate issues around inequality, particularly for those individuals who may already experience disadvantage, including workers with disability and Indigenous Australians.

In addition, there are specific issues that create barriers for the participation of some groups in the ICT sector. For example, in relation to mature-aged workers, the ICT industry is perceived as ageist and discriminatory in its recruitment and job design structures.[322] Industry stakeholders reject the theory that skills obsolescence is the reason for this, and suggest that the demand in the ICT sector for soft skills could in fact be serviced by mature-aged workers. People with disability and Indigenous Australians tend to enter the VET system with lower levels of previous education than their non-disadvantaged counterparts. The National VET Equity Advisory Council (NVEAC) highlights the need for vocational training for many disadvantaged learners to include integrated delivery of foundation skills (including language, literacy, numeracy, employability skills and digital literacy).[323]

Australians based in regional and remote locations often face a different kind of disadvantage in relation to ICT skills development and employment. The high proportion of ICT investment and employment in urban locations makes entry into these occupations more difficult for individuals who cannot commute to metropolitan areas. Better integration of ICT workforce development and recruitment activities with existing regional networks could lead to greater opportunities for regional Australians to enter the ICT workforce.

As noted in the previous chapter, a recent survey of Australian IT professionals found that 50 per cent would be willing to forgo career progression to work flexible hours.[324] A survey

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322 ITCRA, 2012, *Mature Age Workers in ICT: Foundations, effects and approaches to ageism,* ITCRA research paper, January 2011.

323 NVEAC, 2011, *Creating Futures: Achieving Potential through VET (Equity Blueprint 2011–2016)*, www.nveac. natese.gov.au/home/equity_blueprint, accessed 23 May 2013.

324 Ambition, 2013, *Market Trends Report 1H 2013 Australia.*

conducted by APESMA found that 'women were more than twice as likely as their male counterparts to find lack of workplace flexibility and long working hours very demotivating', while 76 per cent of the women surveyed said that lack of work–life balance was a demotivating factor.[325] Flexible working arrangements can include changing the hours worked, changing patterns of work (for example, job sharing) and changing the place of work (for example, working from home and teleworking). While flexible working arrangements may be of value to all workers, they offer particular benefits for the under-represented groups discussed in this chapter.

Several innovative programs have been developed to address the expansion of workplace diversity in the ICT sector and some of these are featured in this chapter. There are also programs to improve career pathways into the ICT sector for young people from disadvantaged groups. The Australian Government's National Career Development Strategy, announced on 23 May 2013, includes a grant of $200,000 for the Service to Youth Council to partner IT-savvy disadvantaged young people with local businesses in need of social media skills.[326] As a relatively new and rapidly evolving industry sector, the ICT industry is well placed to integrate workplace diversity measures at systemic levels to ensure broad and diverse workforce representation. There is growing acknowledgement from stakeholders in the ICT sector that workforce diversity drives productivity and innovation.

6.1   Diversity and the ICT workforce

Workforce diversity is widely acknowledged as a key challenge for the ICT sector. As demonstrated in previous chapters, the ICT workforce is predominantly young and male, and the proportion of women, mature-aged workers, Indigenous Australians and people with disability working in the sector is particularly low.

Workplace diversity provides:

> all workers with the need and ability to develop multiple ways to think about and approach challenges. This capability doesn't exist when the organisation is staffed only by very similar types of individuals. Diversity of thinking results in higher performance both in terms of effectiveness and profitability.[327]

Industry bodies such as APESMA note that workforce diversity contributes to productivity and innovation. APESMA acknowledges that 'diversity creates opportunities to discover new ways of thinking and alternative approaches to doing things' and enhances 'problem solving and decision making'.[328]

The under-represented cohorts in the ICT workforce also suggest untapped sources of skills, particularly in a labour market that reports skills shortages and skills gaps.

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325 APESMA, 2011, *At the crossroads,* p. 13.
326 Garrett, P, 2013, '$6.1 million to kick-start careers', media release.
327 ITCRA, 2011, *Women in ICT: Discrimination Starts with a Stereotype*, ITCRA Research Paper, n.p.
328 APESMA, 2013, submission to AWPA ICT workforce study.

Stakeholders identify several barriers to workforce diversity in the ICT sector, including negative community perceptions of ICT, a theme that is discussed elsewhere in this report. Rebranding ICT to highlight the positive impacts of technology on a range of sectors may encourage greater participation and interest in ICT careers among those under-represented groups.

Submissions provided to AWPA also highlight the cost of training as a barrier to workforce diversity. Re-entry pathways into the ICT workforce for women returning to work and the reskilling needs of mature-aged workers to respond to the rapid technological changes in the ICT industry depend on the capacity of enterprises and individuals to access affordable, relevant and short-term training courses. The submissions highlight the cost and duration of university-based degrees and the increasing costs of VET courses as impediments to the entry and retention of under-represented target groups such as women and mature-aged workers. While online training is increasingly suggested as a solution, stakeholders caution that training models have to meet the preferences of the target groups.[329] Joint research conducted by NVEAC and the VET Flexible Learning Advisory Group also identifies the need for a student-centred approach and adequate learner support for successful e-learning delivery to disadvantaged learners in VET.[330]

The Cisco Networking Academy (see case study on page 124) is a good example of an affordable training program that is assisting under-represented groups in the ICT workforce to gain vital experience and knowledge.

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329 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

330 NVEAC, *Equity in VET: Good Practice Principles,* www.nveac.natese.gov.au/good_practice_equity_in_vet, accessed 13 May 2013.

Case study: Utilising targeted training to develop ICT skills in under-represented groups

Established in 1999, the Cisco Networking Academy is 'a global information and communications technology (ICT) education program' which provides 'increased access to career and economic opportunities in communities around the world'.[331]

The academy focuses on students developing skills in technical, business and '21st century soft skills' for high-level careers in the ICT industry. The courses are delivered through Cisco's global partnerships in 165 countries where 1 million students study at 10,000 academies in 19 languages. To date, 800,000 students have trained in academies in the Asia–Pacific region. The focus areas of the program include economic empowerment, community enablement and development of human capital, targeting women and disadvantaged groups in developing countries through partnerships with non-government organisations.

In Australia, the Cisco Networking Academy has trained 105,662 students as at 2012. The programs and partnerships delivered by the academy in Australia include:

> ➢ **Indigenous partnerships through the National Centre of Indigenous Excellence**[332] **Taoundi College, Port Adelaide:** The training is run onsite and includes support from Cisco to train Indigenous staff to deliver the courses. In addition, Cisco has also developed a Reconciliation Action Plan which includes as its vision to create 'replicable, scalable and sustainable education-to-employment models and tools that will help Aboriginal and Torres Strait Islander students achieve their potential in school, work and life.'[333]

> ➢ **The Cisco Networking Academy for the Vision Impaired (in partnership with Curtin University and the Association of the Blind WA):** This program offers both specialist and broad skills training with the former directed towards full Cisco certification. In the first year of the program, 23 out of 24 students succeeded in gaining employment. The ages of the students ranged from 18 to 80 years, and they came from countries including Canada, the United States, the United Kingdom, Egypt, South Africa, India and Barbados. The project supports students in financial need and states that it 'provides an affordable education solution that many blind people can't get locally. We never turn students away because of financial need.'[334] The program was the winner of the 2011 Australia and New Zealand Internet Access and Digital Skills Award in recognition of its 'borderless' international impact.

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331 Cisco, *About Networking Academy,* www.cisco.com/web/learning/netacad/academy/index.html, accessed 23 April 2013. All other information and quotes in the case study are sourced from the same site.

332 National Centre of Indigenous Excellence, www.ncie.org.au/index.php/support-us/valued-supporters.html, accessed 23 April 2013.

333 Cisco, *Reconciliation Action Plan,* www.reconciliation.org.au/getfile?id=121&file=CISCO+RAP+2012.pdf, accessed 23 April 2013.

334 Cisco Academy for the Vision Impaired and Curtin University Centre for Accessible Technology, www.ciscovision.org, accessed 23 April 2013.

At the enterprise level, models such as teleworking have been suggested as potential solutions to attract some groups, including women, mature-aged workers and Indigenous Australians, but employee and employer views on these models present a mixed picture. Recent media commentary demonstrates that some large enterprises have expressed reservations about remote working models.[335] Some employees, too, may find teleworking limiting, particularly when it has impacts on work–life balance and is based on assumptions about preferences and life circumstances.[336]

Managing workforce culture to integrate inclusive and diverse practices in enterprises is recognised as the foundation of a diverse workforce development strategy. APESMA highlights the influential factors of workplace culture as 'leadership styles, organisation structure, control systems [and] communication processes'.[337] Without attention to workplace culture, areas such as managing diversity, work–life balance and flexibility at work can be affected adversely.

Large enterprises such as Microsoft and IBM have espoused a broad diversity agenda as a core business practice linked both to employee workforce development programs and to their accessible product range. Resources to support diversity at Microsoft include Employee Resource Groups, Employee Networks and the Cross Disability Employee Resource Group, which includes constituents of employees with conditions such as deafness, blindness, visual impairments, attention deficit disorder, mobility disabilities, and dyslexia.[338] At IBM, the IBM Australia and NZ Diversity Council was established in 1996 and is empowered to commission research, recommend policy changes and instigate programs. Each of the diversity constituency areas has a sponsor who is a senior executive from the business and who actively supports and promotes their constituency area through a variety of activities.[339]

In the government context, the Department of Employment, Education and Workplace Relations (DEEWR) offers a range of enterprise-level resources and initiatives to facilitate diversity practices. These include the Experience+ Corporate Champions program for mature-aged workers and the National Disability Recruitment Coordinator. The programs focus on 'providing practical tools and assistance to get employers started in building their commitment to diversity employment and integrating it into workforce planning'. In addition, DEEWR offers a range of support programs aimed at individuals that 'take a career development approach, combining targeted pre-employment training with matching jobs and post recruitment support'.[340]

Submissions provided to AWPA have also drawn attention to cultural diversity issues related to skilled migrants and the need to optimise their skills. The Australian Industry Group notes that 'employing workers from overseas markets is not without challenges' and identifies cultural and

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335 Grubb, B, 2013, 'Do as we say not as we do: Googlers don't telecommute', *Sydney Morning Herald* (19 February), www.smh.com.au/it-pro/business-it/do-as-we-say-not-as-we-do-googlers-dont-telecommute-20130219-2eo8w.html, accessed 23 April 2013; Beer, S, 2013, 'Yahoo! CEO attempts to instil togetherness by ending teleworking', *IT Wire* (25 February), www.itwire.com/it-people-news/enterprise/58841-yahoo-ceo-attempts-to-instil-togetherness-by-ending-teleworking, accessed 23 April 2013.

336 ACS, 2010, *Improving Age Diversity in the ICT Workforce, report by the Australian Computer Society Ageism Taskforce*, p. 10.

337 APESMA, 2013, submission to AWPA ICT workforce study.

338 Microsoft, *Microsoft Global Diversity and Inclusion, Accessibility at Microsoft*, www.microsoft.com/en-us/diversity/programs/access.aspx, accessed 23 April 2013.

339 IBM, 2013, submission to AWPA ICT workforce study.

340 DEEWR, 2013, submission to AWPA ICT workforce study.

language barriers as factors that can impact on the effective engagement of these workers.[341] A workplace diversity strategy needs to address such issues in order to optimise the enterprise's investment in employing skilled overseas workers.

6.2   Engaging mature-aged workers in ICT

The wastage of available skilled labour resources through unemployment and underemployment in the older age cohorts (as well as in others such as for women) was around 9.3 per cent in Australia in 2007.[342] More recent data from the Australian Human Rights Commission indicates that older workers bring a net benefit to their employer of $1,956 per year as a result of factors such as increased retention and greater returns on investment in training.[343]

The participation of mature-aged workers in the ICT sector is lower than the national average for all occupations. Age discrimination is acknowledged as 'particularly rampant' in the ICT sector, even in a context of skills gaps and skills shortages.[344] The 'prime working age' in the ICT sector is reported to be as narrow as 25 to 35 years, compared to 25 to 54 years for all occupations.[345] There are difficulties reported in recruiting skilled ICT professionals at the same time as older ICT professionals report difficulties in finding employment.[346]

Table 1 compares information related to the age profile of the general workforce and the ICT workforce to the age profiles of ICT candidates (or job applicants) in Victoria sourced from recruitment data. While this information relates specifically to Victoria, it does show that the age profiles of the ICT job candidates and the ICT workforce are similar, and demonstrates that the labour market tends to respond to the pervasive trends within the sector around ageism. The New Zealand Department of Labour undertook a study using the Hutchens hiring opportunity index, which is a 'widely cited measure of openness of an occupation to older workers'[347] and represents 'the percentage of all new hires who were in a given age group divided by the percentage of all jobs in that same age group'.[348] The study found overall that jobs with 'high technology skill requirements' recruited the lowest shares of older workers.[349] The findings match international literature on the subject including US-based studies which found that 'occupations requiring computer use are also less open to older workers'.[350]

341   Ai Group, 2013, submission to AWPA ICT workforce study.

342   Mitchell, W, 2007, *Hidden Unemployment in Australia 2007*, Centre of Full Employment and Equity, University of Newcastle, working paper no. 07-05, e1.newcastle.edu.au/coffee, cited in ACS, 2010, *Improving Age Diversity in the ICT Workforce*, p. 12.

343   Australian Human Rights Commission, *Mature Workers: Myths and Facts around Older Workers,* hreoc.gov.au/mature workers/2_myths.html, cited in ACS, 2010, *Improving Age Diversity in the ICT Workforce,* p. 12.

344   ACS, 2010, *Improving Age Diversity in the ICT Workforce,* p. 5.

345   Ibid.

346   Ibid., p. 10.

347   Dixon, S, 2009, 'Who hires older workers? A first look at industry variations in the recruitment of mature workers', Statistics New Zealand and Department of Labour, p. 9, www.dol.govt.nz/publication-view.asp?ID=317, accessed 23 April 2013.

348   Ibid., p. 16.

349   Ibid., p. 23.

350   Ibid., p. 8.

However, enterprises seem to be willing to engage with this issue in a positive way. For example, in 2006, a survey of the top 50 companies in ICT found that only 5 per cent saw the ageing workforce as a challenge while 50 per cent saw it as an opportunity.[351]

Table 1:   Ratio of ages in working-age population compared to ratio of ages in ICT workers, 2010

Age group	Australian population (%)	Australian ICT workforce (%)	ICT candidates in Victoria (%)
15–24	12	11	8
25–34	23	33	44
35–44	23	30	32
45–54	22	18	13
55–64	18	7	3
65 and over	2	1	<1

Source: ITCRA, 2012, *Mature Age Workers in ICT: Foundations, Effects and Approaches to Ageism*, ITCRA Research Paper, p. 3. Sourced from ABS, 2010, *Australian Demographic Statistics*, March (cat. no. 3101.0).

Assumptions and stereotypes feed into ageist practices in the ICT sector. For example, skills obsolescence is often used as a reason for ageism in recruitment and retention decisions. Industry bodies such as the Australian Computer Society refer to the assumption about the limited capacity of older workers to learn new skills on the job as a 'red herring'.[352] Other similar perceptions include presumptions of preferences for part-time and insecure short-term contracts as older workers are assumed to be 'transitioning out of the workforce'.[353]

Assumptions around the currency of qualifications of mature-aged workers are also cited as concerns by recruiters and companies. For example, a recent graduate is assumed to have more current knowledge and skills when compared to an older worker with qualifications.[354] Such a view is at odds with the demand in the ICT sector for industry experience, which often creates challenges for new graduates. Mature-aged workers also contribute 'soft skills' including people skills and business skills, which are identified areas of skills gaps in the ICT sector.

There is a narrow bandwidth at both ends of the spectrum for ICT workers aged under 25 years (new entrants) and the 45 to 65-plus group (mature-aged workers). It is likely that many mature-aged workers are selecting themselves out of the ICT workforce beyond a particular age.[355]

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351 Deloitte Access Economics, 2006, *Deloitte technology Fast 50 Australia 2006: Recognising the 50 fastest growing technology companies in Australia,* cited in ITCRA, 2012, *Mature Age Workers in ICT*, p. 7.

352 ACS, 2010*, Improving Age Diversity in the ICT Workforce*, p. 10.

353 Ibid.

354 ITCRA, 2012, *Mature Age Workers in ICT,* p. 11.

355 Ibid., p. 10.

Several submissions provided to AWPA suggest strategies to increase the participation of mature-aged workers in the ICT workforce. Where mature-aged workers are looking for short-term contracts and flexible, non-standard hours, ICT businesses could benefit from recruiting from this cohort. Other options include the hiring of older workers 'as a test bed for new products aimed at mature IT users' and 'output based' work such as 'developing social media experience'.[356] The Australian Government Information Management Office's research indicates that flexible work arrangements provide particularly attractive benefits for mature-aged workers.

Incentives to mitigate risks make changing jobs later in working life more attractive to the mature-aged cohort. For example, the Queensland Government and industry partnership on graduate internships for mature-aged students could provide a model for the ICT workforce.[357]

Enterprises can include a range of strategies as part of their internal workforce diversity strategies, including:

➤ emulating the experiences of other industry sectors including the not-for-profit sectors, which attract high proportions of workers aged 55 to 74 years, as well as SMEs which tend to recruit older workers from larger enterprises to capitalise on their industry training and knowledge

➤ reassessing the remuneration scheme in ICT where, in many cases, the remuneration decreases or remains stagnant for workers with more than 10 years of experience

➤ changing the one-size-fits-all approach to job design

➤ providing access to upskilling opportunities, including workplace-based learning, for experienced workers

➤ conducting regular role design audits to ensure that the physical and knowledge requirements of the role match the capabilities of the worker.[358]

A recently launched Australian Government program, Experience+ Corporate Champions, supports employers to increase the recruitment and retention of mature-aged workers. The program supports employers to engage a professional assessment of workforce strategies, access to financial assistance, and advice on positive age management, superannuation, occupational health and safety, career planning, training, and recruitment-related age discrimination.[359] Other government initiatives include the Jobs Bonus program which provides $10 million over four years for employers offering ongoing employment opportunities to mature-aged workers.[360] An additional $35 million has been provided to the National Workforce Development Fund 'to improve the skills of workers aged 50 years and over consistent with their workforce development needs'.[361]

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356 IBSA, 2013, submission to AWPA ICT workforce study.

357 NICTA and AIIA, 2013, submission to AWPA ICT workforce study.

358 ITCRA, 2012, *Mature Age Workers in ICT*, pp. 12–13.

359 Ai Group, 2013, submission to AWPA ICT workforce study; DEEWR, *Experience + Corporate Champions,* deewr.gov.au/experience-corporate-champions, accessed 23 April 2013.

360 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 76.

361 Ibid., p. 77.

AWPA has previously highlighted the importance of access to lifelong career advice, noting that career development advice tends to be focused on secondary schools.[362] Access to high-quality labour market information will assist people of all ages to make informed choices and to proactively manage their careers. While earlier recommendations in this report directed to improving perceptions and promoting ICT careers have focused on school students, AWPA recognises some of the resources discussed in Chapter Three may be equally beneficial for older workers.

AWPA recommends that key peak bodies in the ICT sector address the identified need for accessible, targeted and affordable reskilling opportunities for mature-aged workers. As suggested in submissions provided to AWPA for this report, existing models of short retraining courses targeted at mature-aged workers could be adapted for online delivery. Online delivery models have to take into account the target audience, their preferences and their support needs which may require blended delivery modes (including various mixes of online, distance and face-to-face).[363] This could be done by drawing on mature-aged workers themselves as testers and as developers, as noted earlier in this chapter.

In addition, strategies to recruit from this pool of workers can be facilitated by identifying flexible job opportunities that will match the preferences of older workers. AWPA recommends that industry associations develop a register of employment positions that align with the work and lifestyle preferences of mature-aged workers.

Recommendation 12

That industry and professional associations build employer commitment to improving the attraction and retention of mature-aged workers. Strategies should include the following:

a) that Innovation and Business Skills Australia, industry bodies and ICT organisations develop and pilot short online modules to provide retraining opportunities for mature-aged workers wishing to enter the ICT workforce

b) that industry associations, organisations and recruitment firms develop a register of flexible, part-time ICT positions targeted to mature-aged workers.

6.3 Indigenous participation in the ICT sector

The gaps in indigenous engagement in technology, and the ways in which these gaps can be addressed, have attracted international attention. The World Summit on the Information Society (WSIS) Declaration on Indigenous Peoples and ICT sets out issues related to indigenous participation in ICT as well as principles to foster a respectful and collaborative approach to enhancing access for indigenous peoples. The key principle of the WSIS Declaration of Principles 2003 is that 'in the evolution of the Information Society, particular attention must be paid to the special situation of Indigenous peoples, as well as to the preservation of their

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362 Ibid., p. 100.
363 National VET Equity Advisory Council (NVEAC), *Equity in VET: Good Practice Principles.*

heritage and their cultural legacy'.[364] Indigenous Australians have been identified as being at particular risk of being disadvantaged due to limited access to broadband networks and a lack of ICT skills required to participate in the digital economy.[365]

In Australia, research indicates that the greatest barrier is lack of access compounded for some by remoteness and a lack of support infrastructure.[366] Where Indigenous students are provided access to technology, there is an 'overwhelmingly favourable' response.[367] Indigenous Australians are impacted by complex socio-economic factors that limit their uptake of and access to ICT. Where these intersecting factors are addressed, it has transformational outcomes on a range of social and economic circumstances beyond just ICT capabilities. Dr Peter Radoll, an expert in the usage of ICT in Indigenous communities, notes that there are both inhibiting and motivating factors in relation to the uptake of ICT in Indigenous households. Among the inhibiting factors are 'substance abuse, problem gambling, racism in the labour market, and practising Aboriginal law'. The motivating factors include 'education, employment, family and friends with ICTs, having school aged children in the home, and having a purpose to use ICTs in the home'. He concludes that when Indigenous Australians had opportunities to access ICT 'in their everyday activities', it transformed some of the limiting factors and enhanced ICT adoption in the household as well.[368]

Indigenous student outcomes for science, technology, engineering and mathematics lag behind those of non-Indigenous students. The Australian Curriculum, Assessment and Reporting Authority's National Assessment Program for ICT literacy for Years 6 and 10 found that there was a 'substantial gap' in ICT literacy between Indigenous and non-Indigenous students. In Year 6, 31 per cent of Indigenous students were assessed at 'proficient standard', compared to 64 per cent of non-Indigenous students; the percentages for Year 10 were 36 per cent and 66 per cent respectively. In addition, the outcomes showed variances based on location:

> The percentages of Year 6 students attaining the Proficient Standard were 66, 51 and 45 per cent for metropolitan, provincial and remote respectively. Among Year 10 students the percentages attaining the Proficient Standard for metropolitan, provincial and remote locations were 67, 58 and 47 per cent.[369]

As a significant proportion of Indigenous Australians live outside metropolitan regions, this finding will apply to them as well.[370]

364 Borrero, R, 2013, 'Indigenous peoples, WSIS, and the emerging uses of ICTs', p. 1, *World Summit on the Information Society (WSIS) Knowledge Communities,* www.wsis-community.org/pg/groupwiki/view/654701/indigenous-peoples-wsis-and-emerging-uses-of-icts, accessed 23 April 2013.

365 IBSA, 2013, *Digital literacy and e-skills*, p. 27.

366 Dyson, L, 2004, 'Cultural issues in the adoption of information and communication technologies by Indigenous Australians', *Proceedings Cultural attitudes towards Communication and Technology,* Murdoch University, p. 61, project.it.uts.edu.au/ipit/publications.html, accessed 23 April 2013.

367 Ibid., p. 62.

368 Radoll, P, 2011, 'The primary determinants of Indigenous household information and communication technology adoption: remote, rural and urban', *Australasian Psychiatry 19*: S49, apy.sagepub.com, accessed 5 June 2013.

369 ACARA, 2012, *National Assessment Program: ICT Literacy Years 6 and 10 Report 2011,* p. xxiii, www.nap.edu.au/verve/_resources/NAP_ICTL_2011_Public_Report_Final.pdf, accessed 10 June 2013.

370 AWPA analysis of ABS data, ABS, '2011 Census of Population and Housing'.

The OECD's 2009 Programme for International Student Assessment had similar results, finding 15-year-old Indigenous students on average performed more than one proficiency level (almost two full years of schooling) lower in both mathematics and science than their non-Indigenous colleagues.[371] A recent review of higher education access and outcomes for Indigenous students highlighted the significance of these findings, linking lower levels of attainment in science, technology, engineering, mathematics and other areas of literacy with lower transitions to higher education[372] (where only 1 per cent of students identify themselves as being from Aboriginal or Torres Strait Islander cultures).[373] With increasing specialisation in the ICT sector and corresponding increase in the demand for higher-level qualifications and skills, these levels of attainment and under-representation of Indigenous students in the tertiary sector present an important challenge to increasing Indigenous employment in the ICT labour market.

In 2007–08, DEEWR funded a project led by Charles Darwin University to run a series of action research projects to engage remote Indigenous students with ICT.[374] The project was run at several sites and produced, among other outcomes, a set of learnings on best practice in working with Indigenous communities in ICT. Some of the learnings were:

> ➤ Partnership approaches that are led by Indigenous elders and community members, and that deal with issues that are of relevance to the Indigenous culture and way of life, work best.

> ➤ Intuitive and simple technologies that incorporate Indigenous knowledge systems are good starting points for ICT engagement in Indigenous communities.

The work was supported by resources developed by other organisations including the Le@rning Federation.[375] While this project was primarily focused on enabling and enhancing ICT engagement at the school level, it does highlight the principles of engagement with Indigenous people that are of relevance at workforce and enterprise levels.

NBN Co also offers an example of programs currently underway to attract more Indigenous students to ICT training. NBN Co is piloting a marketing campaign encouraging Indigenous and other target groups to undertake telecommunications training. The aim is to increase the supply of skilled workers for occupations including broadband network linesworkers, fibre splicers and NBN installers.

Support to increase Indigenous participation in education and work is available through a variety of Australian Government programs that provide access to training and education and pathways to work more broadly. Examples include Job Services Australia, the Remote Jobs and Community Program and the National Workforce Development Fund.

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371 Thomson, S, De Bortoli, L, Nicholas, M, Hillman, K and Buckley, S, 2010, *Highlights from the full Australian Report: Challenges for Australian Education: Results from PISA 2009*, p. 11, www.acer.edu.au/documents/PISA-2009-In-Brief.pdf, accessed 24 May 2013.

372 Department of Industry, Innovation, Science, Research and Tertiary Education, 2012, *Review of Higher Education Access and Outcomes for Aboriginal and Torres Strait Islander People: Final Report,* p. 19, www.innovation.gov.au/HigherEducation/IndigenousHigherEducation/ReviewOfIndigenousHigherEducation/FinalReport/IHERFinalReport.pdf, accessed 22 May 2013.

373 Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education, 2012, *Student 2012 First Half Year: Selected Higher Education Statistics Publication, Summary, Attachment B*, www.innovation.gov.au/highereducation/HigherEducationStatistics/StatisticsPublications/Pages/default.aspx, accessed 23 May 2013.

374 Wallace, R, 2008, 'Engaging Remote and Very Remote Indigenous Students with Education using Information and Communication Technologies (ICTs)', Final Report, School of Education, Charles Darwin University.

375 Le@rning Federation, econtent.thelearningfederation.edu.au/ec/p/home, accessed 23 April 2013.

The Australian Government's National Digital Economy Strategy update includes initiatives targeted at improving digital access for remote Indigenous communities. It proposes the establishment of a Virtual Advisor service, as part of the Digital Enterprise Program, which will expand services through the 'use of online delivery channels and community centres with adequate broadband connections'.[376] Under the National Partnership Agreement element of the Indigenous Communications Program, there is funding for the installation and maintenance of public internet facilities in remote communities. Ongoing training and support are also provided to community members. By May 2013, more than 4,000 Indigenous Australians had received computer and internet training through the program.[377] Provision of free wi-fi access has also addressed the 'lack of communications services' through 'the installation of satellite community telephones'.[378]

DEEWR also has a suite of programs to assist employers with supporting access for Indigenous workers including the Indigenous Employment Program. This program includes initiatives that support youth career pathways, as well as the Indigenous Cadetship Service which supports Indigenous students to access cadetships with employers through paid work placements, and the Indigenous Wage Subsidy which provides up to $6,600 to employers to support the employment of Indigenous job seekers.[379]

DEEWR also provides funding to support Supply Nation, an organisation formed in 2009 to create business partnerships between its Indigenous and non-Indigenous members.[380] Message Stick is a good example of the mutual benefits of this approach. Message Stick is an Indigenous business specialising in the provision of a range of digital services including integrated audio, web and videoconferencing, engaging with diverse commercial and government partners to deliver these services. The enterprise has 80 of Australia's top corporate customers as clients and an annual turnover of $10 million. In addition to running a successful business, Message Stick aims to build partnerships between Indigenous and non-Indigenous businesses and to become a role model for Indigenous communities by developing successful business executives.[381]

To build on successful examples such as Message Stick, AWPA recommends that industry and professional associations work with employers to support investment and engagement in the Indigenous Australian workforce, by leveraging existing resources including enterprise-level Reconciliation Action Plans and assistance and tools available through Reconciliation Australia. Collaboration between industry, professional associations, tertiary education providers, Indigenous leaders, communities and government agencies is also an important aspect in developing approaches that support successful transitions from training into the ICT workforce.[382]

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376 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 61.

377 Ibid., p. 83.

378 Ibid., p. 85.

379 DEEWR, 2013, submission to AWPA ICT workforce study.

380 Commonwealth Bank of Australia, *Indigenous Australians: Creating social and economic opportunities*, www.commbank.com.au/about-us/sustainability-and-community/community/indigenous-australians.html, accessed 23 April 2013; Supply Nation, 'Case study: Commonwealth Bank of Australia and Message Stick', www.supplynation.org.au/resources/CBA_Message_Stick, accessed 23 April 2013.

381 Supply Nation, 'Case study: Commonwealth Bank of Australia and Message Stick'; Message Stick, *Our vision and objectives*, www.messagestick.com.au/section/30-our-vision-and-objectives.aspx, accessed 13 June 2013.

382 NVEAC, *Equity in VET: Good Practice Principles.*

Recommendation 13

That industry and professional associations and the Australian Government build employer commitment to improving the attraction and retention of Indigenous Australians, including by promoting the development of enterprise-level Reconciliation Action Plans and through assistance and tools available from Reconciliation Australia.

6.4   Engaging women in ICT

As indicated in AWPA's ICT Workforce Issues Paper, female participation in the ICT sector is very low compared to the national averages for all industries. A range of work has been undertaken at the academic level in relation to women's participation issues, and several programs have been developed that target girls at secondary school levels to engage with ICT. Some of these programs were discussed in earlier chapters. The discussion in this section focuses on the barriers and enablers to the engagement of working-age women in the ICT sector.

Some researchers argue that women's entry and career progression in the ICT workforce continues to be constrained by the very nature of the industry. The ICT industry has been cast as:

> not only culturally and discursively unfriendly to women, it appears to be structurally so as well … [and] the competitive, high pressure, aggressive nature of the IT industry makes it extremely challenging for women to return to the ICT field after childrearing.[383]

The separation of technical versus communication skills, creator versus user roles and individual versus collaborative work practices reflects the stereotypes of women as communicative, collaborative and passive users of technology as contrasted with men who are cast as technically adept, competitive and innovators of technology.[384] The prevalence of this stereotyping is evident in responses to job advertisements. For example, jobs such as business development manager attract about 50 per cent female applicants under 25 years of age, compared to 28.8 per cent for business/process analyst. Some jobs attract decreasing numbers of female applicants in the older age cohorts, which point to difficulties in re-entering the workforce after career breaks. For example, while 41.7 per cent of applicants for chief information officer, chief technology officer and ICT manager positions were women in the under-25 years age cohort, this declined to 21.5 per cent in the 35 to 44 years age cohort.[385]

The prevalence of men in high-value, high-income jobs in the ICT sector reinforces the perceptions of ICT as a male-dominated industry. Research in both developed and developing countries has demonstrated 'vertical gender segregation' where there is a 'feminisation' of ICT

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383 Demaiter, E, and Adams, T, 2009, '"I really didn't have any problems with the male-female things until …": successful women's experiences in IT organisations', *Canadian Journal of Sociology,* vol. 34, no. 1, p. 44, cited in ITCRA, 2011, *Women in ICT,* n.p.

384 ITCRA, 2011, *Women in ICT,* n.p.

385 Ibid.

jobs at lower levels.[386] The Australian Government Information Management Office's study of the ICT workforce also indicated that women are disproportionately represented in creative and training-based roles.[387]

The APESMA–ITPA survey of women ICT workers in 2010 identified several barriers to women's participation in the ICT workforce. These include:

- work–life balance (75 per cent of women surveyed indicated that this was the primary reason that they were considering leaving the IT profession compared to 44 per cent for female professionals generally)
- access to career development
- salary parity
- retention
- work culture and practices.

The pay disparities between male and female ICT workers highlight similar issues. Women in ICT jobs such as ICT trainers and business development managers earn more than their male colleagues, while those in more technical jobs such as application architect and software engineer earn about $30,000 less per year than their male colleagues. The difference in salary parity is also evident in managerial roles such as chief information officer, chief technology officer and ICT manager, where women are again paid about $30,000 less than their male colleagues. Research by the Information Technology Contract and Recruitment Association (ITCRA) indicates that skills traditionally associated with men, such as technical skills, can be more measurable in relation to business outcomes of the enterprise than 'soft skills' such as communication, which are generally associated with women and are difficult to quantify.[388] This has implications for determining the value of jobs and the remuneration offered.

However, the ACS 2012 survey of 538 ICT women professionals indicates that a majority of women surveyed (66 per cent) did not perceive that there was a pay disparity between men and women in the ICT sector. This in itself is not unsurprising as research has indicated that successful women often tend to 'downplay the significance of gender' and this could in fact have contributed to their success.[389] They also ranked more pay, more challenging work and better opportunities for promotion above factors such as childcare facilities and access to part-time hours.[390]

A study analysing the findings of the ACS 2012 survey identified diverse issues for women in the various age cohorts. For example, for women under 35 (the establishment career phase), the key issues were lack of training and opportunity and inequities in remuneration. Women in the 35 to 49 years age cohort (the growth career phase) identified work–life balance and support for returning to work after career breaks as key issues, while for the over-50 years

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386 International Telecommunication Union, 2012, *A bright future in ICT*, p. 2.

387 Australian Government Information Management Office (AGIMO), Department of Finance and Deregulation, 2012, 'ICT Skills Issues Paper', unpublished paper, p. 21.

388 ITCRA, 2011, *Women in ICT*, n.p.

389 Demaiter, E, and Adams, T, 2009, '"I really didn't have any problems with the male-female things until …": successful women's experiences in IT organisations', p. 33.

390 ACS, 2013, *Working Report—Australian Computer Society Women's Board Survey 2012*, www.acs.org. au/__data/assets/pdf_file/0020/16724/ACSW-SURVEY-Metric-Results-WORKING-REPORT_11-Feb-2013.pdf, accessed 16 May 2013.

age cohort (the maintenance career phase), male-dominated work culture, ageism and lack of challenging work were the main concerns.[391] These findings demonstrate that the gendered notions of the ICT sector are not homogeneous and can manifest in complex ways that need to be addressed through internal workplace diversity mechanisms.

Several submissions provided to AWPA highlight job redesign as a key strategy for workforce development in the ICT sector. In fact, gendered job designs limit the potential of both men and women in the ICT sector to exercise freedom in accessing jobs that match their individual skills and interests. Research undertaken by ITCRA notes that:

> The greatest danger that this poses is that gender roles shift: employers risk losing both male and female workers if they fail to provide workplaces that are people-friendly.[392]

Job redesign that removes gender-based perceptions of roles, including in relation to the capabilities required for those roles, and provides for flexibility for all workers without gender-based assumptions will bring benefits to the whole workforce. Harnessing the strengths of gender diversity is important for enterprises to develop best practice models for enhanced business outcomes. Studies have demonstrated that diverse teams 'make better informed decisions, leading to less risk taking and more successful outcomes for companies'.[393]

While external support networks play a role in supporting women in ICT, internal workplace diversity measures are equally important.[394] Internal measures should include monitoring and evaluation and reviews of development measures and programs to ensure that they do not include 'diversity averse' language and instead value 'cultural paradigms' with both competitive and cooperative working practices.[395] Internal organisational practices should also incorporate mentoring support, reporting on 'Thinking Capacity/Diversity metrics'[396] and small work group structures that enable a focus on individual capacity and talent.

The importance of accessing women's skills and participation in Australia was acknowledged in AWPA's 2013 National Workforce Development Strategy, which recommended 'government co-contribution funding over three years for industry-led initiatives to support employment for men and women in non-traditional occupations in skills shortage areas'.[397]

391 Bandias, S, and Warne, L, 2009, *The Career Stage Effect on Women in ICT: An overview of the ACS-W survey,* p. 13, www.ntwwc.com.au/uploads/File/.../Bandias,%20Warne.pdf, accessed 16 May 2013.

392 Demaiter, E, and Adams, T, 2009, '"I really didn't have any problems with the male-female things until …": successful women's experiences in IT organisations', p. 44.

393 International Telecommunication Union, 2012, *A bright future in ICTs,* p. 3.

394 Demaiter, E, and Adams, T, 2009, '"I really didn't have any problems with the male-female things until …": successful women's experiences in IT organisations', p. 44.

395 Ibid.

396 ITCRA, 2011, *Women in ICT: discrimination starts with a stereotype,* ITCRA research paper, April 2011, n.p.

397 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy*, p. 74.

Employers are able to seek funding for skills development measures through the National Workforce Development Fund.

Given the range of issues outlined above, AWPA recommends targeted support for women in ICT. First, a code of best practice should be formed to highlight the most effective enterprise-level strategies in place to attract, develop and retain female talent and assist businesses to make their workplaces female-friendly. The Australian Human Rights Commission has released a toolkit of strategies to increase women's recruitment and retention in male-dominated industries, which may assist in the development of the code. The toolkit provides practical examples of strategies to improve attraction, recruitment, retention and development of women in all industries with a particular focus on industries such as construction, mining and utilities which are traditionally male-dominated. The strategies suggested are equally applicable to the ICT sector and provide a valuable reference for the development of a code of best practice for women in ICT.[398]

Second, to support women in the ICT workforce, the establishment of dedicated mentoring and advisory services at the enterprise level could provide valuable support mechanisms. These strategies would support the retention of women in the sector, but they would also send the right message to prospective female employees.

AWPA notes that a range of programs are already in place to mentor female ICT workers, including the Victorian ICT for Women Network, Swinburne University of Technology's Women in ICT, and Women in ICT awards. The Victorian ICT for Women Network is 'an industry-driven initiative which aims to facilitate entry, retention and progression for women working in ICT'.[399] It runs a free mentoring program for its members targeted at women who are currently in the workforce. Swinburne University of Technology's Women in ICT was initiated in 2005 and is open to women enrolled in ICT courses, academics and female staff of ICT faculties. It supports members to foster industry networks by developing various activities around themes such as leadership, women and diversity issues, gender audits and publications.[400] These programs provide excellent models for enterprises to consider in the development of their own mentoring and support services.

In addition, a number of ICT multinational companies put in place targeted programs for their female workforces. For example, IBM has targeted female development programs to attract, retain and develop women, including the Women in Technology community, which provides a forum for IBM women to connect with their peers across the business, share information and experiences, and build support networks that will help build successful and fulfilling IBM careers.[401]

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398 Australian Human Rights Commission, 2013, *Women in male-dominated industries: A toolkit of strategies.*

399 Victorian Women in ICT, www.vicictforwomen.com.au/about-us/about-the-network, accessed 10 May 2013.

400 Swinburne University of Technology, *Women in ICT,* www.swinburne.edu.au/ict/wict/about.php, accessed 10 May 2013.

401 IBM, *Diversity in IBM, Advancing women.*

Recommendation 14

That industry associations and women within IT organisations build employer commitment to improving the attraction and retention of female workers, including by:

a) developing a code of best practice for women in ICT in collaboration with female academics and industry leaders

b) promoting mentoring services for female ICT workers, and providing advice on how to set up an in-house mentoring service.

Support is also required to assist women with career progression in the ICT sector. The following case study features a program that supports women to develop leadership skills through a formal mentoring arrangement.

Case study: Mentoring female ICT executives

The Women in IT Executive Mentoring program, managed by the Australian Government Information Management Office (AGIMO) and sponsored by Dell Australia™, was established in 2007 with the aim of accelerating the development of leadership skills for Executive Level 2[402] women within ICT. The program forms part of a longer-term strategy to attract and retain women within the Australian Public Service (APS). It combines one-to-one mentoring with cross-organisational learning and facilitated group networking. Mentees are matched with mentors, typically chief information officers, from other agencies for the duration of the 12-month program. Since its inception, the Women in IT Executive Mentoring program has had a positive impact on more than 120 mentors and mentees from various senior management roles across the APS.

In 2012, AGIMO piloted a new coaching program to build on the success of the program. The 10-month coaching program combines one-to-many coaching sessions, training modules and facilitated group sharing for small groups of Executive Level 1 women working in ICT. During the pilot, 62 participants benefited from the program. Due to the success of the pilot, the program is scheduled to take place annually, with the next program commencing in July–August 2013.

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402 APS positions are classified according to the nature of the role and level of responsibility. Executive Level 1 and Executive Level 2 refer to middle management positions within the APS.

6.5   Engaging people with disability in ICT

The ICT sector is responsible for many accommodative technologies to assist people with disability. Yet ICT is 'the field where employers are less likely to engage someone with a disability'.[403]

Some of the barriers to employing people with disability include the high costs of accommodative technologies and structural changes where required, and workplace culture issues around diversity training and knowledge.

However, research undertaken by ITCRA notes that the costs of accommodative technologies have decreased over time.[404] In relation to structural changes, adopting principles of 'universal access' can provide better return on investment for employers. In addition, changes made to accommodate specific employees could result in benefits for other workers. For example, flexible work arrangements such as teleworking can address a range of employee needs and not just those of workers with disability. Other stakeholders have also noted that 'telework and desk based activities' can provide opportunities to enhance the employment of people with disability.[405]

The ITCRA study identifies key strategies to enable the engagement of workers with disability by the ICT sector. These include:

> diversity training in the workplace that incorporates issues of disability, including for managers

> technical support including structural changes such as adapted desks and workstations as well as accommodative technology

> flexibility in relation to workplace expectations including for scheduling appointments

> ongoing support and assistance for the employee to access relevant services.[406]

Key stakeholders in the ICT sector acknowledge the invisibility of workers with disability in the sector. For example, the Australian Computer Society has indicated that it is considering whether it will develop an advocacy group for ICT workers with disability.[407]

There are several government programs that support the employment of people with disability. These include DEEWR's Disability Employment Services which can assist ICT employers with recruiting and provide ongoing support and assistance for job seekers. In addition, the DEEWR National Disability Recruitment Coordinator can support and promote employment of people with disability to large employers.[408]

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403 Falls, O, 2000, 'IT accessibility hinges on cooperation', *Government Computer News* (11 September), p. 17; Melymuka, K, 2000, 'IT outsiders don't have to feel alone', *Computerworld* (13 November), p. 55, cited in ITCRA, 2011, *Disability and ICT: Re-think the equation and review the opportunity*, ITCRA Voice research paper, n.p.

404 ITCRA, 2011, *Disability and ICT,* n.p.

405 Information Technology Industry Innovation Council (ITIIC), 2013, submission to AWPA ICT workforce study.

406 ITCRA, 2011, *Disability and ICT*, n.p.

407 ACS, 2013, submission to AWPA ICT workforce study.

408 DEEWR, 2013, submission to AWPA ICT workforce study.

6.6   Engaging regional Australians in ICT

As outlined in Chapter One, the majority of ICT employment is based in New South Wales, Victoria and Queensland, and much of this activity is based in metropolitan locations in these states. Notably, in recent years some regional locations have established ICT hubs, including Wollongong, Ballarat and Geelong.

In the short term, the construction of the NBN will require a pool of skilled workers in each of the major regional centres.[409] The improvement of digital infrastructure through the NBN rollout may increase the proportion of ICT investment and employment in regional Australia. For example, recent research suggests that NBN-enabled telework could create up to 10,000 additional jobs in regional Australia by 2020–21.[410] In addition, given the potential increased decentralisation of ICT and other services to regional centres, and the increasing importance of ICT to a range of industry sectors, improving infrastructure is likely to confer broader economic benefits on regional communities. Research quoted in the National Digital Economy Strategy states that, on average, a 10 per cent increase in connectivity speeds raised regional output by 0.53 per cent, compared with a 0.38 per cent increase in metropolitan areas.[411] The Australian Government's National Digital Economy Strategy update included initiatives to strengthen digital access to regional Australians, including the expansion of the Digital Hubs program and through Digital Enterprise providers.[412]

As economic and employment opportunities enabled by improved digital infrastructure become available in regional Australia, industry and tertiary providers will need to work together to ensure that individuals can access the skills development required to compete for ICT positions. This will require place-based approaches to developing the local workforce and addressing industry demand. These approaches have been used across a number of DEEWR programs, including Local Employment Coordinators and Regional Education, Skills and Jobs Coordinators. These facilitators focus on opportunities for unemployed and lower-skilled workers, but the approaches and methods they use of engaging with employers and employment services providers, and working together to match candidates to courses that meet industry needs, are also applicable to other skills levels such as ICT professionals.

Best practice research by the National VET Equity Advisory Council has highlighted the value of strong partnerships at a local level to support disadvantaged learner pathways and transitions from training into sustainable employment.[413] Supporting partnerships and collaborative arrangements will be equally as important to creating pathways for disadvantaged learners to sustainable employment in the ICT sector.

409 NBN Co, 2013, submission to AWPA ICT workforce study.

410 Colmar Brunton Research and Deloitte Access Economics, 2012, *NBN enabled telework: The economic and social impact on labour force participation*, report for the Department of Broadband, Communications and the Digital Economy, Australian Government, Canberra.

411 The Allen Consulting Group, 2010, 'Quantifying the economic gains of getting more Australian households online', pp. 36–8, cited in Department of Broadband, Communications and the Digital Economy, 2011, *National Digital Economy Strategy*, Australian Government, Canberra.

412 Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 82.

413 NVEAC, *Equity in VET: Good Practice Principles.*

DEEWR suggests that, for highly skilled ICT positions, higher education institutions and the Australian Computer Society may be better placed than employment services providers to provide advice to ICT students, graduates and workers about the location of job opportunities and skills needs. AWPA recommends that these stakeholders work with Local Employment Coordinators and Regional Education, Skills and Jobs Coordinators to develop place-based approaches to matching job seekers with ICT employers and recruitment organisations.

Recommendation 15

That the Australian Computer Society, the Australian Information Industry Association, relevant employment services organisations and tertiary education providers develop place-based approaches to matching job seekers with ICT employers and recruitment organisations, building on existing regional networks, including Local Employment Coordinators and Regional Education, Skills and Jobs Coordinators.

Conclusion

As discussed in this chapter, under-representation of groups in the ICT workforce is not just an issue of equity, but it is also one of lost opportunities. These include the loss of potential sources of skills and the missed opportunity to rebrand ICT as an inclusive sector.

As the discussion and case studies in this chapter illustrate, diversifying the workforce may in fact solve other problems for the ICT workforce. For example, accessing the skills of mature-aged workers could potentially fill gaps in soft skills, and the redesign of jobs to make them more flexible may benefit all workers and not just women or mature-aged employees.

Chapter Seven: Strategies to improve data collection on ICT skills supply and demand

During consultations conducted for this study, concerns were raised about the adequacy of data relating to the demand and supply of ICT skills. Adjusting to the rapid development of new occupations driven by technological change and industry restructuring is a key challenge for any data classification and collection system.[414] In a rapidly evolving sector such as ICT, these issues are not easily resolved. By the time data is cleaned, processed and analysed, considerable time can elapse. It seems much more important to ensure that the method used to collect any data adheres to rigorous scientific principles so its reliability cannot be questioned. Standards for collecting data have to remain constant for a certain period of time so that comparisons over time can be made.

A stocktake of the various datasets that contain information on the ICT sector is a good idea, but it needs to be accompanied by a label to indicate the reliability of each dataset. Stakeholders have suggested including ICT data in the ABS Essential Statistical Assets for Australia initiative, which aims to identify areas of duplication and underutilisation and critical information gaps.[415] The ABS has identified 'the impact of the evolving digital economy on all aspects of Australian society as one of the emerging fields of statistics that are currently under conceptual development'.[416]

Stakeholders also drew attention to the increasing complexity of the sector, to the need to capture ICT-related expertise required by other domains including health, mining and ICT forensic investigators, and to the special cross-disciplinary skills demanded by these sectors. Some telecommunications occupations are not captured in the current ABS ICT occupations list which, according to stakeholders, has been to the detriment of workforce planning for these occupations. As demand in many of these occupations is rising, steps will need to be taken to ensure that they are included in any broader analysis of the ICT sector.[417]

Given the complexity of ICT skills requirements, and the regular development of new products, technologies and services that give rise to new occupations or alter skills requirements in existing occupations, AWPA recommends a regular update of the ABS alternative view on ICT occupations and DEEWR analysis of current trends in the ICT workforce. From the perspective of education and training providers, however, it is more important to have up-to-date information on the changing skills needs than on new occupations. Industry

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414 APESMA, 2013, submission to AWPA ICT workforce study.

415 ITIIC, 2013, submission to AWPA ICT workforce study.

416 ABS, 2013, 'Essential Statistical Assets for Australia' (cat. no. 1395.0), p. 7, www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/DDA6B8011409DCB4CA257B2D000D2C9B/$File/essential%20statistical%20assets%20for%20australia_1395_0.pdf, accessed 12 June 2013; Department of Broadband, Communications and the Digital Economy, 2013, *Advancing Australia as a Digital Economy: an update to the National Digital Economy Strategy,* p. 5.

417 IBSA, 2013, submission to AWPA ICT workforce study.

investment patterns in technology can often provide information about emerging areas of workforce needs.[418]

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Recommendation 16

That the Australian Bureau of Statistics (ABS), together with the Australian Computer Society, the Australian Information Industry Association and other key ICT industry bodies, review current ABS ICT-related collections to help ensure accurate, comprehensive and up-to-date measurement of the ICT workforce and ICT activity in the economy.

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418 Ai Group, 2013, submission to AWPA ICT workforce study.

Conclusion: Recommendations and responsibilities

Recommendations and responsibilities

Table 2:   Responsible body and partners for implementing the recommendations

Recommendation and responsible body	Target group	Partners	Objective
Australian Council of Deans of ICT			
➤ Promote the incorporation of digital literacy into all undergraduate degrees and develop and pilot a cross-disciplinary unit (Recommendation 7)	University students	Other deans' councils	Improving digital literacy across all sectors
➤ Develop and pilot a semester-long ICT module to be delivered and assessed online (Recommendation 1)	Secondary school students	NICTA, Education Services Australia	Improving ICT skills pipeline
➤ Develop and pilot an ICT-intensive skills conversion program for recent graduates from other disciplines (Recommendation 8)	Recent graduates in non-ICT disciplines	ACS, AIIA, IBSA	Increasing supply of high-quality ICT Skills
National ICT Australia			
➤ Develop a suite of targeted careers promotion products using social media and IT platforms that demonstrate how ICT skills can be an enabler across a range of careers (Recommendation 4)	Young people, parents, women, mature-aged workers	AIIA, ACS, industry bodies	Careers development
Australian Computer Society			
➤ Include visits by ICT professionals to schools on the schedule of activities for continuing professional development of ICT professionals (Recommendation 3b)	Secondary school students	ACS members	Careers development
➤ Develop and pilot a one-year professional experience program for entry-level ICT professionals (Recommendation 10)	New graduates	AIIA	Effective use of skills
ACS Foundation			
➤ Undertake a pilot program to broaden its school matching service to include development of curriculum materials, comprehensive support and business-driven mentoring (Recommendation 2b)	Technology teachers	Industry groups, government	Improving ICT skills pipeline

Recommendation and responsible body	Target group	Partners	Objective
Australian Computer Society and Australian Information Industry Association			
➢ Promote the benefits to ICT professionals of participating in the newly expanded Scientists and Mathematicians in Schools program to showcase ICT careers (Recommendation 3a)	Secondary school students	DEEWR, ICT bodies, ICT professionals	Careers development
➢ Develop place-based approaches to matching job seekers with ICT employers and recruitment organisations (Recommendation 15)	Regional Australians	Local Employment Coordinators, Regional Education, Skills and Jobs Coordinators, employment services organisations, tertiary education providers	Increasing the diversity of ICT employment
Association of Professional Engineers, Scientists and Managers, Australia			
➢ Develop and pilot a cross-sector program comprising case studies, testimonials and instructional guides that highlight high-performing workplaces using ICT-intensive skills (Recommendation 9)	Industry employers	AIIA, ACS	Effective use of skills
Innovation and Business Skills Australia			
➢ Develop and pilot short online modules to provide retraining opportunities for mature-aged workers wishing to enter the ICT workforce (Recommendation 12a)	Mature-aged workers	Industry bodies, ICT organisations	Increasing the diversity of ICT employment
➢ Promote the National Workforce Development Fund as a means of upskilling and reskilling existing workers including in relation to the National Broadband Network (Recommendation 11)	Enterprises, especially SMEs, and existing workers	ACS, AIIA	Effective use of skills
Australian Government			
➢ Establish a program dedicated to enhancing the training of ICT teachers based on the existing Enhancing the Training of Mathematics and Science Teachers Program (Recommendation 2c)	ICT teachers	Industry partners, eligible partner institutions	Improving teacher training
➢ Monitor outcomes of the Australian Government ICT Apprenticeship Program, and if successful, develop and pilot a national apprenticeship/traineeship model for ICT technicians and trades workers (Recommendation 6)	Young people, enterprises, especially SMEs	Industry associations, ICT organisations	Increasing supply of high-quality ICT skills

Recommendation and responsible body	Target group	Partners	Objective
Australian Bureau of Statistics			
➤ Review ABS ICT-related collections and report back to improve measurement and reporting of ICT workforce and ICT activity in the economy (Recommendation 16)	All users of government statistics	ACS, AIIA, other ICT bodies	Responding to information needs
Australian Government and state and territory governments			
➤ Introduce scholarships and/or VET FEE-HELP support to enable teachers and pre-service teachers to acquire additional qualifications and/or skill sets in ICT education (Recommendation 2a)	Teachers, pre-service teachers		Improving teacher training
➤ Increase funding support to expand WIL and other professional experience programs and improve integration between WIL and course learning objectives (Recommendations 5a and 5b)	Tertiary students and providers	Tertiary providers, industry	Improving employment readiness of graduates
➤ Promote the mutual benefits of WIL programs for SMEs (Recommendation 5c)	SMEs, tertiary students and providers	Tertiary education providers, industry associations, industry	Improving employment readiness of graduates
➤ Support an evaluation of employment outcomes and career progression of students who have undertaken work-integrated learning (Recommendation 5d)	Potential students and tertiary providers	Tertiary education providers, industry, research bodies	Improving employment readiness of graduates
Industry associations			
➤ Develop a register of flexible, part-time ICT positions targeted to mature-aged workers (Recommendation 12b)	Mature-aged workers	ICT enterprises, recruitment firms	Increasing the diversity of ICT employment
➤ Build employer commitment to improving the attraction and retention of Indigenous Australians, including promoting the development of enterprise-level Reconciliation Action Plans and using assistance and tools available from Reconciliation Australia (Recommendation 13)	Indigenous Australians	Australian Government	Increasing the diversity of ICT employment
➤ Develop a code of best practice for women in ICT in collaboration with female academics and industry leaders, and promote mentoring services and advice for female ICT workers (Recommendations 14a and 14b)	Women in ICT	Female academics and industry leaders	Increasing the diversity of ICT employment

Appendix One: AWPA modelling of future employment across key ICT occupations

AWPA's modelling of future employment across key ICT occupations is based on four scenarios.[419] The scenarios are not projections, nor are they based on past trends, but represent a range of possible futures. The four scenarios are:

1. The long boom: The economy recovers from the financial uncertainty of 2012 and India and China drive the demand for Australian resources. Mining and construction continue to thrive in Australia.

2. Smart recovery: A protracted European downturn and slowing growth in China and India create a drop in demand for Australian resources. As global growth resumes from 2014–15, the Australian economy looks to knowledge-based industries to drive growth, which leads to increased demand in technology-related skills.

3. Terms of trade shock: An oversupply of commodities creates a drop in commodity prices. Australia moves to a broad-based economy with internationally competitive businesses.

4. Ring of fire: In a context of natural disasters, global crises, political unrest and increased protectionism, the lower Australian dollar enables the strengthening of trade-exposed industry sectors.

AWPA analysis of the common themes across the scenarios indicates that technology is a key driver in all cases. Table 3 outlines projected employment in ICT occupations by 2025. The 'ring of fire' scenario is excluded as it has a very different set of assumptions to the other models.

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419 AWPA, 2013, *Future focus: 2013 National Workforce Development Strategy.*

Table 3: Employment in ICT occupations for three AWPA scenarios, as at 2025

Occupation	2025		
	Long boom ('000)	Smart recovery ('000)	Terms of trade shock ('000)
ICT Managers	78.4	70.8	72.9
ICT Trainers	7.4	6.8	7.1
ICT Sales Professionals	25.1	22.4	23.2
Graphic and Web Designers, and Illustrators	73.7	65.7	68.9
Electronics Engineers	12.0	11.2	11.4
ICT Business and Systems Analysts	52.4	47.9	49.1
Multimedia Specialists and Web Developers	21.8	18.9	19.9
Software and Applications Programmers	166.3	147.5	153.2
Database and Systems Administrators, and ICT Security Specialists	62.3	57.4	58.8
Computer Network Professionals	50.3	45.7	47.1
ICT Support and Test Engineers	21.7	19.5	20.1
Telecommunications Engineering Professionals	14.0	12.6	13.0
Electronic Engineering Draftspersons and Technicians	7.0	6.5	6.6
ICT Support Technicians	78.5	72.0	73.0
Telecommunications Technical Specialists	7.0	6.6	6.5
Electronics Trades Workers	42.3	39.4	39.2
Telecommunications Trades Workers	17.5	15.8	15.6
ICT Sales Assistants	26.9	25.0	25.3
TOTAL ICT	764.4	691.7	711.0
Proportion of employment in ICT occupations	5.1%	4.9%	5.0%
Rate of growth of ICT occupation employment	3.3%	2.5%	2.7%
Rate of growth of all occupation employment	2.0%	1.5%	1.6%
Comparison of ICT occupation growth with all occupation growth ('XX per cent faster than overall employment growth')	64%	66%	72%

Source: Deloitte Access Economics, 2012, *Economic modelling of skills demand and supply: Australian Workforce and Productivity Agency,* unpublished data.

Appendix Two: Stakeholders in AWPA ICT workforce study

1. Box Hill Institute of TAFE*
2. Australian Council for Private Education and Training*
3. Deakin University*
4. Australian Computer Society*
5. Computing Research and Education Association of Australasia (CORE)*
6. Australian Council of Deans of Information and Communications Technology*
7. Communications and Information Technology Training Limited (CITT)*
8. National ICT Australia*
9. Australian Information Industry Association*
10. Innovation and Business Skills Australia*
11. IC Central*
12. Swinburne University*
13. Australian Government Information Management Office*
14. National Broadband Network (NBN) Co*
15. Australian Industry Group*
16. Information Technology Industry Innovation Council*
17. Australian Services Union*
18. Association of Professional Engineers, Scientists and Managers, Australia*
19. Department of Education, Employment and Workplace Relations*
20. IBM Corporation*
21. Telstra
22. Cisco Systems, Inc
23. Google Australia
24. Microsoft
25. Energy Skills Australia (E-Oz)
26. Westpac
27. Bike Exchange
28. Digital Economy White Paper Task Force, Department of the Prime Minister and Cabinet
29. Universities Australia
30. TAFE Directors Australia
31. Communications Electrical Plumbing Union
32. Northern Sydney Institute TAFE

Additional stakeholders consulted

1. Department of Broadband, Communications and the Digital Economy
2. Enterprise Connect
3. Industry Skills Branch, Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education
4. Department of State Development, Business and Innovation, Victorian Government*
5. Office for Learning and Teaching
6. National VET Equity Advisory Council
7. Australian Curriculum, Assessment and Reporting Authority
8. Education Services Australia

* These organisations provided submissions and/or input into the Overview and Recommendations.

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