A REVIEW OF THE ICT SKILLS SUPPLY & DEMAND IN WESTERN AUSTRALIA

A Research Report

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Executive Summary

The following report outlines the findings of study into the supply and demand for ICT skilled occupations in Western Australia. The study involved an analysis of the 2006 Census data and selected occupational categories from the Australia and New Zealand Standard Classification of Occupations (ANZSCO) framework. Surveys were also undertaken with universities and training colleges and employers from a cross section of industries in order to obtain a supply and demand perspective. The study also involved a review of existing literature and discussions with key industry bodies.

Current Status of the ICT Sector in WA

The WA ICT sector employs between 16,000 and 20,000 people depending on how the sector is measured. They are organised broadly into ICT Professionals, ICT Engineers, ICT Technicians and ICT Sales, Designers and Trainers. These individuals work within either ICT producing firms (e.g. those that manufacture software or hardware), or ICT using firms. There are an estimated 1,800 specialist ICT firms in WA although this "sector" is difficult to accurately measure due to the way in which the ANZSIC industry classifications are designed. For example, a large proportion of the ICT sector is located within the property and business services area where it comprises just over half that ANZSIC classification but is not recognised as ICT industry. The largest pool of ICT employees are support technicians, particularly the ICT Customer Support Officers or ICT Help Desk Officers. Software programmers are also numerous, followed by Software Engineers and then Systems Administrators.

The ICT workforce in WA, like its counterparts elsewhere in Australia, is predominately male, young and well educated. It is also significantly more international than other sectors, with a high proportion of people born overseas. Ninety-five percent of the ICT workforce is located in Perth. Most ICT occupations require university or trade qualifications, however, a relatively high proportion of employees have no post-secondary education and have presumably secured their jobs with a combination of experience and vendor certification.

The Demand for ICT Skills for the WA Workforce

A survey of 80 firms across nine key industry sectors was undertaken. Interviews took place with the CEO or Managing Director, senior Human Resource Managers or senior ICT managers. The firms were a balance of large, medium and small firms, and all were employing ICT workers across all ANZSCO occupational categories.

Problems were identified in recruiting ICT Professionals, particularly Programmers, Software Engineers and Systems Analysts. Larger firms were experiencing more problems in finding analysts than their smaller counterparts. Fewer problems were found in recruiting ICT Engineers, although there was some who identified problems finding Electronics Engineers. A similar pattern emerged for ICT Technicians, although some shortages were identified in finding computer systems technicians and electronic engineering technicians. There were also relatively few problems finding ICT Sales, Design and Training staff.

Forty-five percent of firms reported a desire to keep all ICT roles in-house rather than outsourced, with larger firms more likely to adopt this policy than their smaller counterparts. Just over half of those surveyed perceived the supply of locally educated ICT specialists to be in decline, although a majority forecast their demand for ICT skills would increase over the next three years.

When asked to indicate the importance of a series of factors likely to impact on the supply of ICT graduates in WA, the industry respondents rated as most important: the need for enhanced collaboration between industry and educational institutions; the need to make ICT courses and careers more attractive to women; and the need to promote ICT courses more effectively in the schools.

The Supply of ICT Skills for the WA Workforce

A survey was also undertaken with 32 senior academic and administrative staff from all five of the State's universities, six of the TAFE Colleges in both metropolitan and regional WA, and five other training colleges. When all ICT related courses (e.g. electronic engineering, computer sciences, multimedia design and business information systems) are included, the survey suggests that in 2008 there were around 2,574 students enrolled in local universities within ICT courses, and that 742 were expected to graduate this year.

This included students enrolled across engineering and computer science, business information systems students and multimedia, web development and design courses. An additional 1,260 students were identified as being enrolled within the TAFE Colleges, and 1,060 in the other colleges interviewed. The total pool of ICT students enrolled in WA education and training institutions in 2008 was estimated at 4,894 with a forecast of 2,412 graduates anticipated for that year.

It should be noted that these were not official statistics, although considerable effort was taken by both the survey collection team and the respondents to provide accurate information. These numbers may also need to be discounted by as much as 30 percent to exclude the International students who are enrolled. In summary, there seems to be an ICT student pool of around 5,000 of which 3,500 are locals. What is noticeable is that these statistics are significantly larger than the existing estimates previously made available by the Department of Industry and Resources.

As with the employers, the educational institutions considered the need for enhanced collaboration between their sector and industry was a key factor likely to alleviate any problems in attracting students into ICT courses and careers. They also considered the promotion of ICT courses and careers within schools was an important issue, as well as general improvement in the image of ICT and its career opportunities.

The Future Demand for ICT Skills in WA

The findings from this study suggest that while much of the current ICT skills shortage has been met, predominately from the recruitment of overseas migrants, the longer term outlook is for an increased demand for ICT skills within the State's workforce. Modelling undertaken for the Australian Computer Society (ACS) suggests a potential national shortfall in ICT skills of around 14,567 by 2010 rising to 25,994 by 2020 if policy does not change. Identifying the precise location of these shortages by industry or occupation is problematic given the available information. However, there is evidence of a growing use of ICT across most industry sectors, particularly in the mining and resources sector and the emerging Mining Technology Sector (MTS) that supports the core firms in this area.

There is evidence that the role of ICT within WA industry at both the ICT producer and user ends of the industry spectrum will intensify. The existing landscape of industries and occupations is likely to change and this will force change in the education and training sector that will need to adapt to the rapidly changing nature of industry and technological convergence.

Recommendations

There are three strategic options available to the WA Government for addressing the needs of the ICT sector. The first is to do nothing and simply maintain the status quo. This is not recommended as it will not alleviate the future skills supply shortfall. Option two is to address the problem by tackling only one side (e.g. education and training). This is not desirable as it will risk a continuation of the existing problem of supply not meeting demand.

The preferred option is one of integration in which there is a collaborative effort between the education and training sector and industry. This is also an option identified by both these parties as the most important factor in alleviating the supply and demand discontinuity. To address this we make seven recommendations for future action:

1. Develop a robust understanding of the size and impact of the ICT sector in WA via the mapping of industry supply chains and the interrelationship between ICT-producing and ICT-using industries in WA;

2. Establish more precise annual measures of the size of the ICT skills supply chain by collaborating with education and training providers across WA;

3. Develop a K-12 School Curriculum in ICT with special focus on teacher education and in-service training and support;

4. Provide an agreed ICT careers pathway model using the ANZSCO occupation framework to help students identify meaningful career options for ICT courses within ICT-producing and ICT-using industries;

5. Develop appropriately recognised postgraduate and vocational short courses targeting skills upgrades for the existing ICT workforce;

6. Review the existing approach to teaching ICT within the post-secondary education system to take into account the impact of technological convergence;

7. Strengthen the resources for facilitative mechanisms by providing adequate funding to organisational entities such as the ICT Industry Collaboration Centre of WA.

Introduction

This study was commissioned by the WA Department of Industry and Resources (DOIR). The main aim of this research was to collect data and analyse the current status of supply and demand for skills in the areas of information and communications technologies (ICT), and prepare a report addressing the following questions:

1. What is the current status of ICT classified professional in WA including workforce numbers and job classification?
2. What is the supply for these positions, concentrating on Universities and TAFE's and expanding to private institutes?
3. What is the future demand for ICT skills, including workforce numbers and specific skills needed?

Methodology Used

The study was undertaken during July to September 2008 using a methodology that commenced with a briefing from DOIR on the current state of play within the WA ICT sector and existing initiatives designed to alleviate the skills shortage. A literature review was then completed with material sourced from DOIR as well as other agencies such as the WA Chamber of Commerce and Industry (WACCI), the Federal Department of Education, Employment and Workplace Relations (DEEWR), the Australian Bureau of Statistics (ABS) and other sources.

Interviews were then conducted with senior academics from the university sector in the fields of electronic engineering and computer science, as well as with the industry. Questionnaires for both the supply-side (e.g. education and training providers) and demand-side (e.g. employers) were prepared. These examined the current level of ICT related enrolments in courses and employment within industry. They made use of the Australia and New Zealand Standard Classification of Occupations (ANZSCO) categories for the ICT sector. Respondents were also asked to provide an opinion as to some of the factors likely to impact upon the flow of suitable ICT skilled workers into the WA economy.

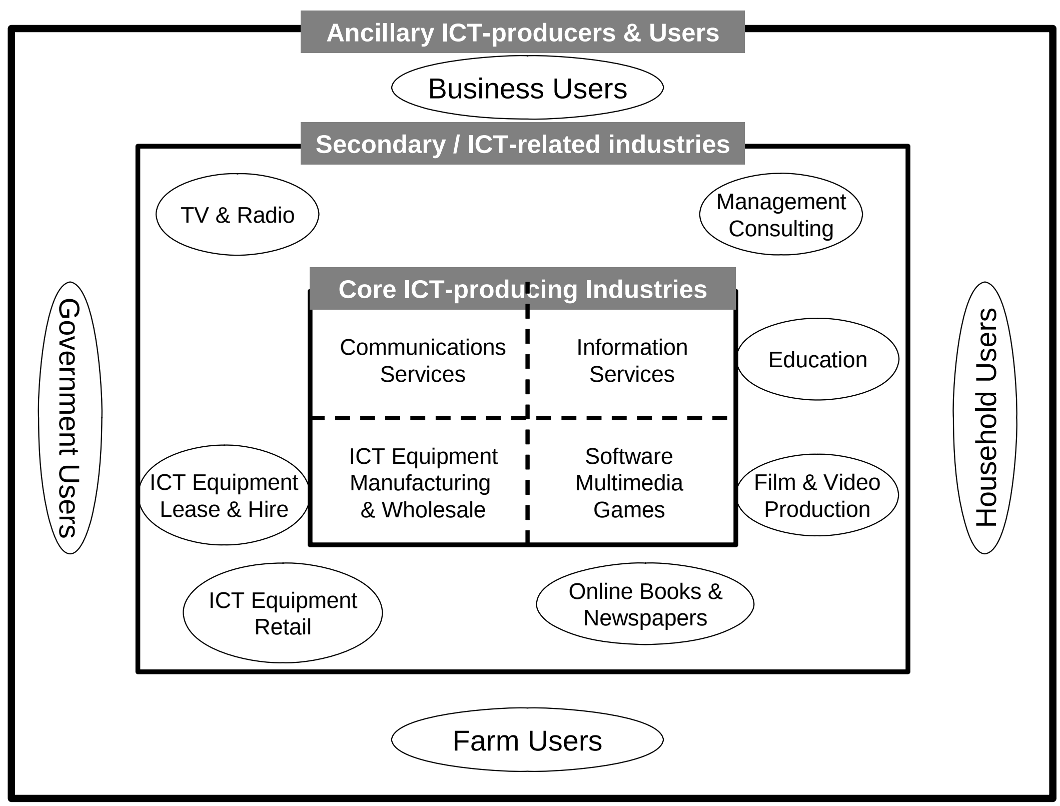
Telephone interviews were also undertaken with senior academic and administrative staff from the universities, TAFE colleges and private VET schools within WA using the questionnaire for the supply side. Similar interviews were undertaken with senior managers from a cross section of large and small organisations in WA that employ ICT skilled workers. This second interview used the demand side questionnaire.

In addition to the primary research undertaken the study also sourced data from the ABS and DEEWR on the current size of the ICT skills work force in WA. This used the ANZSCO categories and data from the 2006 Census to map the overall size and demographic profile of the ICT work force in the Perth metropolitan area. These ANZSCO categories were also mapped against the Australia and New Zealand Standard Industry Classifications (ANZSIC) to identify concentrations of ICT skills within WA industry.

Discussions were also held with third party industry support and advocacy groups including the WACCI, Australian Computer Society (ACS), Australian Information Industries Association (AIIA) and iVEC. These discussions were focused on understanding the role such groups might play in enhancing the ICT skills shortage and to get their perspective on this situation and its causes.

Defining the ICT industry

The term Information and Communications Technologies (ICT) is an all encompassing title that includes a wide range of technologies that communicate multimedia information via wireless or cable telephony. The convergence of mobile telephony with broadband computing, internet and broadcast services has meant that ICT is rapidly transforming, which makes precise definitions problematic. Due to its complexity and constant change in the face of dynamic technological innovation, the precise structure of the Australian ICT industry is difficult to assess. In a report for the ACS, Houghton (2001) provided a framework for understanding the Australian ICT industry.



Source: Houghton (2001)

Figure 1: ICT Production and Use in Australia

As shown in Figure 1 there are three primary levels, the first are the core ICT-producing industries, which include the telecommunications services, software and hardware manufacture, wholesaling of ICT equipment, and computer services. These are what the ABS refers to as the ICT specialist industries. The second level comprises secondary ICT-related industries such as equipment leasing and hires, plus TV and film or video production, management consulting, education and training in ICT and TV and radio networks. The third level is comprised of the producers and users in domestic, business, rural and government sectors. For the purposes of this study the core ICT-producing industries are the principal point of focus.

The Australian ICT Industry

A major problem in seeking to define and measure the ICT industries is the confusion that exists in its definition and classification. The Australian Bureau of Statistics (ABS) classifies the ICT sector into those industries that are specialists in ICT and those that are not. ICT specialists are sectors such as computer services, telecommunications services, computer wholesaling and those engaged in telecommunications broadcasting and transceiver equipment manufacturing. For a business to be classified as an ICT specialist it must generate over 50 percent of its revenues from ICT activity. The specialist ICT industries are those shown in the first level of the framework illustrated in Figure 1.

Table 1: ICT Specialist industries Australia 2004-05

Industry Sector	Employment	Income from ICT	Capital Expenditure	Industry value added
Manufacturing	5%	3%	1%	3%
Wholesale Trade	18%	33%	5%	14%
Telecommunications services	30%	40%	80%	52%
Computer Services	46%	24%	15%	31%
Total	244,238	$86.7 billion	$7.3 billion	$35 billion

Source: ABS (2006).

As shown in Table 1, the ICT specialist industries are broadly segmented into manufacturing, wholesale trade, telecommunications services and computer services. The manufacturing sector is in turn divided into four sub-sectors. The first are manufacturers of computer and business machines, comprising 20 percent of all employment. The second group are the manufacturers of telecommunications broadcasting and transceiver equipment who comprise 46 percent of all employment. Third are the manufacturers of electronic equipment with 28 percent of employment, and finally the manufacturers of electric cable and wire with 6 percent of employment.

It can be seen from Table 1 that the manufacturing sector comprises only 5 percent of all ICT specialist employment and a relatively low proportion of the overall industry income and value added. By comparison the wholesale trade is separated into those firms wholesaling computers who employ 57 percent of the workforce in this sector, and those wholesaling business machines and other electrical and electronic equipment. Each of these sub-sectors employs around 21 percent of the ICT wholesale sector workforce.

The largest sector in terms of employment is that of computer services which is in turn divided up into four sub-sectors. The largest of these is computer consultancy services, which employs 95 percent of the workforce in this sector. The other sub-sectors include computer maintenance, data processing and information storage and retrieval. It is also clear from Table 1 that the telecommunications services industry, while not the largest employer of ICT skills, is the biggest investor in capital expenditure and generates the most value adding.

At the national level the Australian ICT industry generated a total income in 2004-2005 of over $103 billion, of which almost three quarters was within the wholesale and telecommunications sectors. Specialist ICT firms accounted for around 89 percent of this income; the major areas of activity being in the fields of telecommunications services, computer wholesaling, and computer consultancy services. In 2005 there were 274,132 persons employed in Australia's ICT industries of which the majority (89%) were employed in the specialist ICT businesses of computer services, telecommunications services and the wholesale trade (ABS, 2006a).

However, according to research commissioned by the ACS, the total ICT labour pool in Australia was estimated to be around 514,000 in early 2008 (CIIER, 2008). This included an estimated 282,000 ICT professional and technical workers, including those within telecommunications. The Australian Computer Society (ACS) estimates that the Australian ICT industry comprises around 25,562 firms, of which the majority (95%) are small businesses with fewer than 20 employees. Foreign ownership within the sector is also high, with multinational corporations making up around 43 percent of all employment in 2001 (ACS, 2008a).

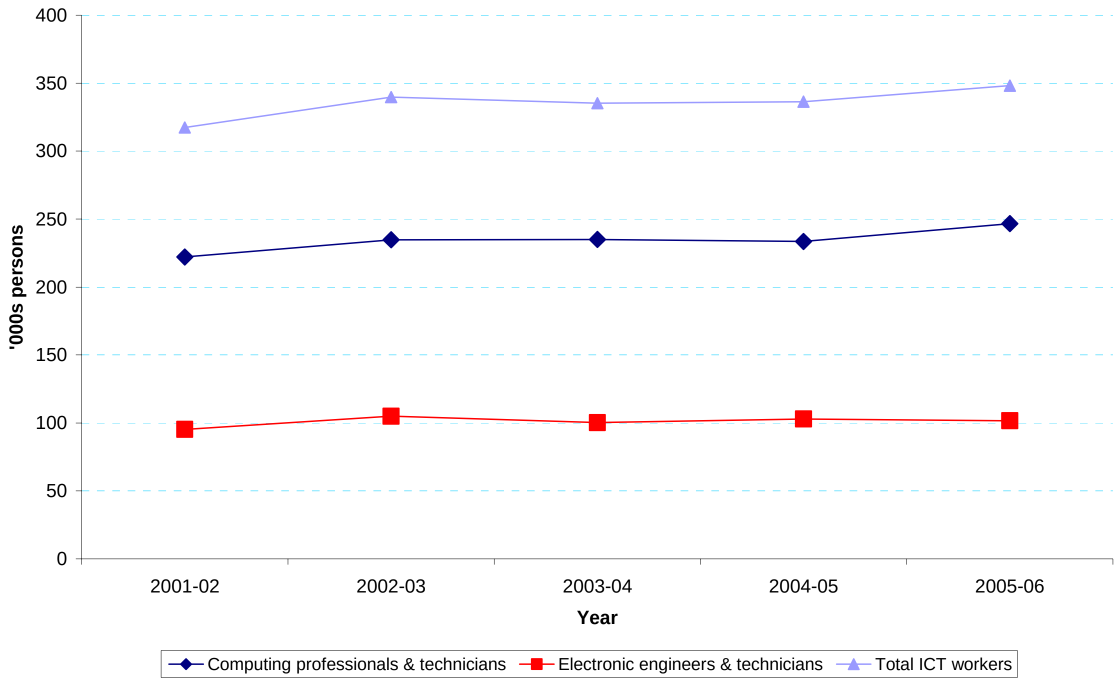
Australia is a net importer of ICT goods and services. In 2004-2005 a total of $22.7 billion worth of ICT products and services were imported for a net export of only $5.1 billion. The majority (88%) of these imports were computer and communications hardware, plus electronic equipment and cabling. In the field of software, Australia imported $954.8 million in packaged software and associated licensing in that same time period, while exporting $225.6 million. The balance of trade was better in the field of computer services with $1 billion in imports and $1.1 billion in exports. In telecommunications services Australia imported $694 million and exported $768 million (ABS, 2006a).

Employment in ICT Occupations

Analysis by the ABS (2006b) suggests that the size of the ICT workforce in Australia did not change significantly over the period from 2002 to 2004, but grew by 4 percent from 2004 to 2006. The strongest growth was driven by increases in the area of computing professionals and technicians. These findings are illustrated in Figure 2 where it can be seen that the overall number of ICT workers has remained steady with only modest growth since 2004-2005. The most growth took place in the area of computing support technicians, which saw total employment in that category rise from 29,400 in 2001-02 to 41,300 in 2005-06. All other occupation groups remained stable.

The ICT work force is typically younger than the average within the wider Australian work force, and remains highly male dominated. For example, male ICT workers comprised 85 percent of the work force in 2005-06 and the number of women in the ICT occupations actually fell between 2004 and 2006 (ABS, 2006b). Women are most represented in the areas of computer support technicians, computing professionals and IT managers (ABS, 2008a).

Around 28 percent of the workforce in ICT related sectors is aged below 30 years. Skilled migration supplies a relatively large number of ICT workers. For example, 19 percent of all the migrants entering Australia in the period 2004-2005 had skills in the fields of computing and ICT (DBCDE, 2006). The influence of overseas migrants within the ICT industry is significant. Compared to the wider Australian work force, the ICT work force is more likely to be born overseas. The proportion of foreign born ICT workers grew from 36.3 percent in 2001-02 to 38.6 percent in 2005-06 (ABS, 2006b).



Source: ABS (2006)

Figure 2: Employment in the ICT occupations in Australia, 2001 to 2006

Most ICT employees (91%) are full time workers and they work an average of 42.5 hours per week. Part time ICT employees work an average of 21 hours per week (ABS, 2006b). The level of education within the ICT workforce is also high. For example, it has been estimated that over half the workforce in Australian ICT specialist firms are professionally or technically qualified and over 70 percent of technical and professional ICT workers are employed in the ICT sector (CIIER, 2008).

ACS Employment Survey

In 2007 the ACS undertook a survey of people within the ICT industry (ACS, 2007). This survey found that unemployment levels within the ICT industry had fallen significantly with rates of around 3.8 percent. Working hours had increased to over 40 hours a week and there were concerns over discrimination on the basis of age and gender.

The general profile of the ICT workforce that emerged from this survey was that while 86 percent of respondents viewed themselves as working in the ICT industry, many had entered the sector from other fields and more than half had worked elsewhere during their careers. Only 56 percent held a university degree or vocational diploma in any field of study. A relatively high proportion (37%) held only vendor or non-university level qualifications.

These findings suggest that the ICT industry remains an emerging one within Australia and one that is poorly defined. To work in the ICT industry is to work in a sector that is largely hidden behind a wide range of other more established sectors. While the importance of the ICT sector is not in dispute, the identification of the sector remains a work in progress.

Identifying an ICT Sector

As the ACS recently noted in a review of ICT skills forecasts (CIIER, 2008 p.10):

> The term "ICT Industry" is also often used in the press, or by other commentators, for a confusing range of different things, ranging from a synonym for ICT professionals, to a "tight" definition of companies solely concerned with the provision of ICT products and services, but that includes companies with major units supplying ICT good and services, through a "looser" definition that may include retail ICT, that may include call centres that are mainly parts of other industries (e.g. banking), that may include significant sections of the electronics industries, and of other professional services (e.g. management consultants and, historically, accountants), to a "broad" definition that can include anyone working on ICT related matters in any industry.

A problem with identifying the ICT industry is that its boundaries are poorly defined and the skills and qualifications required to enter the sector are also not clearly identified. As noted by the ACS there is a ‘significant overlap’ found across a number of sectors that comprise the ICT industry (CIIER, 2008). Such confusion and lack of definition makes any assessment of ICT sector difficult and also serves to create problems for those seeking to increase the flow of suitably qualified ICT professionals and technicians into the industry.

Industry analysis is undertaken using the ANZSIC codes that divide Australian industry into a series of categories and sub-categories. A problem with the classification of ICT industries is that they do not readily conform to these ANZSIC codes. The property and business services area is the industry sector which appears to concentrate the largest proportion of ICT occupations. In 2005-06 37 percent of all ICT workers were employed in this sector. The majority (85%) of these employees were computing professionals and technicians. The telecommunications services industry is the second largest concentration. This employs electronic engineers, technicians and communications technicians.

It has been suggested that the ICT sector is sufficiently large to warrant being separately identified (CIIER, 2008). The property and business services sector is where the majority of the ICT specialist industries are found and these are thought to comprise as much as 56 percent of the total activity in this sector. Much of the business activity in this area is engaged in software development and computer services and consulting.

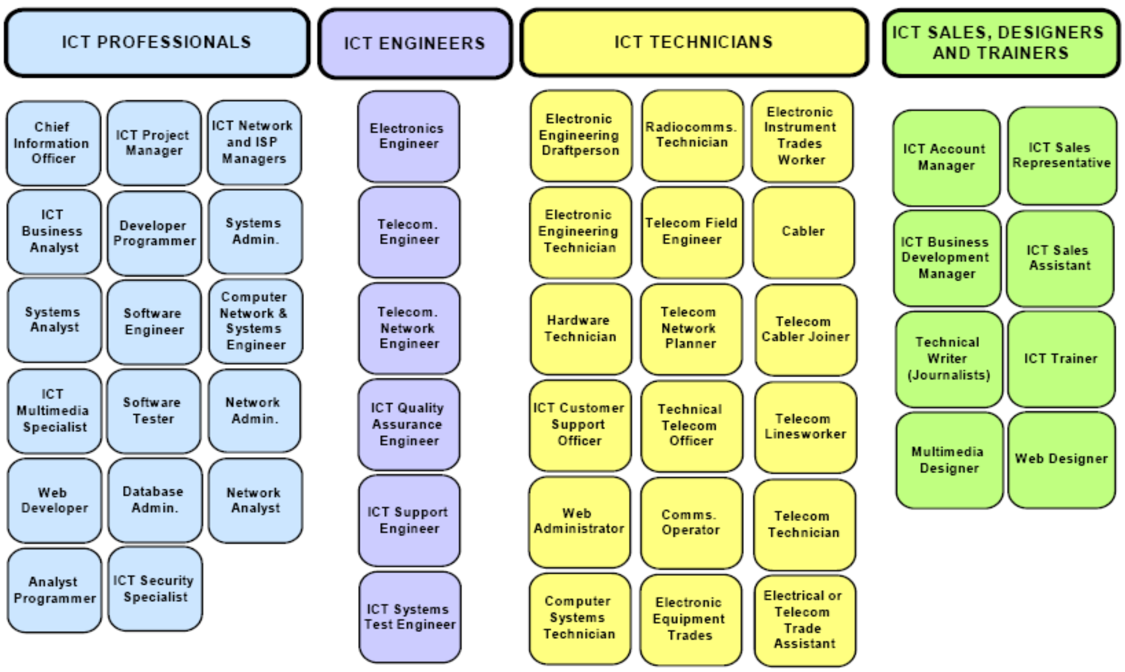
The other major sectors are wholesaling and communications services. These ANZSIC codes include sub-categories that include ICT related activities. As with property and business services the overall activity of the ICT related firms is often hidden within the “data noise” created by the ANZSIC coding.

In this report we have made use of the ANZSIC code structure and applied with care against the ANZSCO occupational codes. However, as will be shown the ICT occupations are heavily focused within the property and business sector. Further interpretation of this data will be dealt with later in the report.

The survey of employers undertaken for this study also highlighted the weaknesses of the current ANZSIC coding system. Many firms outsource their ICT services and the firms who sub-contract to them tend to identify their industry orientation not in terms of the ANZSIC codes but the industry sector in which the majority of their clients are located. For many ICT specialist firms the wide ranging application of their products or services to a number of industry sectors makes it difficult to adequately classify their industry orientation.

ICT industry Employment – the ANZSCO Framework

The structure of the ICT related workforce in Australia has been investigated by the ABS and DEEWR using ANZSCO categories to provide a framework.[1] As shown in Figure 3, there are four broad categories comprising ICT professionals, ICT Engineers, ICT Technicians and ICT sales, designers and trainers. Each of these four broad categories is subsequently divided into sub-categories comprising different levels of qualification, skill and expertise.



Source: DEEWR (2008a)

Figure 3: ANZSCO ICT Occupations

The first group comprises such occupations as the Chief Information Officer (CIO), software engineers and systems administrators. Typically these are relatively senior occupations and require formal qualifications and experience. The ICT Engineering fields are occupations that generally require the completion of university degree programs to gain entry. By contrast the ICT Technicians are occupations that are more likely to require technical trade training certificates. The fourth category of ICT sales, designers and trainers is an eclectic mix of occupations which may require a range of vocational or higher education qualifications as well as experience.

[1] The ANZSCO coding system was introduced in 2006. It replaces the ASCO coding system prevsiously used by the ABS. The ANZSCO coding system has been aligned with the International Labour Organisations (ILO) ISCO-08 coding system.

ICT Professionals

The first of the ANZSCO categories is that of the ICT Professionals who are responsible for high level analytical, conceptual and applied tasks within the ICT industries and related services. It includes business and systems analysts and programmers, database systems administrators, ICT security specialists, plus ICT network and support professionals. A full list of these ICT professionals and their roles is provided at Appendix A.

Entry into these occupations typically requires a bachelor's degree or higher qualification. In some cases employees can enter these occupations with a minimum of five years relevant work experience and / or a vendor certification (ABS, 2006d). As described by the ANZSCO framework the ICT Professionals perform the following tasks:

- Developing and documenting strategies, policies and procedures relating to the use of ICT technologies and services;
- Planning, analysing, designing, developing, implementing, testing, operating, maintaining and assisting with the use of technologies and services that enable information, such as voice, image and data, to be accessed, networked, stored, processed, transformed, manipulated and transmitted over a variety of media;
- Assessing the performance of ICT technologies and services, identifying limitations and inefficiencies, and recommending and implementing solutions; and
- Providing troubleshooting and service support in diagnosing, resolving and correcting problems associated with the use of ICT technologies and service.

ICT Engineers

The ICT Engineers group comprises Electronics Engineers and ICT Support and Test Engineers. A full list of these ICT Engineers is provided at Appendix B.

The Electronics Engineer:

> Designs, develops, adapts, installs, tests and maintains electronic components, circuits and systems used for computer systems, communication systems, entertainment, transport and other industrial applications. Registration or licensing may be required (ABS, 2006d).

As with the ICT Professionals this occupation will normally require an undergraduate degree or higher degree, as well as some form of licensing or accreditation. The ICT Support and Test Engineers also typically require university degree qualifications, but may also need industry experience or on-the-job training in addition to qualifications. ICT Support and Test Engineers:

> Develop procedures and strategies to support, create, maintain and manage technical quality assurance processes and guidelines and systems infrastructure, investigate, analyse and resolve system problems and performance issues, and test the behaviour, functionality and integrity of systems (ABS, 2006d).

ICT Support and Test Engineers encompass four sub-categories. The first of these are Quality Assurance Engineers, also known as Quality Analysts, Quality Managers or Quality Specialists. They may also specialise in computer systems auditing. The second is the ICT Support Engineer, or Support Analyst or Support Architect. The third occupation is the ICT Systems Test Engineer, also known as a Systems Tester or Test Analyst. The final group are ICT Support and Test Engineers, which might also be described as Usability Specialists.

These occupational categories are likely to involve some overlapping of functions within particular organisations.

Also included in the ICT Engineers occupation category are the Telecommunications Engineering Professionals. This group includes Telecommunications Engineers and Telecommunications Network Engineers. The Telecommunications Engineer is responsible for design, construction, installation, service and support of telecommunications equipment, systems and facilities. The Telecommunications Network Engineer is responsible for planning, designing and monitoring complex telecommunications networks and associated broadcasting equipment (ABS, 2006d). This latter occupation is also referred to as a communications consultant, communications specialist (ICT), telecommunications consultant or telecommunications specialist.

ICT Technicians

The occupations listed within the ICT Technicians category are a combination of ICT related technical specialisations that group within the ANZSCO framework under the broad category of Engineering, ICT and Science Technicians. These occupations generally require the person to have completed a vocational trade qualification such as an AQF Associate Degree, Advanced Diploma or Diploma. In some cases a minimum of three years relevant work experience can be a substitute for these formal qualifications. Many areas will also require some form of on-the-job training in addition to formal qualifications. A full list of these ICT Technicians is provided at Appendix C.

The main sub-category within this field is the ICT and Telecommunications Technicians. This group is responsible for the development and maintenance of computer infrastructure, web technology and telecommunications networks, as well as diagnosing and resolving technical problems within ICT systems (ABS, 2006d). The ICT Support Technicians comprise such occupations as Hardware Technicians and ICT Customer Support Officers, also known as ICT Help Desk Officers, Help Desk Technicians and Systems Support Officers. While the Hardware Technician supports and maintains ICT Hardware systems, the ICT Customer Support Officers are more likely to deal with software and education of end users in the operation of these.

Web Administrators also fall within the ICT Support Technicians. This occupation is sometimes referred to as a Web Master and is responsible for the design, construction and maintenance of the websites within an organisation. They may also provide web technology solutions and services to end user clients.

Other ICT Support Technicians found in this group are Applications Packagers, Computer Systems Technicians and Telecommunications Computer Systems Technicians.

The Telecommunications Technical Specialists incorporate those trades who develop, monitor and support telecommunications networks and associated ICT equipment. This might include computer systems, microwave, telemetry, multiplexing, satellite and other forms of wireless communications (ABS, 2006d). The types of occupations that are found here are Radio communications technicians, Telecommunications Field Engineers, Telecommunications Network Planners and Telecommunications Technical Officers or Technologists. As with the other types of occupation listed in this category; these trades usually require an Associate Degree, Advanced Diploma or Diploma, plus some on-the-job training.

The ICT Technicians also include Telecommunications Trades Workers, who install, maintain and repair data transmission equipment, cables and radio antennae, as well as telecommunications equipment and appliances (ABS, 2006d). Unlike the other occupations in this category these jobs are usually an ANZSCO Skill Level 3, which require AQF Certificate III plus two years on-the-job training, or AQF Certificate IV. The occupations of Cabler, Telecommunications Cable Jointer and Telecommunications Lines worker and Telecommunications Technician are included.

ICT Sales, Designers and Trainers

The fourth group is comprised of an eclectic mix of occupations such as Journalist technical writers, ICT trainers, ICT sales professionals such as account managers or business development managers, web and multimedia designers. These all fall within the fourth grouping, and a full list is provided at Appendix D.

The ICT Sales Professionals form a sub-group that comprises ICT Account Managers, ICT Business Development Managers and ICT Sales Representatives. In a general sense the role of these ICT Sales Professionals is to:

> Manage client accounts and represent companies in selling a range of computer hardware, software and other ICT goods and services to industrial, business, professional and other organisations (ABS, 2006d).

Most of these occupations require a bachelor's degree or higher qualification, although five years of work experience and vendor certification is also a substitute in some cases. It is common for such positions to also require on-the-job training in addition to formal qualifications. As with many sales roles the level of seniority is driven more by experience and performance than qualification.

The most senior of these occupations is the ICT Account Manager, followed closely by the ICT Business Development Manager, and then the ICT Sales Representative. However, there is often a degree of overlap between these positions.

The category also includes the ICT Sales Assistant, who is a more junior position responsible for sales of computing and telecommunications products or services either at the wholesale or retail level. While many positions may be secured with experience alone, it is common for such jobs to require at least the completion of a Year 10 High School Certificate or an AQF Certificate I.

In the field of designers a further sub-category includes that of the graphic and web designers and illustrators. This group includes the Web Designer and Multimedia Designer occupations. The Web Designer role is to:

> Plan, design, develop and prepare information for Internet publication with particular emphasis on the user interface, ease of navigation and location of information using text, pictures, animation, sound, colours, layout and data sources to deliver information tailored to an audience and purpose (ABS, 2006d).

By comparison the Multimedia Designer role is to:

> Plan, design and develop the production of digitally delivered information, promotional content, instructional material and entertainment through online and recorded digital media using static and animated information, text, pictures, video and sound to produce information and entertainment tailored to an intended audience and purpose (ABS, 2006d).

Both these positions typically require the completion of a post-secondary qualification, usually a bachelor's degree or higher qualification. On the job training is often required in some organisations and in some cases a minimum of five years work experience and a vendor certification can substitute for formal qualifications.

The last two occupations are the ICT Trainer and Technical Writer. The ICT Trainer, also known as an ICT Educator, is responsible for the design, development and delivery of ICT-based systems training. Such positions usually require a bachelor's degree or higher qualification and in most case a minimum of five years work experience in the ICT industry.

The Technical Writer occupation is a part of the ANZSCO category of Journalists and other writers. It is a specialist area focusing on the preparation of technical manuals and other publications. The role involves:

> Researches and writes technical information-based material and documentation for articles, manuals, text books, handbooks, or multimedia products, usually for education or corporate purposes (ABS, 2006d).

As an ANZSCO Skill Level 1 occupation, the Technical Writer is typically educated at a bachelor's degree level or higher, in some cases five years of work experience and vendor certification can be a substitute for formal qualification.

It should be noted that the actual configuration of occupations within industry is likely to change and adapt as the process of technological convergence continues to drive change within the sector. Discussions with industry experts undertaken as part of this study suggests that new areas are emerging that are not currently contained within the ANZSCO framework. For example, the field of "Information Management" is one area that comprises the storage, retrieval and maintenance of emails, documents and other records within the enterprise.

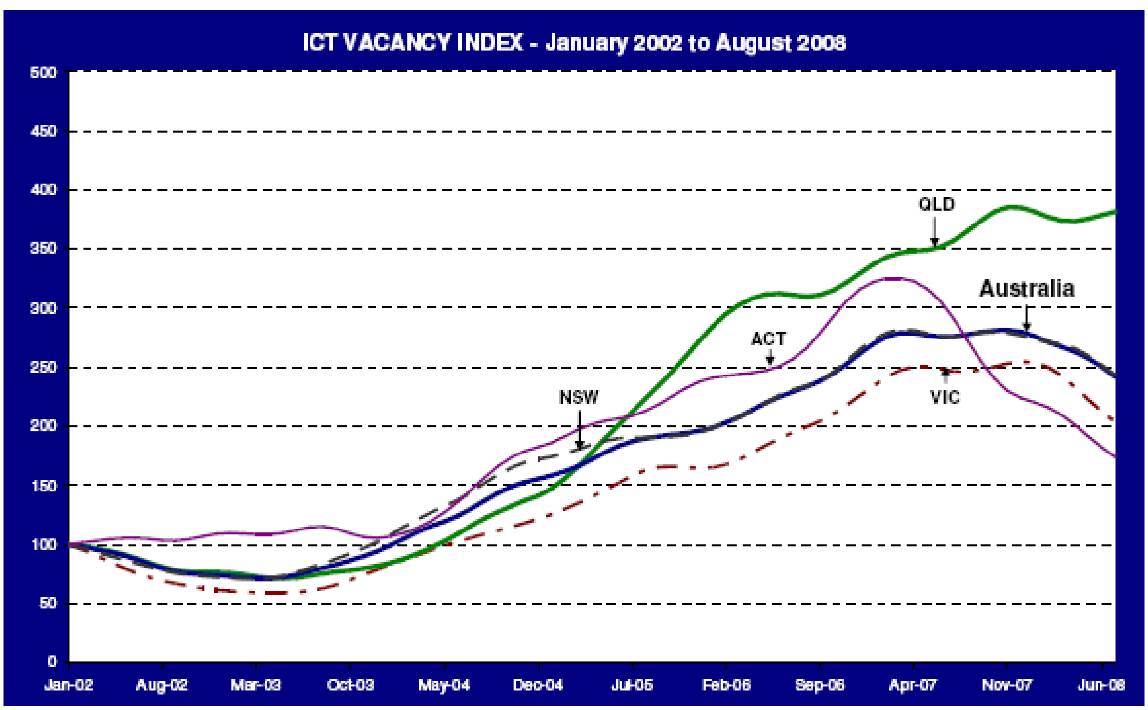
Supply and Demand in the ICT Labour Market

The DEEWR ICT Vacancy Index is a count of information and communications technology vacancies listed on selected Australian websites. It seeks to provide a national benchmark of the ICT sector's demand for skilled workers. Analysis of the likely demand for ICT skilled workers within the Australian economy suggests that there are insufficient graduates being generated from local universities and colleges to supply the longer term requirements of industry. As reported by the ACS:

> It is universally acknowledged by the ICT community that Australia does not have sufficient skilled ICT practitioners to satisfy its needs today…Continued ICT skills shortages will continue at current or worse levels until at least 2012, regardless of optimistic presumptions in respect to forecast levels of graduates and migration settings. The current shortfall is being addressed through the use of temporary Visa migrants, but even the current historically high numbers of these Visas will not be sufficient for future ICT demand, even on the most optimistic scenario, until 2012 (CIIER, 2008; p.7).

A "most likely" forecast by ACS research suggests that the level of ICT skills shortages will grow by 29 percent to the year 2010 to around 14,500 full time equivalent workers, by 2020 this could increase to over 25,000 positions if current conditions and policy settings continue (CIIER, 2008).

According to the DEEWR ICT Vacancy Index for August 2008 the number of vacancies in the ICT sector is around 16 percent lower than it was 12 months ago after having risen strongly over the previous five years. This trend is shown in Figure 4 which also illustrates the continued growth in ICT vacancies in Queensland, compared to declines in NSW, Victoria and the ACT.



Source: DEEWR (2008d)

Figure 4: DEEWR ICT Vacancy Index – Australia, QLD, NSW, ACT & VIC

Skills shortages in the WA Economy

The growth in international demand for commodities, particularly mining and energy resources has resulted in Western Australia enjoying one of the longest and most significant economic booms in its history. Since 2001 the WA economy has commenced a protracted period of growth that has resulted in a significant tightening of the labour market in this State.

Over the period from 2001 to 2005 the total job vacancies for skilled workers in the construction, metals, electrical and electronics, and automotive trades grew significantly. This was followed by such occupations as building and engineering professionals and science professionals. However, in the same period the job vacancies for computing professionals actually declined significantly.

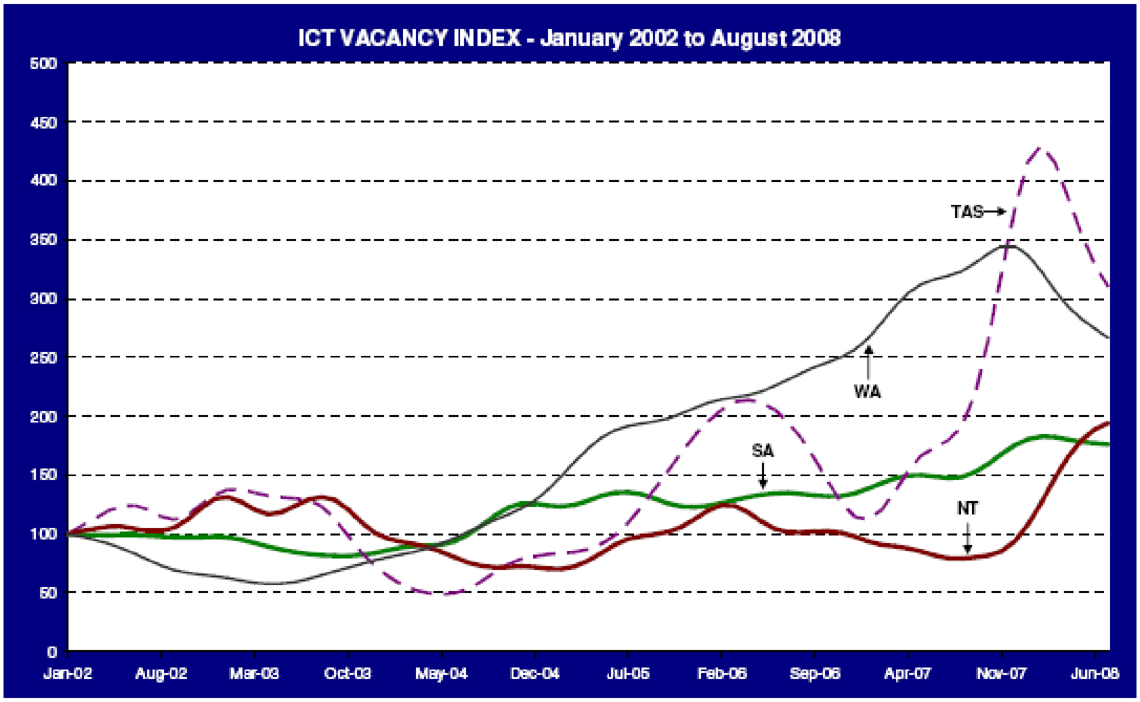
Analysis by the ABS (2006c) suggests that many of these ICT jobs were filled with migrant workers as there was a correlation between the rise in computer professional entering the country and a commensurate decline of around 49.5 percent in the number of advertised vacancy for such jobs.

An analysis by the Labour Economics Office WA of DEEWR in June 2007 found a major shortage of skilled professionals and trades workers in most areas of the WA economy. Engineers were in particularly short supply across all areas, particularly those related to the mining and resources sector. Demand for civil, electrical, electronics and mechanical engineering associates increased by 58 percent over the period 2006 to 2007. Strong demand was identified in such areas as computerised-numerically-controlled (CNC) machinery and instrumentation and there were few qualified applicants (DEEWR, 2007).

Although the skills shortage in WA industry remains high, the most chronic shortfalls appear to be in areas not directly associated with the ICT industries. However, an analysis undertaken by DEEWR in May 2008 identified state wide skills shortages in the area of electronic engineers and electronic engineering associates. In the latter case vacancies were particularly hard to fill for those positions seeking 5 to 10 years experience (DEEWR, 2008c).

Job vacancies in WA fell by around 17 percent in the first quarter of 2008 although the trend over 2007 had been one of continuous increases. As might be expected the main industries seeking to recruit labour were mining, construction, education and manufacturing. Some of these job skills gaps are being alleviated by immigration, which has contributed around 53 percent of the State's population growth in recent years. Interstate migration also contributed to the population increase with around 38,159 such interstate movers identified in the 2006 Census (ABS, 2008b).

Demand in WA also fell sharply after a substantial growth in demand over the previous five years, while South Australia and the Northern Territory experienced continued demand. These trends are illustrated in Figure 5. Despite these trends the overall number of ICT vacancies across Australia continues to be around 23,200 as was estimated in June 2008 (AIIA, 2008).



Source: DEEWR (2008d)

Figure 5: DEEWR ICT Vacancy Index – WA, SA, NT & Tasmania

Supply-side problems

Given the forecast shortage of ICT skilled employees a concern has been the concurrent decline in the number of students entering courses of study in information technology. For example, over the period 2001 to 2005 there was a 53.5 percent fall in the number of applicants for ICT courses at Australia's universities. Over the period 2006 to 2008 this decline has eased but remains around 11.4 percent (DEEWR, 2008b).

This decline in the number of enrolments into ICT courses is in contrast to increases in most other fields over the same time period. It has been attributed to the poor image of ICT generated by the "Dot.com bubble" and its subsequent collapse during the period from 1995 to 2001. This stock market crash saw not only the loss of significant investor fortunes on the NASDAQ, but also the loss of a substantial number of jobs within the ICT sector. While its effects were most felt in the United States, the Australian ICT sector was also impacted.

The ACS has argued that the impact of the "Dot.com bubble" is overstated. In the period 2000 to 2002 as the "Dot.com bubble" burst, there was a sharp decline in employment within the Australian ICT sector. However, ICT employment bounced back in 2003-04 and has seen steady growth ever since (CIIER, 2008).

Despite the relatively robust demand for a skilled ICT workforce the level of enrolments in information technology courses within WA educational institutions remains subdued. Over the period from 2002 to 2005 enrolments fell by 58 percent, the largest decline of any field of study. However, it should be noted that enrolments into engineering and related technologies grew by

27.9 percent over the same period (ABS, 2006c). Although this includes all engineering subjects not just those related to ICT.

An examination of TISC data for the four publicly funded universities in WA suggests that around 410 students enrolled in computer science, information technology and related courses in 2008. The majority (68%) of these students were enrolled in computer science or a computer science and mathematics or other double degree program. About 14 percent enrolled in multimedia design and 8 percent in information technology. Software engineering and electronic engineering numbers were relatively small.

Discussions undertaken as part of this study with senior academics from within the WA university sector suggest that enrolments in computer science, electronic engineering and related courses are indeed under pressure. They attributed this to a hangover from the "Dot.com bubble" and the competition from other industries. For example, students entering engineering courses were being attracted towards fields of study targeted towards the mining and resources sector rather than the ICT sector.

The Structure of the WA ICT Labour Market

An analysis of the WA ICT labour market was undertaken using data provided by the ABS that drew together those ANZSCO codes relevant to the ICT sector. The selection of these ANZSCO occupations was based upon the framework developed by DEEWR and illustrated in Figure 2 above. This data was drawn from the 2006 Census so it may be slightly out of date but is the most reliable benchmark available at the time of writing.

The Western Australian ICT Industry

The WA ICT sector appears to have grown significantly in recent years. For example, in 1999 the WA ICT industry was estimated to have around 400 firms actively engaged of which the majority were very small (TIAC, 1999). By 2001 WA was estimated to have around 6 percent of all ICT employment in Australia, and its ICT sector was rapidly growing (Houghton, 2003).

The ABS (2006a) estimated that in 2004-2005 there were at least 18,890 persons employed in the ICT specialist industries in Western Australia. Of these, the largest concentration (43%) was in the area of computer services. This was followed by telecommunications services (37%), then wholesaling (12%) and then manufacturing (7.8%). However, it was noted by the ABS that their estimates of the size of the ICT workforce in WA were subject to statistical errors and should be used with caution.

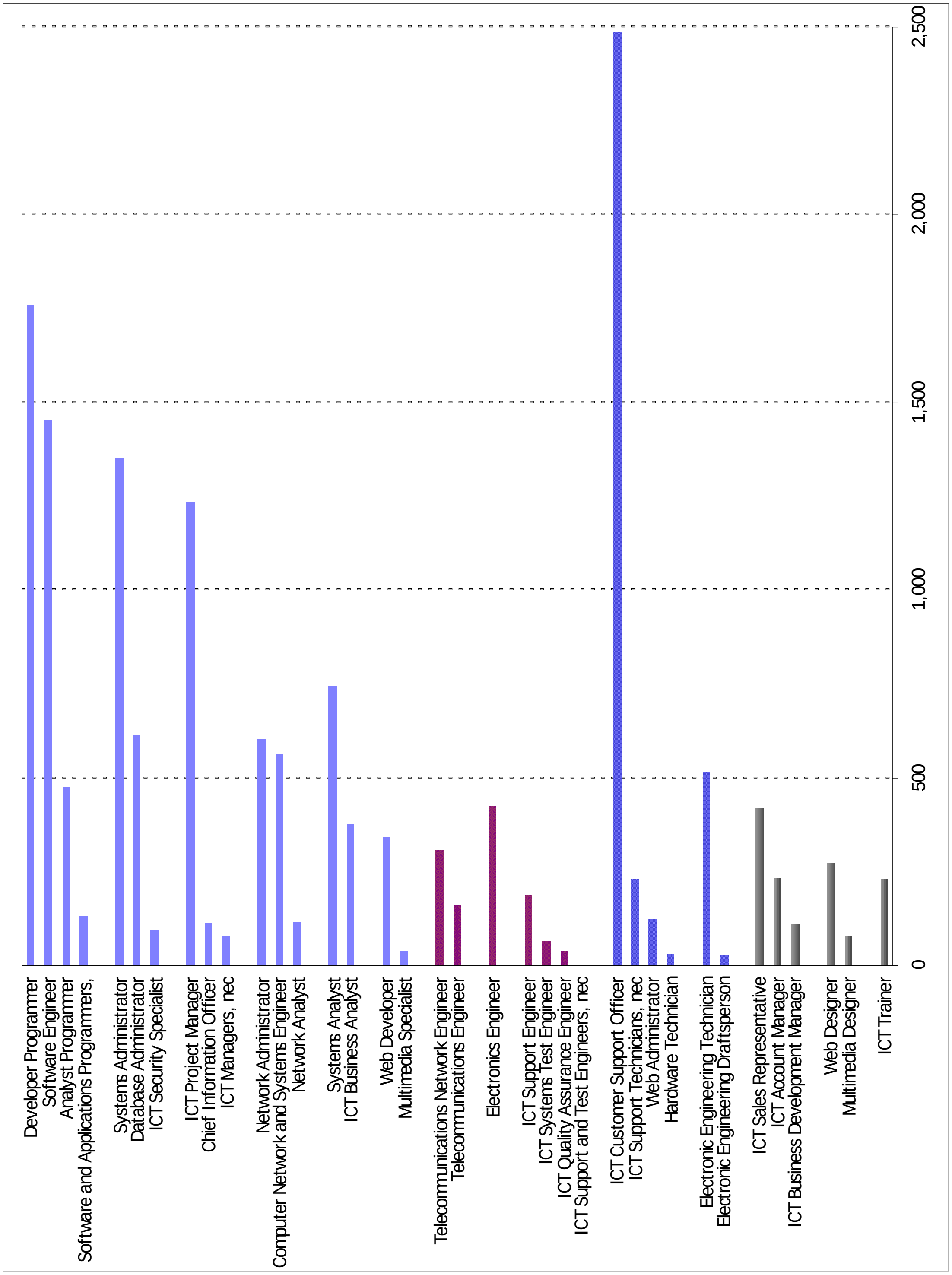
Further estimates of the size of the WA ICT sector were undertaken around the same time. For example, in 2004 the Western Australia the ICT industry was estimated to encompass 1,800 specialist ICT firms and to provide direct employment for around 23,000 people. The sector was reported to be generating around $6.6 billion in annual revenues and to have a multiplier effect of between $10.1 and $17.6 billion (TIAC, 2006).

Our own assessment of the size of the WA ICT skills labour pool is somewhat more conservative, although the final estimate of the overall size of the sector is contingent on the inclusion of occupations that might be considered on the fringe of the sector. Our analysis has focused on the specialist ICT occupations.

The overall ICT employment pool in Western Australia

At time of Census in 2006 there were a total of 16,038 people employed within the 36 ANZSCO ICT occupations reviewed by this study. The majority (94.5%) of these people were based in the Perth metropolitan area. Figure 6 illustrates the relative distribution of this ICT workforce across these occupational classifications.

It can be seen that largest total pool of ICT workers was concentrated in the ICT Customer Support Officer Field, with 2,489 persons employed across WA in this role. This particular occupation is part of the ICT support technician category and is involved with the support for the deployment and maintenance of computer infrastructure and web technology. The field also involves the diagnosis and resolution of technical problems. The ICT customer support officer position is also referred to as an ICT Help Desk Officer, Help Desk Technician or Systems Support Officer. The size of this particular occupation category is reflective of the growth in ICT use across organisations and the need for on call support to keep these systems operating efficiently. Further details of this occupation can be found at Appendix C.



Source: ABS (2006)

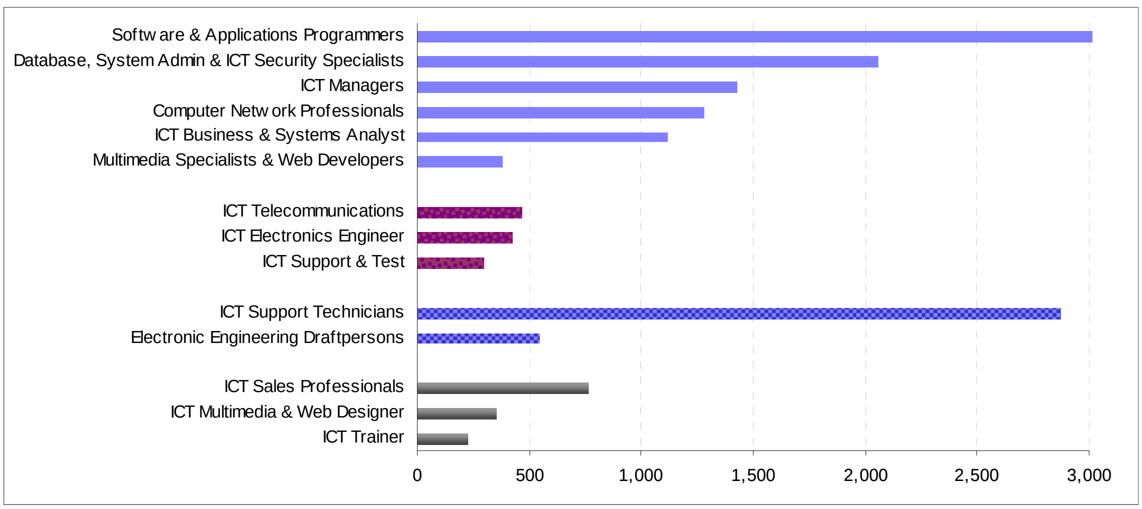
Figure 6: Employment in the ICT occupations in WA 2006

The next two largest occupation groups were from the category of Software and Applications Programmers. The first of these and the second largest group overall were the Developer Programmers, with a total of 1,761 persons employed. This occupational category is also referred to as an Applications Developer, ICT Developer or ICT Programmer. Further details on these occupations can be found at Appendix A.

The third largest group was that of the Software Engineers, with 1,452 people employed in this category. This occupation is also referred to as Software Architects or Software Designers. As with the Developer Programmer, the Software Engineer usually requires a bachelor's degree qualification or at least five years experience and a vendor's certificate.

The fourth largest occupational grouping with 1,353 was that of the Systems Administrators. This occupation is also referred to as a Systems Manager. Also within the top five largest ICT occupational categories were the ICT Project Managers with 1,235 people employed.

The remaining occupations had fewer than 1,000 members with the majority employing less than 500 people. Most of the professional ICT engineering job categories had fewer than 500 members. The largest of these were the Electronics Engineers with 425 members.



Source: ABS (2006)

Figure 7: Employment in the ICT occupations in WA 2006 by Aggregated ANZSCO Levels

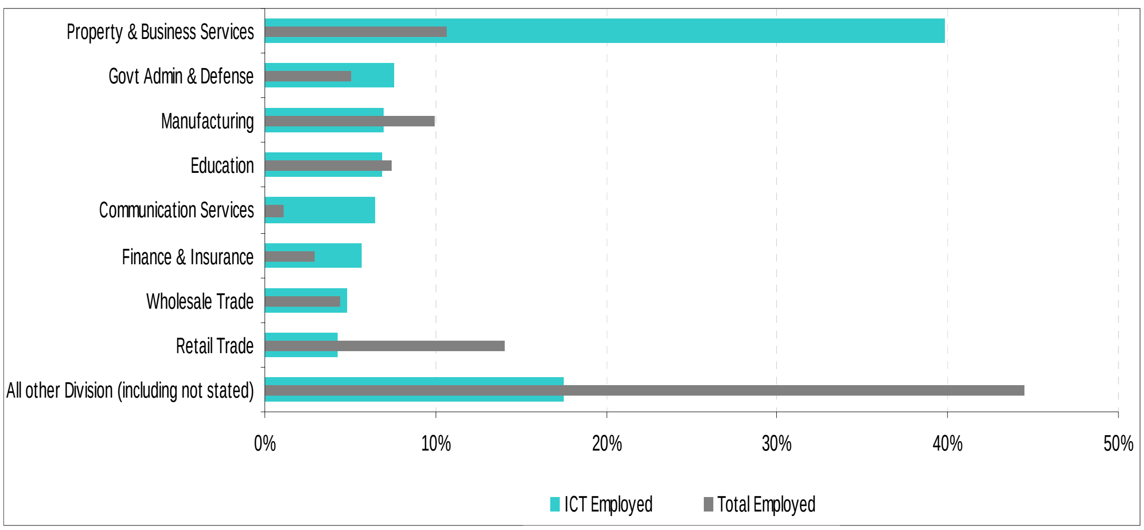
As shown in Figure 7 the largest occupation categories within the WA ICT labour pool are the Software & Applications Programmers and ICT Support Technicians. Databases, Systems Administration & ICT Security Specialists are also a large category. While the size of the ICT labour market in WA has grown strongly over the past five to eight years, the demand for ICT skills is likely to increase further over coming decades. As suggested by ACS analysis, there is an anticipated national shortage of between 14,500 and 25,000 (CIIER, 2008). This is likely to impact upon WA in much the same way as the mining and resources sector transitions towards a greater use of ICT controlled systems in the automation of the exploration, extraction, processing and transportation of minerals and LNG.

The Concentration of the WA ICT Labour Market

In this section the concentration of the WA ICT labour market is examined by mapping the ANZSCO occupation groups against the ANZSIC industry categories. As has already been noted, there is a high concentration of ICT occupations in the property and business services category of the ANZSIC coding system. This has a tendency to mask the actual size of the ICT industry.

ICT Employment within WA Industry by ANZSIC Classification

The ANZSIC industry structure comprises four levels, the first of which is shown in Figure 8. Some industries are significantly more ICT focused than others, or at least have a much higher concentration of ICT skilled employees as a proportion of their total work force. Figure 8 illustrates the general break down of ICT employees within the various ANZSIC industry categories. Figure 8 shows the proportion of the total workforce employed in each sector as well as the proportion of the ICT work force employed in that same sector.



Source: ABS (2006)

Figure 8: ICT Employment in the WA 2006 by ANZSIC Classifications

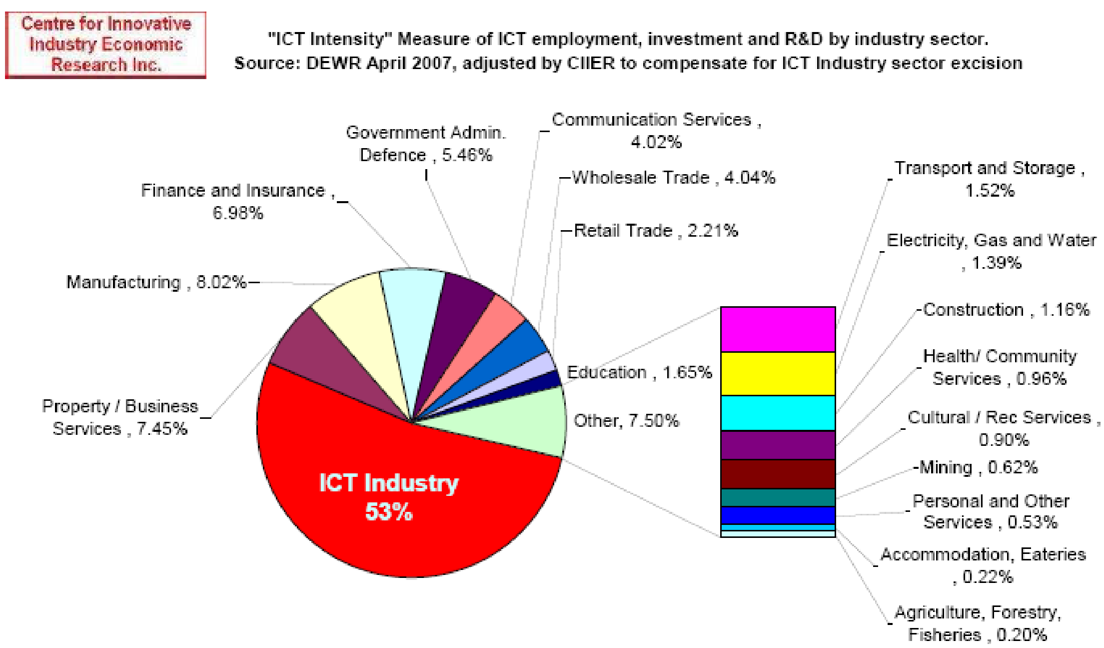
As shown, the largest concentration of ICT employees is found in the property and business services group. This industry sector employs around 40 percent of the total ICT skills labour pool in WA. Within the property and business services sector are computer services which include such sub-sectors as computer consultancy services, data processing services and information storage and retrieval services.

The property and business services category also includes sectors such as advertising services and commercial art and display services. These sectors employ Web Designers and Multimedia Designers, as well as Web Developers and ICT Multimedia Specialists. It also included a range of consultant engineering services that encompasses such groups as Electronic Engineers and industrial designers. The category also includes surveying services, which make a strong use of ICT skills in the areas of map making and spatial sciences.

Other industry sectors that have high concentrations of ICT skilled employees are education, the communications services, finance and insurance and government administration and defence. Within education are computer and ICT trainers as well as the universities and TAFE colleges who are involved in ICT activity. The communications services include the telecommunications services sector which includes a wide range of ICT systems and services. The high concentration of ICT skills in the finance and insurance sector is a reflection of the significant use within that sector of ICT systems to undertake these services.

Is the ICT Sector "Hidden"?

The high concentration of ICT skills within such sectors as property and business services has prompted the ACS to suggest that the ICT Sector is largely hidden and needs to be recognised in a more meaningful way. Figure 9 is taken from the recent ACS commissioned ICT Skills Forecast Project and was created by the Centre for Innovative Industry Economic Research (CIIER, 2008). As illustrated, the diagram has removed the ICT sector from within the property and business services, communications and manufacturing sectors. However, the CIIER warns that the data should be treated with caution as the level of ICT outsourcing varies considerably across different industry sectors. Nevertheless, over 56 percent of the property and business services sector is understood to be engaged in the ICT sector (CIIER, 2008).



Source: CIIER (2008)

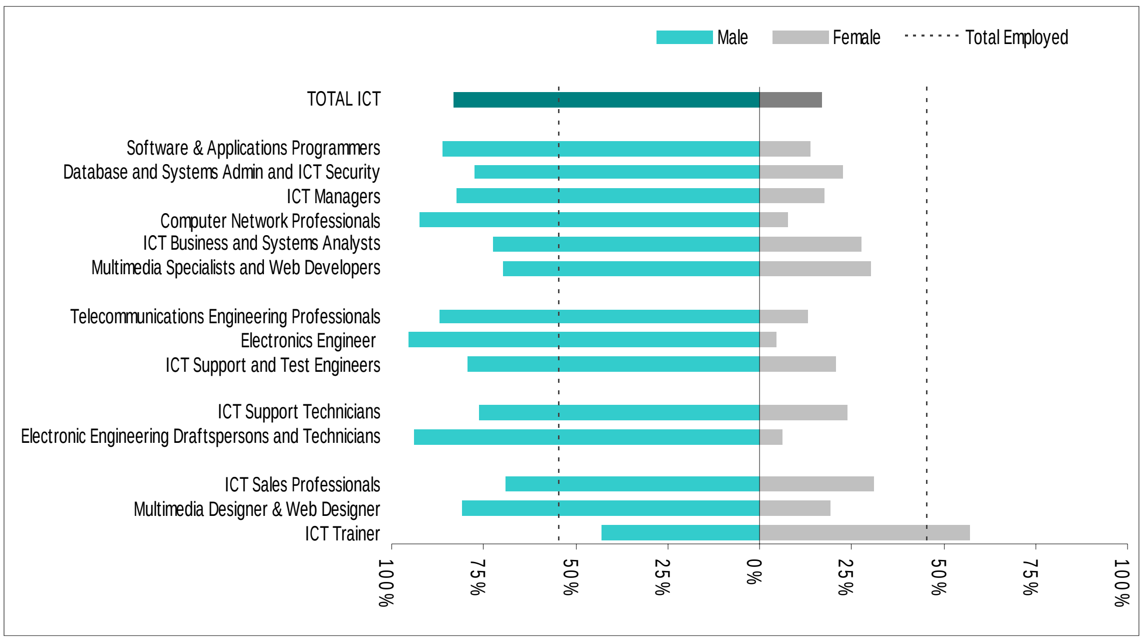
Figure 9: The ICT Sector in Australia – ACS Suggestion

The Demography of the WA ICT Labour Market

The nature of the ICT skilled labour pool within WA is also worthy of analysis to identify its general demography. In this section we examine the WA ICT workforce using ABS data from the 2006 Census.

Gender Bias in the ICT Sector

As already noted earlier in this report, the ICT sector is largely male dominated. Figure 10 shows the gender breakdown within the different ANZSCO ICT categories. It can be seen that the proportion of males is significantly greater than females across all occupational categories with the exception of ICT Trainers.



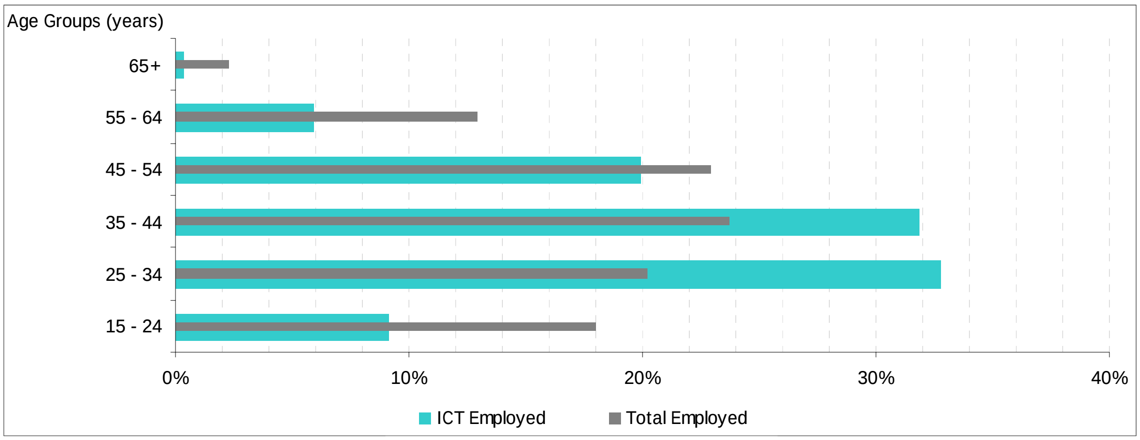
Source: ABS (2006)

Figure 10: The ICT Sector in WA – Gender

The ICT sector has traditionally always suffered from a gender bias and with women comprising around 50 percent of the WA population this male dominance is an area that needs attention. A study undertaken by the Australian Women Educators (AWE) suggests that many women who do work in ICT did not originally aspire to work within the sector but just “fell into it”. For many women and girls the ICT industry is perceived as boring, “nerdy”, too technical or requiring too much math. Attitudes appear to be shaped in early primary school and reinforced over time by parents, peers and teachers. While girls are little different from boys in their awareness and ability to use computers, it is boys who tend to dominate the ICT equipment in classrooms. Male teachers are also more likely than female teachers to be the ICT specialists in the schools. Female teachers, particularly those over 50 years of age in the Primary Schools are particularly likely to have low ICT skills (AWE, 2006).

A Young Workforce

In addition to being male dominated, the ICT workforce is also relatively young in comparison to the broader workforce. Figure 11 shows the ICT workforce in comparison to the overall workforce in WA by age. It can be seen that the ICT workforce is much more likely to be represented in the 25 to 34 years and 35 to 44 years age range. For example, approximately 33 percent of the ICT workforce is aged between 25 and 34 years, and 32 percent is aged between 35 to 44 years, compared to only 20 and 24 percent of the total workforce in these two age ranges.



Source: ABS (2006)

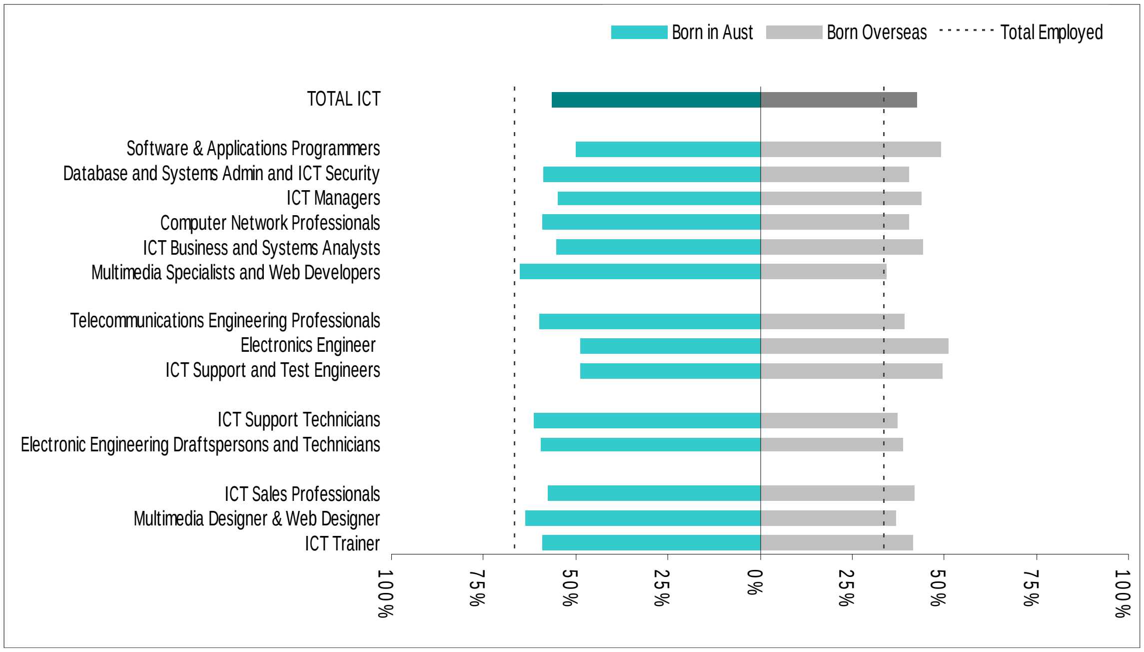
Figure 11: The ICT Sector in WA – Age profile compared to total workforce

An International Workforce

Another feature of the WA ICT workforce is that it is comprised of a high proportion of people who were born outside Australia. Figure 12 illustrates these findings and shows proportion of people born in Australia and Overseas for each of the main ANZSCO occupations. Also shown in the graph is the proportion of the total WA workforce that is Australian or foreign born as marked with a dotted line.

It can be seen that while the majority of the workforce is of Australian birth, the proportion of ICT workers born overseas is much higher than the norm for the overall WA workforce. This is the case for almost all ICT occupations, although in some job categories the proportions are very closely matched. For example, 51 percent of the Electronics Engineers and about half the ICT Support and Test Engineers in WA were born overseas.

Overall the proportion of the WA workforce born overseas is around 33 percent. By comparison, the proportion of foreign born workers in the ICT sector is around 43 percent. This supports the findings from other studies suggesting that a lot of the ICT jobs in WA are being filled from overseas (DBCDE, 2006; ABS, 2006b).

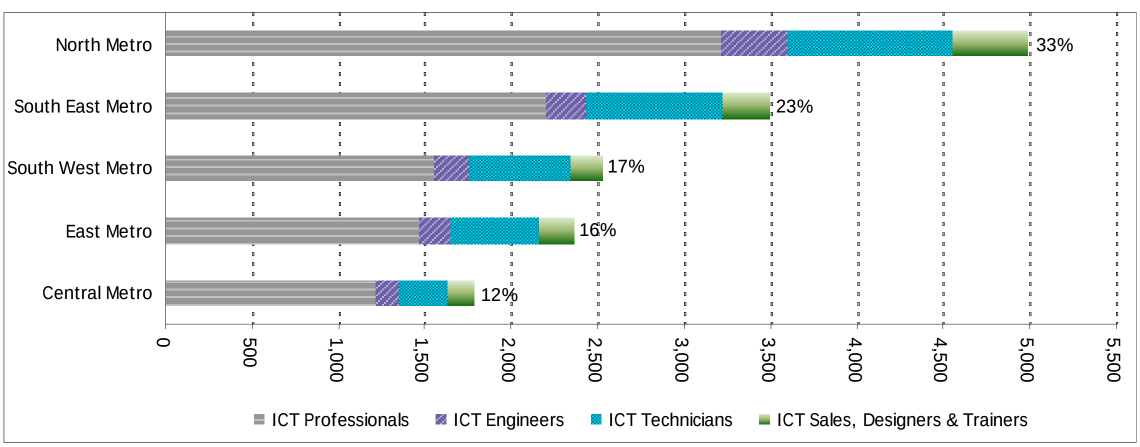


Source: ABS (2006)

Figure 12: The WA ICT Workforce – Australian or Foreign Birth

An Urban Workforce

In addition to its gender, age and ethnicity, the ICT workforce in WA is also largely urban based. As noted earlier, 95 percent of the workforce is concentrated in the Perth metropolitan area. As shown in Figure 13, the distribution of these individuals is relatively even across the city with most living in the North Metro area.



Source: ABS (2006)

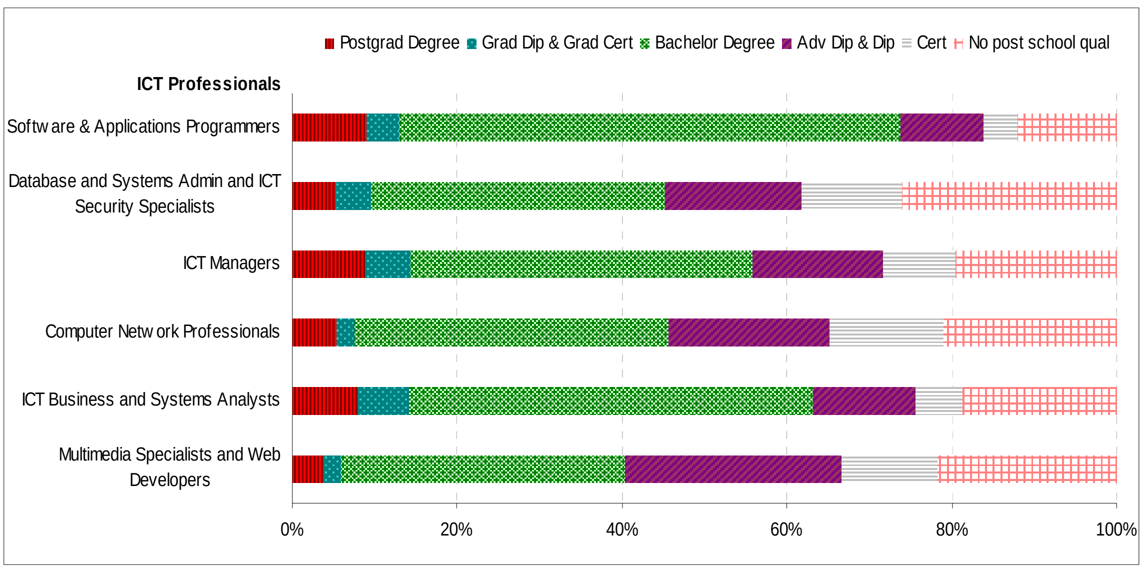
Figure 13: The WA ICT Workforce – Residential Distribution in Perth Metro Area

An Educated Workforce

A key feature of the ICT workforce is its education and training. Most of the ICT Professional and ICT Engineer job classifications require ANZSCO Level 1 qualifications, which are a bachelor's degree or higher degree. The ICT Technicians either require ANZSCO Level 1 or Level 2 qualifications, typically an AQF Associate Degree, Advanced Diploma or Certificate IV. This is also largely the case for the ICT Sales, Designers and Trainers.

However, the need for formal qualifications can be waived in some cases if the individual has at least five years of work experience and a vendor certification. Within the WA ICT workforce around 6 percent have postgraduate degrees and 3.5 percent postgraduate diplomas. Some 41 percent hold bachelor's degrees and 15.6 percent have AQF diploma or advance diploma level qualifications. A further 12 percent have AQF certificate level qualifications, but as many as 22 percent of the workforce holds no formal post-secondary level qualifications.

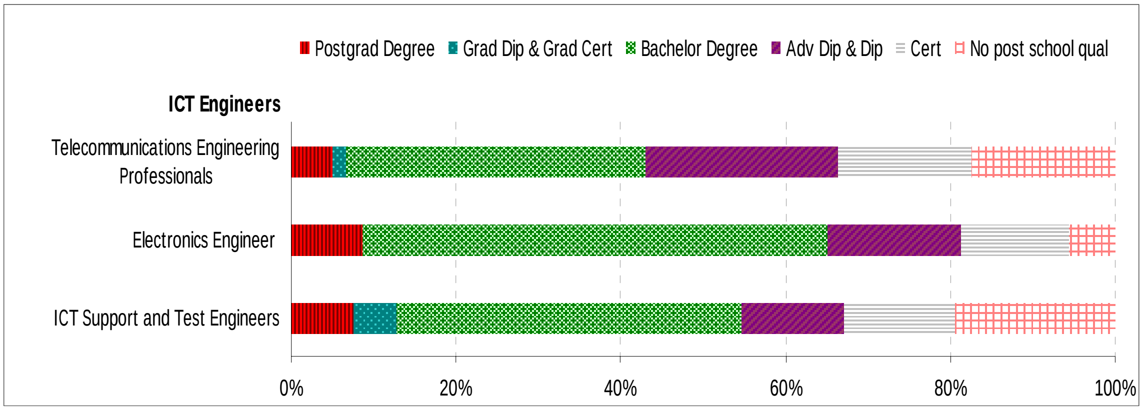
For example, Figure 14 shows the break down of education level within the ICT Professionals category. It can be seen that while the majority (74%) have advance diploma qualifications or higher, there are a relatively high proportion (18%) who lack any qualifications beyond high school.



Source: ABS (2006)

Figure 14: The WA ICT Professional Workforce – Education Levels

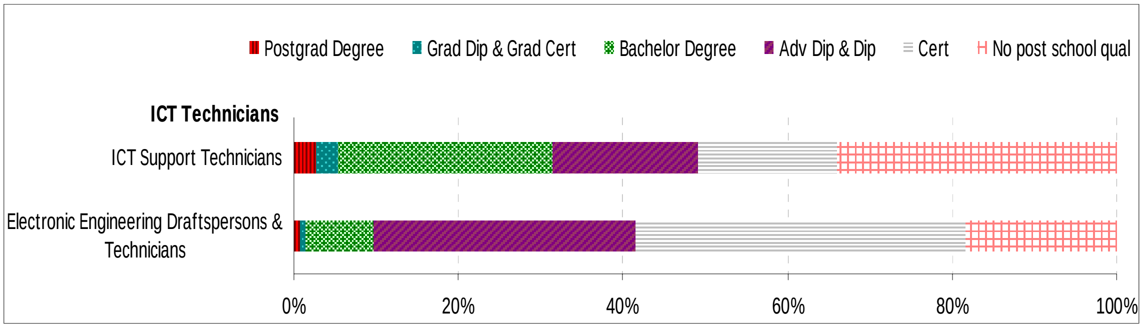
The level of formal qualifications among the ICT Engineers is generally higher as illustrated in Figure 15 below. It can be seen that some 54 percent of the workforce holds bachelor's degree or higher qualifications, and a further 32 percent hold AQF certificate or diploma level qualifications. Nevertheless, around 14 percent of this workforce is unqualified in a formal sense beyond high school. As shown in Figure 15 this is more the case amongst Telecommunications Engineers and ICT Support and Test Engineers rather than the Electronics Engineers.



Source: ABS (2006)

Figure 15: The WA ICT Engineer Workforce – Education Levels

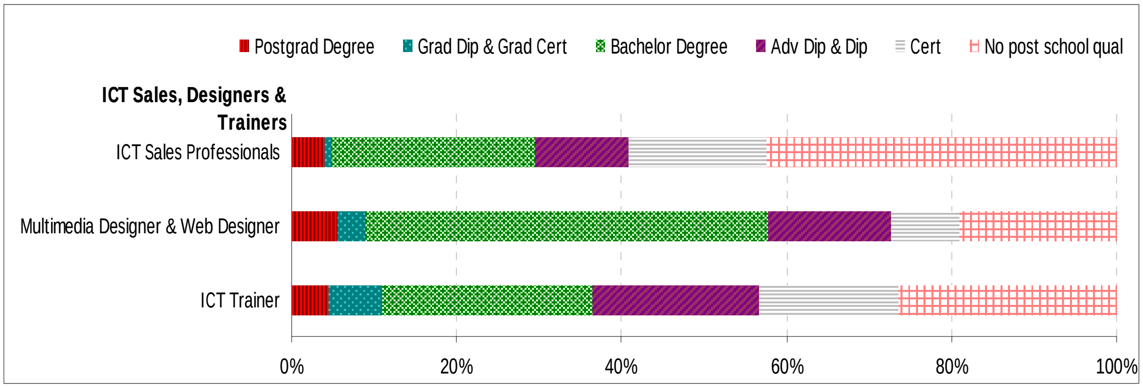
For the ICT Technicians only about 28 percent of the workforce holds bachelor's degree or higher qualifications. Around 40 percent have AQF diploma or certificate level qualifications and as many as 31 percent have no post school qualifications. Within this group the ICT Support Technicians have the highest proportion of unqualified workers.



Source: ABS (2006)

Figure 16: The WA ICT Technician Workforce – Education Levels

Amongst the ICT Sales, Designers and Trainers workforce the group with the lowest level of formal qualification is the ICT Sales Professionals. As shown in Figure 17 around 42 percent of this workforce has no post-secondary level qualifications. The Multimedia Designers and Web Designers are generally well qualified, with 58 percent holding bachelor's degrees or higher, and around 9 percent holding postgraduate qualifications. The ICT Trainers have the most postgraduate qualifications with around 11 percent holding either postgraduate diplomas or masters degrees.



Source: ABS (2006)

Figure 17: The WA ICT Sales, Design & Trainer Workforce – Education Levels

The pattern emerging from this data suggests that the WA ICT industry is generally well educated but that there is a good opportunity for upgrading the qualifications of this workforce. Given the problems facing the WA education and training sector in attracting students from school into their ICT courses, consideration might be given to targeting courses to those already employed in the industry. This was a point noted by the ACS (2008b) in their submission to the review of Australian Higher Education which noted:

> Higher Education providers could better address this market by providing short term certification programs that allow current ICT professionals to quickly pick up new skills or to re-train in new specialisations to increase the supply of ICT professionals in areas in strong demand (ACS, 2008b; p.12).

The ACS (2008b) also suggested that there should be better articulation of ICT careers via the vocational education and training (VET) sector in order to fill skills gaps in the ICT industry and make it more attractive for Year 10 High School students to move into VET certificate level courses in ICT. The need for enhanced collaboration between the different levels of the education sector was emphasized to offer clear pathways for both education and careers through the ICT industry.

The Demand Side Perspective

In order to gain an understanding of the demand side of the ICT supply and demand situation a survey was undertaken with a cross section of WA industry. Rather than a comprehensive survey of the local industry, the study was aimed at taking a snapshot of the employment market for ICT skills. A final sample of 80 respondents was undertaken using a telephone interview lasting approximately 15 minutes. This survey was administered by the Survey Research Centre at Edith Cowan University.

Overview of the Demand Side Sample

The final sample of 80 respondents consisted of representatives from a range of firms in a number of industries. As shown in Figure 18 this included firms associated with the WA mining and resources sector, as well as those in the ICT intensive sectors of communications services, professional services and computer-ICT consulting.

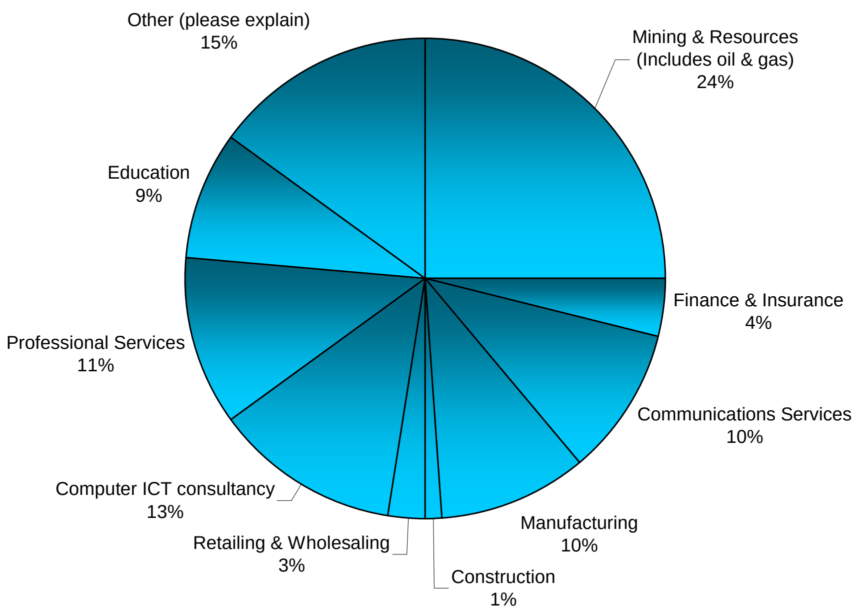


Figure 18: The ICT Demand Side Sample – Industry Sectors

The selection of these firms was deliberately biased towards large firms as it was considered important to investigate the ICT skills shortages within such organisations, and because such firms are important to the development of an ICT industry career path. Almost half (49%) of the sample were drawn from large firms (e.g. those with over 200 employees); and 26 percent from medium sized firms (e.g. those with 20 to 200 employees). The remaining 25 percent were small firms with only 6 percent being micro-enterprises with fewer than 5 employees.

The majority (67.5%) were local WA firms with their headquarters in Perth. Of the remaining sample, 22.5 were branch offices for overseas firms and 10 percent were branch officers for national firms. Not surprisingly the larger firms were more likely to be branch offices, although 49 percent of the large firms surveyed were headquartered in WA.

When asked about their organisational structure, 41 percent of these firms reported having multiple sites around the world, 15 percent had multiple sites across Australia and 14 percent had multiple sites within WA.

Of the 80 respondents interviewed, 35 percent were Human Resource Managers, 32.5 percent were either the CEO or Managing Director of the firm, and 31 percent fulfilled a variety of functions including such titles as: "General Manager", "Operations Manager", "Vice President", "Research & Development Manager", "IT Manager", "Technical Director", "Business Manager for IT Selection" and "ICE Manager". Only one individual described themselves as a "Chief Information Officer".

In summary, the final sample was appropriate for the requirements of this study. Targeted at the larger firms engaged in the ICT intensive industries, the sample captured respondents at an appropriate level of seniority and experience able to provide meaningful comment on the issues associated with the recruitment and selection of ICT skilled employees.

Employment of ICT Workforce

The respondents were provided with a description of the four generic types of ICT occupation as defined within the ANZSCO framework and asked to indicate how many employees that had as at August 2008 within the four broad categories of: ICT Professionals, ICT Engineers, ICT Technicians and ICT Sales, Designers and Trainers.

Table 2 lists the findings from this question along with the allocation of such occupations by size of firm. In the table the mean or (average) number of employees for each category is listed, along with the range (e.g. from lowest to highest) of the number of employees in each category.

It can be seen that the average number of ICT Professionals across the entire sample was 34, with a range from nil to 300 employed within a single firm. Not surprisingly the larger the firm the larger the number of ICT Professionals employed.

The next largest group is that of the ICT Technicians, with an average of 19 employed in the sample firms, but with a range from nil to 500 in a single organisation. Once again the large firms are more likely than the smaller ones to employ such people.

The average number of ICT Engineers employed was 15 across the sample, but large firms had an average of 24 such engineers and as many as 300 in a single organisation. Somewhat surprising was the relatively small number of ICT Sales, Design and Training employees identified within the sample. Even though the total number of such employees is relatively small in comparison with the ICT Professionals and ICT Technicians, these results are probably due to the deliberate biasing of the sampling process to avoid firms engaged in wholesaling of ICT products and services in favour of those engaged in more ICT application and management.

These findings also support the original contention of this study that the larger firms are more likely to provide a focus for ICT employment and career development than the small business sector.

Table 2: ICT Demand Side Sample – Employment of ICT Workforce by size of firm

Size of Firm (employees)	ICT Professionals	ICT Engineers	ICT Technicians	ICT Sales, Design & Training
	Mean & (range)	*Mean & (range)*	*Mean & (range)*	*Mean & (range)*
Large (>200)	55 (1 to 300)	24 (0 to 300)	35 (0 to 500)	5 (0 to 50)
Medium (20-200)	24 (0 – 90)	12 (0 – 90)	7 (0 to 60)	3 (0 to 15)
Small (5-20)	5 (0 -14)	2 (0 to 7)	1 (0 to 6)	1 (0 to 3)
Micro (<5)	3 (2 to 5)	-	-	-
Total sample	34 (0 to 300)	15 (0 to 300)	19 (0 to 500)	3 (0 to 50)

Problems Recruiting ICT Professionals

The respondents were provided with a description of the four generic types of ICT occupation as defined within the ANZSCO framework and asked to indicate how many employees that had as at August 2008 within the four broad categories of ICT employees as defined by the ANZSCO framework.

In relation to the recruitment of ICT Professionals 59 percent of the respondents indicated that they had experienced some problems recruiting this type of employee. When asked to indicate if these problems were associated with a specific category of ICT Professional the most difficulty was found in sourcing Development Programmers, Software Engineers, Analyst Programmers, Systems Analysts, Web Developers, Systems Administrators and ICT Business Analysts.

Figure 19 illustrates these findings. This is a “radar chart” and the different types of ICT Professional occupation are shown on the radii. The occupations listed show those experiencing the greatest recruitment problems at the top of the chart and reducing in a clockwise direction. It can be seen that 30 percent of respondents reported experiencing problems recruiting Development Programmers, with 27.5 percent having problems recruiting Software Engineers and Analyst Programmers.

An examination of these shortages across different industry types suggests that the shortage of Development Programmers and Software Engineers is not restricted any particular industry. However, for Analyst Programmers there was a particular shortage identified amongst firms in the computer consultancy and education sectors. These same sectors also reported shortages in ICT Multimedia Specialists, ICT Business Analysts, ICT Project Managers and also Systems Administrators.

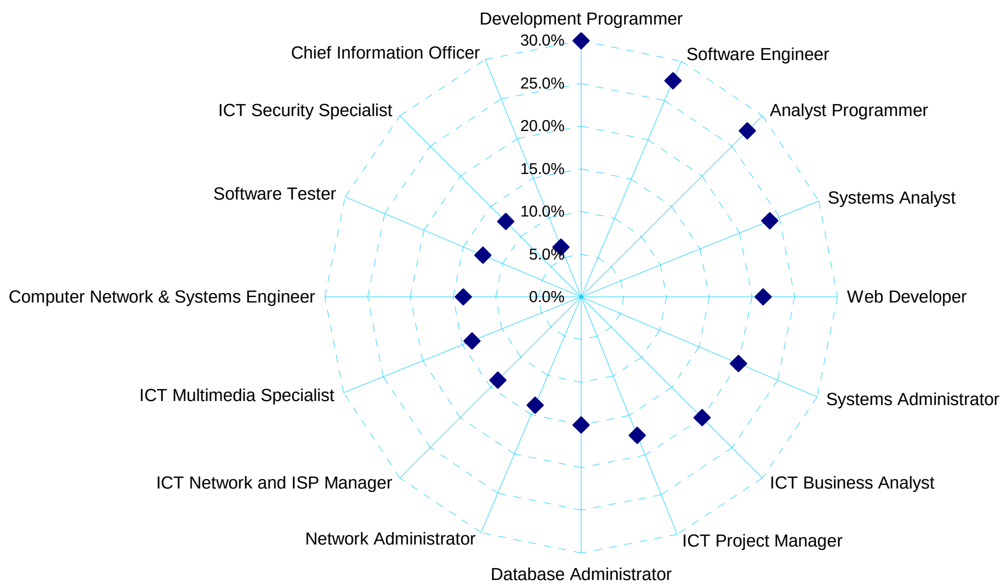


Figure 19: Recruiting ICT Professionals - % experiencing problems

Large firms were found to be more likely than their smaller counterparts to be experiencing problems in recruiting ICT Business Analysts. However, for all other occupations the effect of size was not found to be significant.

It is important to note that these results, which were generated from chi-square tests with significance at a 95 percent confidence interval, involve a small sample and even smaller sub-populations within the sample. As a result they should be treated with extreme caution and do not represent a precise image of skills shortages in these occupations in WA industry. However, they can be used as broad indicator of recruitment problems for specific types of ICT Professional occupation.

Problems Recruiting ICT Engineers

Only 20 percent of respondents indicated that they had experience problems recruiting ICT Engineers. Figure 20 below shows the responses to this question by type. It can be seen that the largest shortage was reported amongst the Electronics Engineers, although only 11 percent of the sample reported difficulties recruiting this occupation. Telecommunications Engineers and Telecommunications Network Engineers were also reported as difficult to recruit by 9 percent the sample.

Engineering shortages were not found to be influenced by size of firm or industry, although once again we caution the use of industry results given the nature and size of the sample. The results do not indicate a significant shortage of ICT Engineers among the firms surveyed although DEEWR has reported a state wide shortage of Electronics Engineers in 2008 (DEEWR, 2008c). However, these results point to the relative problem of recruiting this occupation in WA at present.

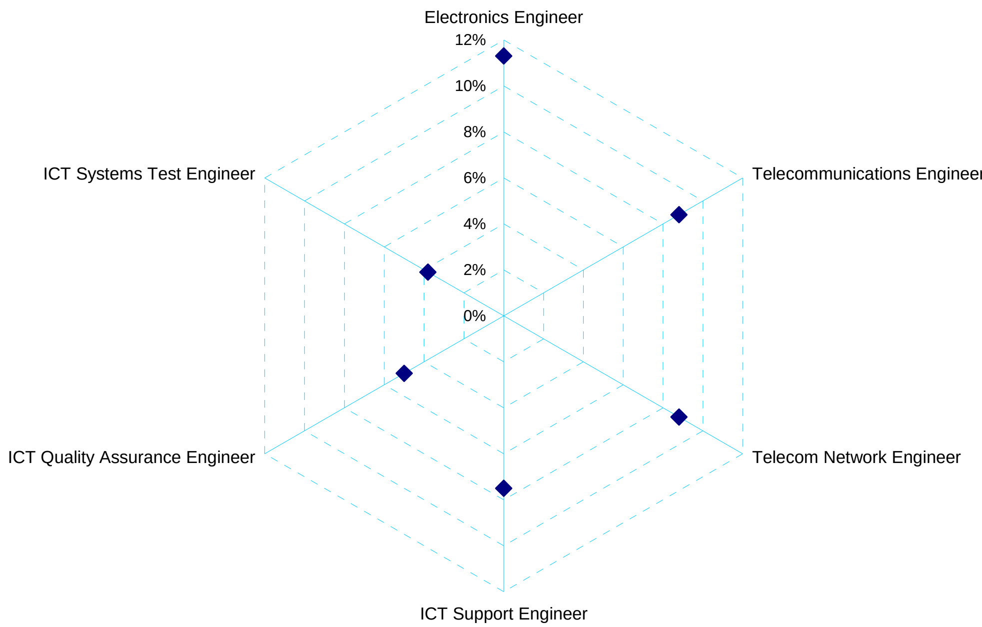


Figure 20: Recruiting ICT Engineers - % experiencing problems

Problems Recruiting ICT Technicians

As with ICT Engineers, only 22.5 percent of the respondent's indicated that they had experienced problems recruiting ICT Technicians. Figure 21 illustrates the pattern of these shortages, where it can be seen that those trades identified as being in greatest shortage were Computer Systems Technicians, Electronic Engineering Technicians and ICT Customer Support Officers.

Analysis of the way these shortages influenced particular firms by size or industry type suggest that Electrical Engineering Draftspersons were in most shortage among medium sized firms, and recruiting ICT Customer Support Officers was a particular problem within retail and wholesale firms, as well as computer ICT consultancy firms. Web Administrators were found to be in short supply within the education sector.

Once again the interpretation of these findings needs to be taken with care as the sample size is very small. The findings provide an indicator of ICT skills shortages only rather than a definitive conclusion. They do indicate that shortages or a difficulty in recruiting ICT Technicians is not critical, but that it is concentrated across a few specific occupations rather than a broad cross section of occupational types.

These findings are supportive of the DEEWR skilled vacancy reporting showing state wide shortages of electronic engineering associates and electronic equipment trades, as well as recruitment difficulties for general communications trades in 2008 (DEEWR, 2008c).

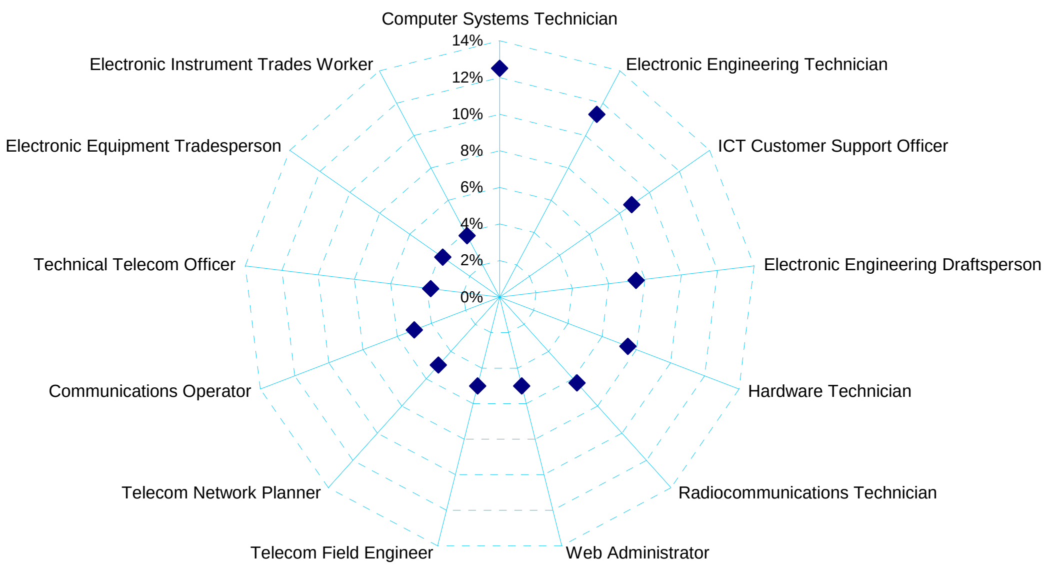


Figure 21: Recruiting ICT Technicians - % experiencing problems

Problems Recruiting ICT Sales, Designers and Trainers

Only 15 percent of respondents indicated that they were experiencing problems recruiting ICT Sales, Designers or Trainers. As illustrated in Figure 22 below the most difficulties were found in recruiting ICT Business Development Managers and ICT Sales Representatives, although only 6 percent of respondents indicated problems in this regard. Around 5 percent indicated problems recruiting ICT Account Managers, Technical Writers and ICT Trainers.

The size of the firm did not appear to be significant in terms of these shortages, and no differences were found for industry type. This indicates that shortages, while modest in general terms, for ICT Sales, Designers and Trainers are not particularly influenced by size or industry within the sample.

It should be noted that the sample did not include a representative sub-population of firms within the ICT wholesale or retail sector so these shortages in ICT sales personnel may be misleading for these industry sectors.

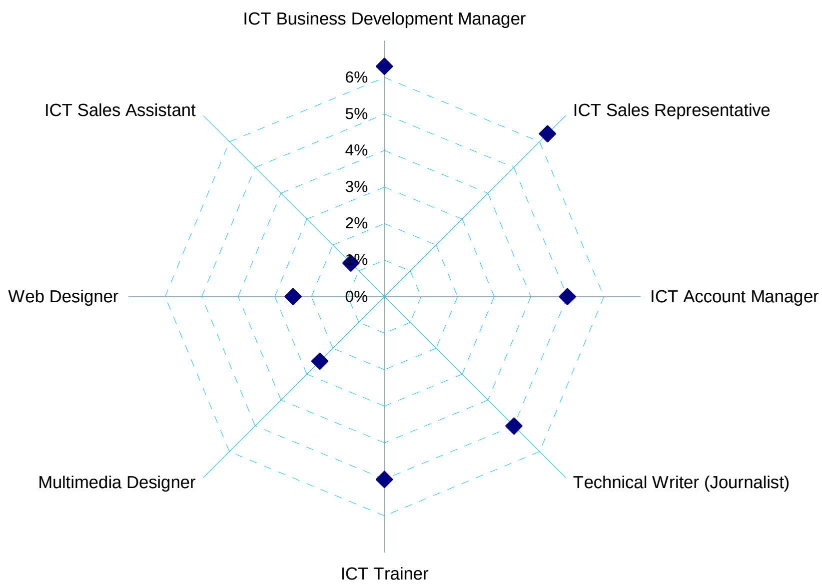


Figure 22: Recruiting ICT Sales, Designer & Trainers - % experiencing problems

In-house or Out-source

The ICT sector has been identified as a field that can be subjected to outsourcing. However, the findings from this study indicate that the majority of firms preferred to retain their ICT workforce in-house.

When asked about their organisation's intention to retain ICT employees in-house or to outsource these functions, 45 percent of respondents indicated a desire to retain all ICT workers in-house. A further 39 percent indicated their policy was to outsource only a few areas and retain most workers in-house. Only 6 percent sought to outsource all ICT work and 10 percent opted to outsource most of the work while retaining core services in-house.

Larger firms were more likely to seek to retain their ICT workforce in-house than smaller ones, with micro-enterprises trending towards outsourcing all ICT work, presumably due to a lack of scale to justify in-house retention. Only those micro-enterprises that were ICT specialists followed an in-house retention strategy.

Although the sample size and structure makes the findings highly problematic, the preference for in-house retention of ICT workers was strongest among the mining and resources and professional services firms.

ICT Supply and Demand Trends

The respondents were asked to indicate their perceptions of the general trend in relation to the demand for ICT skilled employees and the supply of suitably qualified graduates in these fields from local education and training institutions.

Just over half (54%) of the sample felt that the supply of suitably qualified ICT graduates from local educational institutions had been generally in decline over the previous five years. A further 34 percent felt that the supply had been holding fairly steady. By contrast 41 percent felt that the supply of overseas trained ICT graduates had been generally increasing, with 35 percent of the view that the supply of foreign graduates was holding steady.

When asked about their forecast as to the need within their organisation for ICT Professionals, around 87 percent felt that the demand for these workers would be either similar to today or increasing over the next three years. A similar outlook was forecast for ICT Engineers, with 66 percent predicting a similar or increasing level of demand for such people over the next three years.

In the area of ICT Technicians, 66 percent of respondents anticipated similar or increased levels of demand for such employees over the next three years. The anticipated demand for ICT Sales, Design and Training employee was forecast to be the same or higher amongst 56 percent.

When asked how satisfied they were with their current ability to recruit ICT employees, 45 percent expressed satisfaction, while 35 percent were dissatisfied. Despite some of the apparent concerns over finding suitably qualified ICT employees, 56 percent of the sample expressed a sense of optimism in their ability to recruit graduates in the future.

Factors Influencing the Demand for ICT Courses

The respondents were told about the significant decline in the number of enrolments in ICT courses across Australian educational institutions. They were asked to indicate on a 5-point rating scale their perceptions as to the importance of several factors in influencing the attractiveness of ICT courses to WA students.

Figure 23 illustrates these findings where it can be seen that the factors rated as the most important by the respondents were the need for enhanced collaboration between industry and the education sector to create a sustainable pipeline of skilled graduates; and the need to make ICT courses more attractive to women. Both these factors scored a mean of 4.5 out of 5.

In second place was the perception that ICT courses and careers needed to be better promoted within high schools. All the other factors were of lower importance. These findings are consistent with earlier research that highlights the need to attract more women into the ICT industry, and the call by the AIIA and ACS for better collaboration between industry and the university and vocational education and training sector (AIIA, 2008; ACS, 2008b).

As will be seen later in this report, these findings are broadly consistent with the views expressed by the educational institutions within the supply side survey. They point to the need for more coordinated action across local industry and educational institutions to overcome the falling enrolments in ICT courses. These issues are discussed further in the later sections of this report.

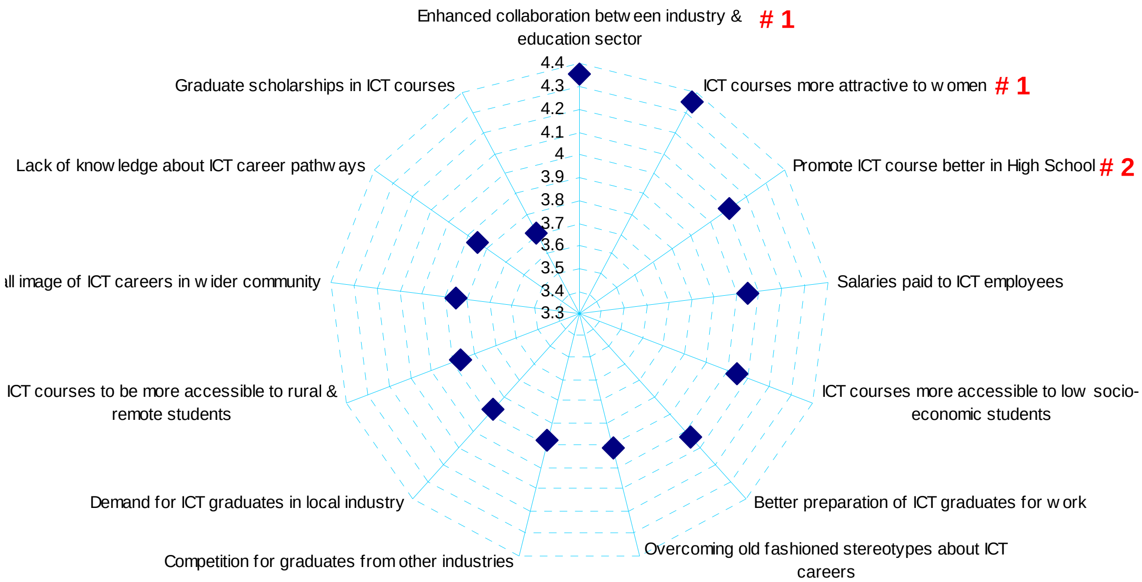


Figure 23: Factors influencing enrolments in local ICT courses – demand side view

Comments from Industry

In the conclusion of the survey respondents were given the opportunity to make additional comments in relation to the supply and demand for ICT employees in WA and what future initiatives might be taken by the WA Government to alleviate supply shortages. A variety of comments were made which are transcribed below.

There was a call from some of the need to develop the overall ICT industry within WA which was viewed as not attractive to local graduates, or not able to retain local graduates. The following comments are typical:

> I think they need to develop the overall industry / they are coming out but they are just going over seas.

> There are no stepping stones for those who have industry skilled qualifications / all the medium level jobs have gone overseas so there is no next level for them.

The need for the universities and TAFE or VET colleges to change their courses and approaches was also a feature of many comments, with calls for changes to curriculum and also to the need for more industry relevance in the course content and collaboration between industry and academe. For example:

> The important thing is the relevance of the training / when students come out of university they don't really know how to work within the industry / they need to learn more practical work / they might be good at formulas and mathematics but they should also be good at application.
>
> There needs to be more accurate or timely feedback from the employers to the educators, and what the needs of the employers are aren't being met by the trainers.
>
> The industry and the education system are slow to react and remain relevant, they need to act quickly on the information that we are collecting. Language and communication skill are just as important as their engineering skills.
>
> More involvement in the educational institutions by the companies.
>
> The TAFE and others training bodies should be more proactive in talking to the industry / they just don't seem to be interested / they do the training and then it seems that just leave it up to the graduate to find a job / I talk to TAFE about our needs.

There was also a call for students to be better prepared for work though their education and training courses:

> So that the students have some idea about the work force they should have as part of their course a unit where they actually have to work out in the field for a while / so they have a better idea of what to expect when they get a job
>
> With graduates it's getting the experience while studying that would be good / maybe partnering with companies to allocate a certain number of graduates to go through experience based learning / so that they're not just fresh from university with no experience.

The need for universities to be better supported financially and to maintain high standards was also acknowledged, as was the need for postgraduate courses targeted at those already in the industry, with particular emphasis on hybrid courses or double degrees:

> I think that the universities need to be better supported financially by federal government as reduction in ICT students has resulted in staff reduction at universities and then the problem becomes cyclical / more funding means more staff to teach.
>
> I have a few points: I think that we had a reduction in students in ICT and the quality has been very bad / I would be wary of lowering the bar to attract just anyone as the quality is often bad / it would be better to attract fewer but better quality.
>
> We need to have people with transferable skills across borders / we are an it company but mainly work in the mining industry so people with engineering degree etc have great opportunity to work in it as well / they bring their experience to it when they transfer.
>
> We are very pessimistic about our ability to fill the roles that need filling / we need dual discipline / we need both ICT and mining backgrounds which is extremely hard to fill and we know it is so we are ever pessimistic.
>
> I think that perhaps the teaching institution should do things other than programming / we have people on the floor who would like to up skill and we have nowhere to send them / we are stuck in a strange place in the market / we are not even offered.
>
> Just that I think that there should be a cross-discipline ICT / we are in the mining industry and it would be good to get geologist that have done and ICT course or an ICT graduate that's done a geology course / this would be more functional as opposed to the current system.
>
> Focus on the content of the courses / not just the qualifications / don't try to specialise in one area / maybe get the students to study one area for 3 months then another area for 3 months and so on / so that when they get to company they are not limited.

There were also a number of comments about the need for the school system to do a better job of promoting or teaching ICT skills, plus maths and science, and helping children identify future careers in the sector:

> By the time kids get half way through high school their perceptions are already / stuck as to which way they want to go / we need to look at educating in even primary school / for maths and physics / it needs to be pushed more so that when they get to university they can enter the courses.

> I think that it's quite important that science skills are raised in high schools, more emphasis needs to be placed on maths and science so that students entering into the university level training can actually perform.

> There needs to awareness that the ICT careers are good careers for the low income high school kids / re education the teachers and the parents / they seem to think that it is not a good career path.

> I think promoting work experience amongst high school leavers, it helps them decide what university course they want to go for, its very valuable, I have had a few work experience people who have realised that it wasn't the path for them, so a good thing.

> There is a large number of self taught young people who play around with computers and think they know it all / they haven't had all the formal training and they come for jobs because they have the experience which is what we need but there's too many without qualifications.

> My daughter is just going through the process of choosing subjects at high school and I have noticed there is no push to promote IT / it's still classed as quite nerdy and students are apprehensive to choose it as a forte / there needs to be more promotion of IT.

> The big issue is the lack of interest and involvement from the department of education / the careers guidance officers in the schools get no training and information about ICT careers / DOIR and the education department should be working together to solve this.

Numerous comments related to the perceived pressure from the mining and resources sector for graduates to enter other careers in the more lucrative occupations offered by that industry:

> The supply very is limited at the moment / I think that people are more attracted to the minerals and resource sector and we just cant compete with that / they are driven by the money / we can't really cater for that / we need to find a balance.

> It is hard to compete with the mining industry / we need to have flexible working hours in the industry / it has been seen in the pass as people working excessive hours / the WA government need to market more to try and encourage people into the industry.

> The biggest problem is the resources industry sucking up everyone they can get / people are choosing to go to the mines to work and get quick money with no skills rather than go to university and study for a career which is essentially going to leave.

> From my point of view the shortage is not so prevalent in my industry, mining, because of our ability to offer a higher salary package.

> It's all really a cycle / oil and gas that's what people are going into and it creates a shortage for ICT careers / but by then it's too late and the shortage has already happened / I don't really know.

Others saw the problem as something the Government could solve with a change to procurement and innovation policy:

> Governments need to be much more responsible in the way they manage their outsourcing for large it projects, governments are by far the biggest users of it and when they tender for it projects overseas they are sending the wrong image to future graduates.

They could look at expanding the science and innovation scholarship award / which is run from the DOIR / they only take 20 people/ they have trouble filling it actually / if they pushed it more and got more people in / maybe combining it with an electronics support program.

There was a call to have ICT careers more effectively promoted and for career paths to be better mapped out in order to encourage people to enter the industry:

Need to advertise more / the course and career paths / try to get away from the stereotypes / more advertising and education / need for better information about the ICT careers at the high school level.

Maybe a graduate program that can be offered to potential students if they follow a certain path in their studies? / unfortunately our industry has outsourced a lot of the lower end roles to specialised service providores, however, the career path for ICT is good.

To make people more aware of the fields that they can go into / show them that it is not just a service desk help officer and that they just don't sit all day in front of a computer / we are now paying for the government push for people to go into this sector.

Better information to the graduate about the career paths they can take / if they are not aware of then they will not go down that pathway / you have to make it exciting I have 3 sons and they wont do anything unless it is attractive and exciting.

We bring ICT students in at the bottom end and train them up through the company / ICT students are attracted to our company so we very rarely have problems recruiting.

I think information technology went from being a cool thing to do to a geeky thing to do, so that image needs to be addressed / I also think that as part of the training they need to focus on interpersonal skills, there are a lot of real tech heads.

People need to be motivated into courses / to get results you have to put in / they need to get as many people in as you can / knowing that not all will be the cream of the crop but you have to do that to get at least some / someone needs to go round to the schools and promote ICT careers and courses.

Some respondents viewed the problem as a cyclical trend and others were either positive or highly pessimistic:

We function in a boom bust cycle of supply of graduates / look at the long range trends and cater to the long range, if there's a tendency towards off shoring, look at where we will be left in 3 years time / digital content industry is a behemoth.

There is less people out there applying for jobs in general / 5 years ago we would have 120 people applying for the same engineering job / today we are lucky to get 20 / 10 will be from WA and the rest from India / the mining boom has hurt our industry.

We have only tried once to recruit people locally and were very successful so have no problem so far / we have had no need to recruit overseas educated people either / so no problems so far

Can't do much / they are doing what they can / they need to build the capacity in Australia / maybe a skilled migrate program from overseas.

We target specific people who are experienced on a global level / we don't hire graduates really / that's why I said unimportant to most of the questions as it doesn't impact us what so ever.

The only thing I can see that can be done is to recruit from overseas and inter state.

There has been a softening of the market / we have to be careful that we don't end up like the .com boom / we need to understand the demand trends and not over re act

> We have had to open a programming house in Delhi India because it is just impossible to hire programmers over here / its not that we wanted to open one abroad / it would be far more convenient for me if I didn't have to go to Delhi for a week every f

> Of all the professionals and skilled workers we employ, ICT is the field where we are least worried about the pool of available applicants. We have had staffing trouble in every other field, down to receptionists, but never in this category.

General Conclusions from the Demand Side Survey Data

The findings from the demand side survey were broadly consistent with other published data that suggests the demand for ICT occupations will increase over the longer term and that there has been difficulty in recruiting local graduates in specific areas. The local industry responses in this survey support the view that overall demand for ICT occupations has eased slightly and that many firms are recruiting from overseas to fill vacancies.

In general terms the shortages in specific job categories such as Electronics Engineers, Software Engineers, Programmers or Systems Analysts is potentially cyclical and can be solved by most of the larger firms through overseas recruitment. The Australian Federal Government has been promoting ICT skills vacancies within international recruitment of skilled migrants for sometime.

The longer term challenge, as noted by most of the respondents, is to develop a sustainable pipeline of local ICT graduates from the higher education and vocational education and training sectors into the WA workforce. The recognition of the need for enhanced collaboration between industry and the education sector, plus the need for more promotion of ICT careers in the schools, are highlighted from this study.

In the next section the perspective of the education and training sector is examined.

The Supply Side Perspective

In order to investigate the supply side of the ICT skills labour force in WA a further survey was undertaken with representatives from local educational institutions. This survey was designed as a mirror to the demand side study and also involved telephone interviews of approximately 15 minutes undertaken by the Survey Research Centre at Edith Cowan University.

Overview of the Supply Side Sample

A total of 32 respondents were interviewed for the study. They represented senior academics and administrators from schools and faculties involved in the design, development and delivery of ICT courses at the post-secondary level. Multiple interviews were undertaken with respondents from all the universities (e.g. Curtin, Edith Cowan, Murdoch, UWA and Notre Dame), the TAFE sector and other vocational training providers including privately owned degree issuing colleges. The final distribution of the sample was as follows:

- Universities = 19 interviews in five institutions
- TAFE colleges = 9 interviews in six colleges
- Other VET colleges = 5 interviews in five institutions

The respondents were identified in advance from institutional websites as heads of department, school or faculty within the ICT fields relevant to this study. Of the respondents 41 percent were Heads of School or Faculty, the remainder were either senior academics or senior administrative officers within these institutions.

We believe that this sample, while small, is a good representation of the WA education and training sector engaged in the ICT sector.

Types of ICT courses offered

Given the complexity of many courses and the variety of course titles and codes offered across the education sector in the area of ICT, it was decided to focus the survey on the occupations into which the graduates might move. The ANZSCO framework was used as a guide for this process.

All respondents were given a description of the four broad ANZSCO ICT occupational categories and then asked whether or not their courses were designed to prepare students to enter this type of occupation within the first 3 to 5 years from graduation.

The majority (75%) of the respondents reported that their courses prepared students to enter ICT Professional careers, and 59 percent were engaged in courses designed to prepare students to enter careers in ICT Sales, Design and Training. However, only 31 percent of respondents were involved in courses preparing students for entry into ICT Engineering careers, and 34 percent in ICT Technical careers.

Half the respondents indicated that their institution offered undergraduate or postgraduate degree qualifications in the field of ICT. In the non-degree areas, 34 percent offered AQF Certificate II level courses in ICT, 37.5 percent AQF Certificate III level courses, 34 percent AQF Certificate IV level courses and 9 percent Advanced Diploma courses.

Number of Students Enrolled

Respondents were asked to indicate approximately how many students their institution had enrolled in ICT courses in 2008, how many were expected to graduate in 2008 and what proportion of these students were international rather than local.

It should be noted that this study does not present these findings as a definitive report on the current level of ICT enrolments in the WA Education sector. While interviews took place with Heads of Faculty and School and most respondents took care to provide accurate statistics, we do not consider these as official enrolment statistics. A point to note is that obtaining a reliable estimate of the number of students enrolled in ICT courses within the WA education sector is not straightforward.

According to information provided to this study by DOIR, there is a lack of reliable data on the number of ICT enrolments and graduations in the ICT field from within the TAFE sector. Data on the number of enrolments into university courses across the four publicly funded institutions reported to DOIR, identified around 320 students, but this did not include the Curtin Business School's information systems courses.

As noted earlier in this report, an examination of TISC data for the four major universities suggested enrolments in 2008 of around 410 into ICT courses. However, this did not identify those entering electronic engineering courses which involve a specialisation chosen in second year following the completion of a common first year within the engineering faculties. This suggests the need for more accurate and reliable mapping of the ICT graduate "pipeline" with attention given to separation of international and domestic students as the former are generally unable to remain in Australia and seek employment upon graduation.

To acquire precise enrolment figures will require access to different institutions actual enrolment and graduation statistics. The statistics reported below should therefore not be viewed as an official estimate of enrolments. However, these findings do provide indicative data confirming what has been reported in other sources, that the total level of enrolment from local students in ICT courses has declined in recent years. It should also be noted that most respondents took care to check these figures before providing these so some degree of accuracy is to be assumed.

Table 3 lists the reported statistics from the universities. It can be seen that the total estimated enrolments in ICT courses across all institutions for 2008 was 2,574, with forecast graduations of 742 for the same year. These statistics include both engineering degree programs and ICT courses within business faculties in Information Systems as well as fields such as multimedia and web design. It should also be noted that despite our best efforts we may have missed some schools or faculties who undertake courses relevant to the ICT occupations identified elsewhere in this study.

As is also shown in Table 3, the proportion of full fee paying overseas students (FFPOS) within these figures ranges from around 13 percent to as high as 100 percent in the case of the University of Notre Dame. For Curtin University some courses are taught offshore and to the best of our knowledge these enrolments have been removed from the figures. Nevertheless, the total enrolments shown in the table may need to be discounted by between 15 and 50 percent if the FFPOS are taken into account. This suggests that the total university enrolments of local students in 2008 is around 2,000 with 600 anticipated graduations.

Table 3: ICT Enrolments and Graduations 2008 – Universities*

Institution	ICT Enrolments	ICT Graduates	% FFPOS
Curtin UT	1,350	400	Varies by course from 15% to 50%
Murdoch U	460	150	Varies by course from 15% to 40%
Edith Cowan U	400	70	Varies by course from 33% to 50%
UWA[1]	362	120	Varies by course from 13% to 30%
U Notre Dame	2	2	100%
Total	2,574	742	

[1] UWA figures are for Faculty of Engineering, Computing and Mathematics

* Figures drawn from telephone interview with senior academics in each institution across several faculties, does not represent official institutional reporting.

An analysis of the sources of these enrolment statistics by faculty was attempted but the sourcing of reliable data from the universities even when in contact with the Deans and Heads of School proved highly problematic. This is due to the complexity of enrolments within these institutions, where full time and part time students or those enrolled in cross disciplinary programs makes clear identification of ICT focused students very difficult.

What these figures show is a relatively large pool of students enrolled in ICT courses with engineering and computer science students comprising at least half these figures. Given the complexity of some courses and the tendency towards different institutions combining ICT programs in different ways, these figures can only be indicative.

Interviews were sought with all WA TAFE colleges as part of this study but only six institutions responded. The results of these interviews are shown in Table 4 where it can be seen that most of the larger metropolitan colleges reported between 250 to 520 enrolments in ICT courses, with almost the same number of students anticipating graduation in 2008. By comparison the smaller, regional colleges had fewer students and did not report any international student enrolments.

The pattern emerging from this data is that the TAFE sector has around 1,260 enrolments in ICT courses and is anticipating the graduation of around 750 students from such courses in 2008. It was not possible to differentiate within this data the type of courses undertaken by these students. However, the indication from the respondents was that the majority of these enrolments were in ICT fields other than those targeting the ICT Technician occupations.

Table 4: ICT Enrolments and Graduations 2008 – TAFE Colleges*

Institution	ICT Enrolments	ICT Graduates	% FFPOS
Challenger TAFE	520	380	3-4% depending on area
West Coast TAFE	380	100	
Central TAFE	250	200	15%
CY O'Connor TAFE	50	20	
Great Southern TAFE	30	20	
Central West TAFE	30	30	
Total	1,260	750	

* Figures drawn from telephone interview with senior academics in each institution across several faculties, does not represent official institutional reporting.

Only Challenger TAFE indicated that its students were undertaking courses targeting the ICT Technical fields. In their responses the other institutions indicated that their graduates would be entering the ICT Professional or ICT Sales, Design or Training occupations. Given the reported state wide shortage of Electronic Engineering Associates and Electronic Equipment Trades jobs, this apparent emphasis within the TAFE sector on other ICT occupations may suggest a miss alignment between the needs of industry and the training sector.

Table 5: ICT Enrolments and Graduations 2008 – VET Colleges*

Institution	ICT Enrolments	ICT Graduates	% FFPOS
Excom Education	500	500	10%
Canning College	100	100	5%
Hands on Computer Training	400	300	30%
Advanced Business College	10	10	
College of Electrical Training	50	10	
Total	1,060	920	

* Figures drawn from telephone interview with senior academics in each institution across several faculties, does not represent official institutional reporting.

Interviews were also undertaken with a small number of VET colleges. Initially six institutions were identified as being involved in delivery of ICT courses but some either declined to participate in the study or indicated that they did not actually run ICT courses as was originally thought. Five institutions did participate and their combined enrolments totalled 1,060 with a forecast of 920 students to graduate in 2008. Table 5 illustrates these findings.

The total reported number of enrolments for all sectors was 4,894 students with 2,412 expected to graduate in 2008. While we suspect some errors in this data and caution that it is not to be considered definitive in nature, they offer a general snapshot of the WA ICT student pool. When FFPOS are removed the numbers can be discounted by around 30 percent.

When asked about their perception of past and future trends in ICT student enrolments 69 percent reported a general decline over the past five years in the number of local students who had enrolled. However, 69 percent also reported international student enrolments over the same time period had either been holding fairly stable or generally increasing.

Most respondents were fairly optimistic about the future. Eighty-four percent reported that they expected enrolments from local students to either hold steady or increase over the next three years. A further 81 percent felt the same about international student enrolments.

Despite 75 percent feeling optimism about the future, 62.5 percent were dissatisfied with their current level of enrolments. These views were broadly shared across all education sectors with no differences identified between universities, TAFE Colleges or private education institutions.

Preparation for ICT Professional Careers

Given the complexity of many courses and the variety of course titles and codes offered across the education sector in the area of ICT, it was decided to focus the survey on the occupations into which the graduates might move. The ANZSCO framework was used as a guide for this process.

As shown in Figure 24 the ICT professional careers these institutions felt their students would most likely enter within 3 to 5 years after graduation were those of Systems Administrators, Network Administrators, Web Designers, Database Administrators, ICT Project Managers, ICT Network and ISP Managers, Software Testers, Development Programmers and ICT Multimedia Specialists. At least half the sample felt their courses prepared students to enter each of these occupations.

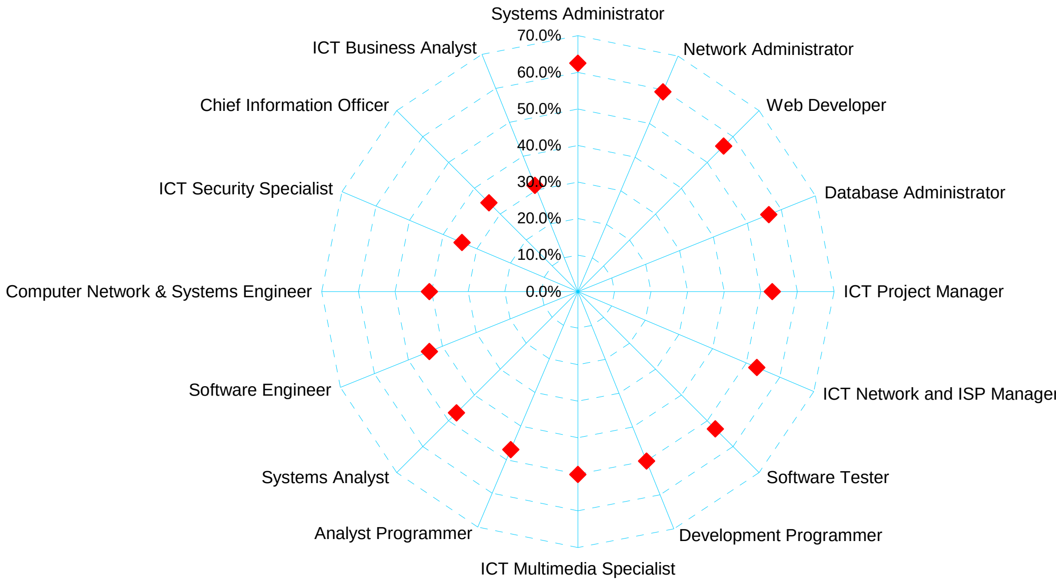


Figure 24: WA Educational Institutions % preparing graduates for ICT Professional jobs

Preparation for ICT Engineering Careers

Within the field of ICT engineering careers some 28 percent of respondents felt that their courses would prepare students to become ICT Support Engineers within the first 3 to 5 years after graduation. A further 25 percent identified their courses as targeting Telecommunications Network Engineer careers, and 22 percent Telecommunications Engineer and ICT Systems Test Engineer careers. Only 16 percent reported preparing students to become Electronics Engineers and 9 percent ICT Quality Assurance Engineers.

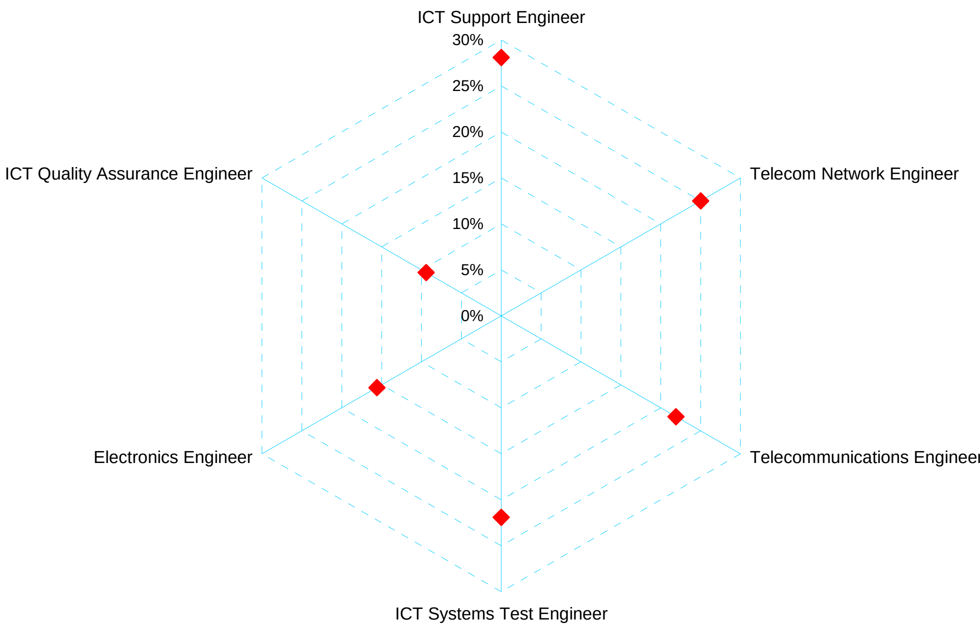


Figure 25: WA Educational Institutions % preparing graduates for ICT Engineer jobs

Preparation for ICT Technical Careers

Relatively few institutions appeared to be preparing graduates to enter ICT Technical careers. Figure 26 below, illustrates these findings, where it can be seen that 25 percent of respondents indicated that their courses would prepare graduates for the role of ICT Customer Support Officers or Web Administrators. Only 19 percent of courses were preparing students for entry into the roles of Computer Systems Technician or Hardware Technician. A further 13 percent reported preparing students to become Telecom Network Planners.

All other ICT Technician occupations were being targeted by fewer than 10 percent of courses according to the respondents. Given the reported shortage of ICT technical trades specialists in the WA economy this apparent paucity of courses targeting these fields is a concern.

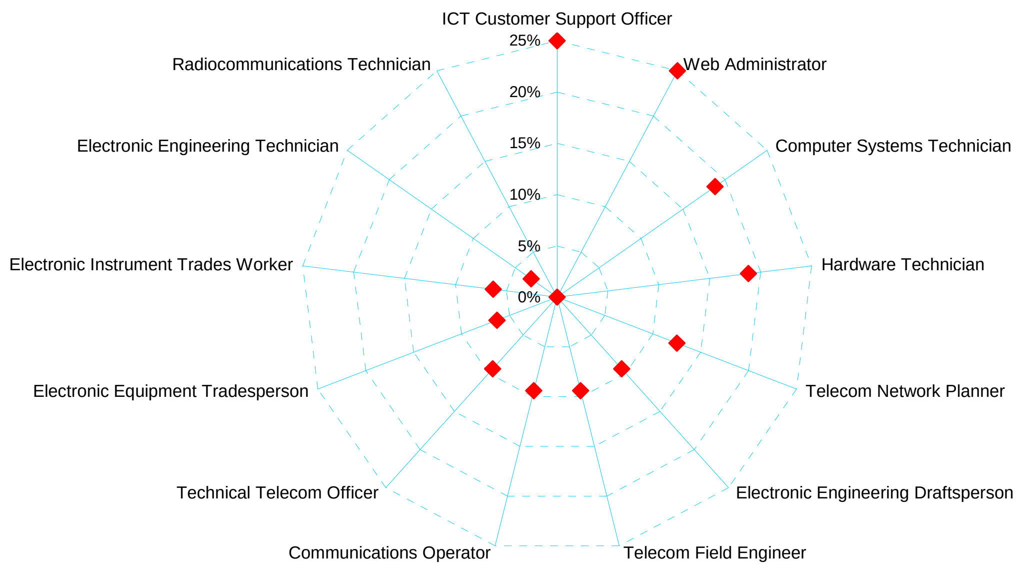


Figure 26: WA Educational Institutions % preparing graduates for ICT Technical jobs

Preparation for ICT Sales, Design & Training Careers

Compared with the ICT technical and engineering occupations, the number of courses preparing graduates for careers in the fields of ICT sales, design and training was much greater. Figure 27 shows these findings.

One of the most popular courses was in the area of Web design with 56 percent of respondents reporting that their courses prepared graduates for the role of Web Designer. A further 41 percent of respondents indicated that their courses were preparing graduates to become ICT Business Development Managers or Multimedia Designers. All other ICT Sales careers or training and technical writing occupations were being targeted by around 30 percent of courses.

The reporting of enrolments outlined earlier in this report confirms these findings and suggests that along with some of the ICT Professional occupations, the primary focus of ICT courses in the local WA education and training sector is targeted more at the sales, multimedia, web and design areas. This is instead of the engineering and technical disciplines.

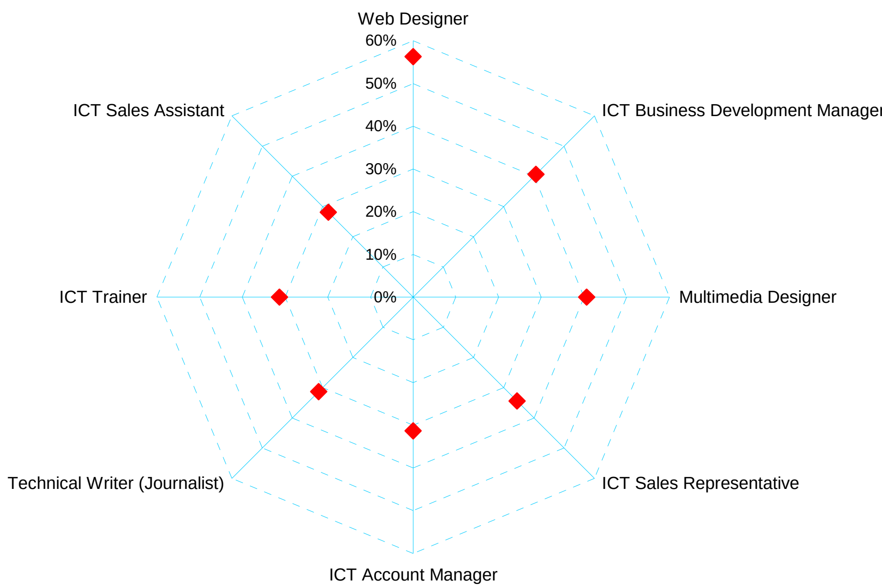


Figure 27: WA Educational Institutions % preparing graduates for ICT Sales & Design jobs

Factors Influencing the Supply for ICT Courses

As with the demand side survey, this questionnaire explored the respondent's views on a range of factors likely to be influential in the number of students enrolling in ICT courses. As shown in Figure 28 below, the top two factors considered of most importance were the need for better promotion of ICT courses and careers within the WA school system, and the need for enhanced collaboration between industry and the education sector.

The next factors viewed as important were the need to enhance the overall image of ICT careers amongst the wider community and the lack of information on ICT careers within schools, as well as the need to overcome stereotypes about ICT. Of equal importance was the need to make ICT courses and careers more attractive to females.

Other factors, such as the level of preparation of school students into ICT courses and the accessibility of such courses to regional and disadvantaged students were considered slightly less important. TAFE Colleges were particularly adamant that regional students should be given more access to ICT courses.

Interestingly the cost of courses and lack of mathematics and science amongst school leavers were not rated particularly high by the sample overall. However, the private VET colleges were more likely than the other institutions to view course fees as an issue.

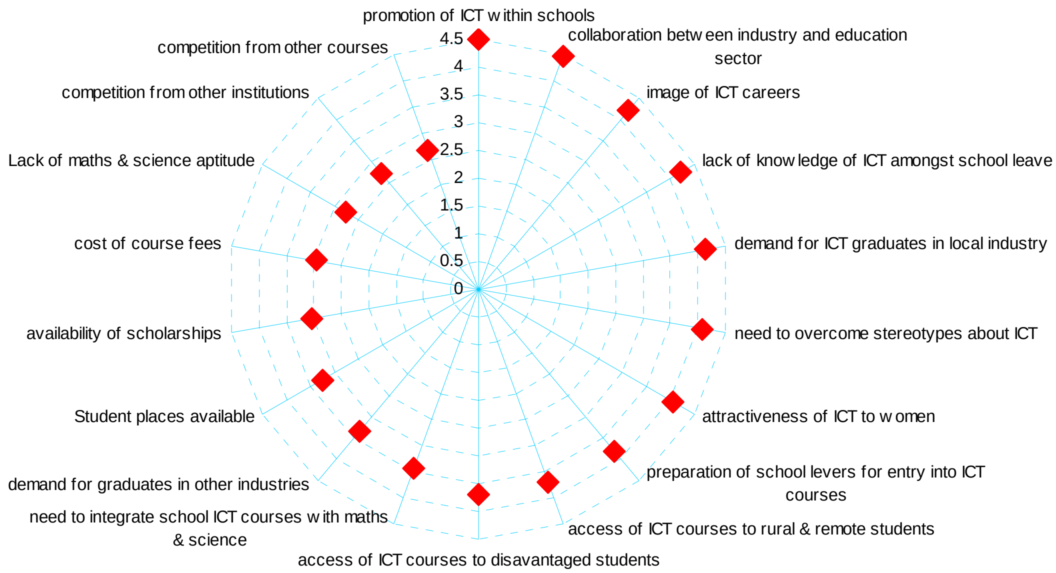


Figure 28: Factors influencing enrolments in local ICT courses – supply side view

Comments from the Education sector

In the conclusion of the survey respondents were given the opportunity to make additional comments in relation to the supply and demand for ICT employees in WA and what future initiatives might be taken by the WA Government to alleviate the problem of low enrolments into ICT courses. A variety of comments were made which are transcribed below.

There were a number of comments about the need for enhanced promotion of ICT careers within the WA school system:

> There just needs to be a marketing campaign, because the perception of high school students, if you want a job you go to civil and other types of engineering, somebody need to be telling them that there a lot of opportunities within ICT / the shortage.
>
> Support the ICT skills committee / the information from this committee is important / an area that we need to market well to student and parents.
>
> The main problem is with a perception from parents of the importance of ICT, the current market for most engineers are in mining, most parents don't realise that there is huge demand for ICT engineers, students just aren't enrolling, when they are making their decisions.

Related to this was the perception that ICT had a “nerdy” or unattractive image and was subject to old fashioned stereotypes, which were also working against attracting women:

> There is a geek factor, dissuading girls from entering IT courses, this needs to be overcome / the image about the IT industry is being spoilt by outsourcing to 3rd world countries, prospective graduates look at these jobs being moved overseas and look elsewhere.

> I think the main problem is that perception of ICT is still very nerdy, to break that idea that it’s a 17 year old boy domain. when you say computing they think of programming, lack of promotion of skills shortage, need to take a good long hard look at this.

> Needs to be a marketing focus / used to be the thing to go into new going back 10 years / people seem to think that the jobs are not there now seem to think its dieing area which is not the case.

> Just generally we need to find a way of making ICT careers more attractive / the dated stereo type of the 'nerd' is still with us / its very wrong people think ICT career people are anti-social but that is the opposite / they are very social.

> Need to advertise more / media high schools

Some viewed the problem as being related to the need for enhanced collaboration or integration of the ICT education programs with industry needs and make use of scholarships or internships to attract graduates:

> Needs to be more involvement with TAFE in workgroups to determine future steps by government.

> I think the need to setup an enabling program like they have for engineering, provided alternative pathways into engineering / extensive marketing for career pathways / a few years ago when web design was all the range IT was a booming area for our institute.

> Release scholarships to attract students into the area / realistically I think that's all they could do / sends a message that the government is serious about IT too.

> For industry to provide internships for graduates / industries to come and tell us what they want in a graduate / if we do not have more enrolments over they next few year they is a real possibility that we will be closing some departments.

The Government was seen as playing a role in the solution at both the State and Federal level:

> Strong belief that the government and industry have a responsibility to ensure there is a good supply of graduates, there needs to be an understanding to actually promote ICT, the government needs to understand its dependency on ICT and they should promote ICT.

> More funding and support for the educational institutions, struggling with facilities and staffing, problem is that universities aren't supported by state government / we have difficulty placing students into the industry / students have difficulty in knowing where there degree will take them.

A number of other issues were raised; these included the need to make changes to university entry into engineering courses, as well as changes to the accessibility of courses to regional students and links to industry:

> Fixed intake for engineering, no fixed intake within the discipline areas, we take 500 engineers and then let the students decide, rather than having a fixed number of mechanical, civil and robotics. This ends up reducing our budget, results in reducing the intake of students to IT.

I suppose the infrastructure for rural areas needs to be looked at / the technology that's provided from our rural campus is not really of a high enough standard to capitalise on training students in order to help them get into a better career.

The demand is actually very high at the moment we have seen a great success rate with our graduates getting employment / we work with companies together to get employment / maybe if more institutions worked together with big companies to get these people into jobs.

Depends on the leadership of the institute how well they project the importance of the course how they articulate it when talking with industry.

Industry is filling positions with people that are not fully qualified / the student leave to go to the mining industry for the money before they graduate / they then come back after a few years to finish their studies because they can go no further.

General Conclusions from the Supply Side Survey Data

The findings from the supply side are consistent with the established picture that enrolments into ICT courses are down and that some of this is due to the poor image of ICT within the wider community, the lack of adequate marketing or information to schools, and the need for enhanced collaboration between industry and the education sector.

As noted in the findings, the outlook amongst most respondents was positive despite some current pessimism and dissatisfaction over the existing levels of enrolment. While the findings are not a precise measurement of the number of students enrolled in WA ICT courses, they suggest a potential pool of around 5,000 to 10,000 students coming through the education and training pipeline, with some evidence of a need for a better alignment of courses to the needs of industry.

An examination of the reported demand for specific types of ICT occupation reported by the employers and the focus of the courses from the educational institutions suggests a miss-alignment. For example, there is a reported demand side problem in recruiting Electronic Engineers, and this occupation was noted as suffering from a state wide shortage by DEEWR in 2008. Despite this apparent demand for Electronic Engineers, only a relatively small proportion of the educational respondents were reportedly preparing students for this career. A similar issue emerged for the ICT Technicians occupations.

What is noticeable is the relative agreement between the educational institutions on the supply side and the employers surveyed on the demand side over the causes of these enrolment shortfalls and what might be done about them. The broad consensus amongst both parties over the need for enhanced collaboration between industry and academe to address the problem of ICT skills shortages is a key observation from this study.

Conclusions and Recommendations

The specific research questions this study set out to address were threefold:

1. What is the current status of ICT classified professionals in WA including workforce numbers, and job classifications?

2. What is the supply of these positions, concentrating on Universities, TAFE's and expanding to private institutions?

3. What is the future demand for ICT skills, including workforce numbers and specific skills needed?

In the following sub-sections we will review these questions and the ability of the findings from this study to answer them.

The Current Status of ICT Occupations in WA

This study suggests that there is a total ICT labour pool of around 16,000 to 20,000 employed across all industry sectors, but heavily concentrated in property and business services. The ICT "intensity" of some industries is also high, with sectors such as finance and insurance, mining and resources, education and government, administration and defence now having an increasing dependency on ICT related activities.

The analysis of ABS data has confirmed at the state level what has already been reported at the national level (ABS, 2006b). This shows a workforce that is well educated, urbanised, young, international and predominately male. Although not reported directly in this study, these ICT jobs are also generally well remunerated. For example, according to DEWR (2006) ICT managers and other professionals are an aged around 35 to 39 years and earn an average income before tax of about $60,000 to $75,600 per year.

An initial observation from this study is that there is a need for better measurement of the ICT industry and its impact on the WA economy. For example, it has been estimated that the property and business services sector is the largest single sector in the WA services economy, accounting for around one third of all services output (DTF, 2005). What is not clear is the contribution of ICT related services within this sector.

As this study has shown, there is a need for better classification of ICT related activities at both the occupation and organisation level. The adoption of the ANZSCO framework by the ABS in 2006 is a useful contribution to this, although there are still some problems in the application of this system.

During the process of reviewing the ANZSCO framework and how it is understood and interpreted by industry; this study found that many different job titles and descriptions are in use. An example of this is the ACS website which includes a list of different jobs and career paths available within the ICT industry. Listed is the occupation "Computer Engineer" along with a number of alternative titles or sub-categories. A cross-reference to the ABS website and the ANZSCO coding system reveals that there is no correlation between the ACS and ABS titles. This observation is not meant as a criticism of the ACS, rather it is an illustration of the underlying problem of an ICT industry that is largely ill-defined and suffering from an identity problem.

The report has also noted that the ANZSIC industry classification system does not adequately identify the ICT industries. A high proportion of the specialist ICT firms are effectively hidden within the "property and business services" sector. This creates a tendency for miss-reporting or under representation of the overall economic impact of the ICT sector within the state and national economy. As has been shown by the research commissioned by the ACS, over half the property and business services sector is engaged in the ICT industry (CIIER, 2008).

The Supply of ICT Skills from the WA Education Sector

Generating precise estimates of the number of students enrolled in ICT courses in the State's colleges and universities remains problematic. This is due in part to the absence of any systematic reporting mechanism, and also because of the complexity of precisely defining the ICT industry a therefore any courses related to it. It has been noted that there are problems in defining the ICT occupations; this only serves to compound the problem of identifying courses that can lead into such jobs.

The results of this study suggest (with appropriate caution) that there is pool of around 10,000 students enrolled in ICT courses within WA education and training institutions of which perhaps 7,000 are local and the rest international. It is not clear how many of these students are enrolled in specific courses within the ICT field. However, it seems that fewer are targeted towards ICT engineering or technical areas, than towards the ICT professional, sales or design occupations.

As shown in the findings of the survey of WA education and training institutions the significant decline in the number of students enrolling in ICT courses over the past decade has had a major impact on universities and colleges. This situation has eased in recent years, but not in all areas and there remains a concern that ICT continues to be poorly understood within the schools sector and the wider community.

An example of the above was highlighted in a search of the ICT courses offered by each of the four publicly funded universities. Each has a wide range of degrees and double degree programs within areas such as computer science, computer science and commerce, computer science and economics, computer science and engineering, computer science and games programming, computer science and arts, computer science and mathematics and computer science and geophysics.

Degree programs are also offered in computer systems, computer systems and networking, electronic and communications engineering, computer technology, computing and education and software engineering. There are also bachelor's degrees in such fields as information technology, multimedia design, business informatics and information systems, and even cyber forensics, information security and management.

This bewildering list of courses is just the tip of a much large iceberg of ICT related programs offered by the four main universities at the undergraduate level. To this must be added the wide range of courses offered via TAFE and VET colleges in the ICT field. It should be noted that the convergence of ICT into ever more sophisticated systems and products will only serve to increase the complexity of courses.

Discussions with senior academics from the university sector undertaken as part of this study suggest that the need for more double degrees and hybrid courses is likely to increase. This was also echoed in discussions with representatives from the ACS, AIIA iVEC and industry. They saw greater convergence and the emergence of new occupational fields such as "information management" or "enterprise content management".

The need for employees with multiple disciplines was also identified. For example, in the mining sector there were identified needs for employees who possessed skills in both geophysics and ICT to undertake specialist work. These combinations of courses were not currently being taught within the local universities or colleges. This also included the need for ICT courses to be linked more closely with business studies to better prepare graduates for engagement in the business world.

In their submission to the Federal Government's Review of Higher Education in 2008 the ACS called for better accreditation of ICT courses, with the ACS as the accrediting body. They also sought the adoption of a "core body of knowledge" (CBOK) to be incorporated into all ICT courses and programs. Some of the key observations made by the ACS about ICT courses included a need for educational institutions to maintain currency with a rapidly changing industry environment. Also noted was the need to prepare graduates for both technical and business application skills. This included a shift from ICT as a "back office" technical function, to a "business and service" focused area. The implications were that students must learn how to apply their ICT skills with a business and customer oriented focus (ACS, 2008b).

The AIIA submission to the Federal Government Review of Higher Education in 2008 followed a similar pattern, but also noted that ICT studies were relatively new fields within Australia's higher education institutions. As a result these disciplines often struggled to attract teaching faculty and secure the required resources to fully develop their programs. The dynamic nature of the ICT sector and the problems associated with recruitment of students into universities and colleges also posed a threat to the sustainability of many programs and courses across the education sector. The sheer cost of maintaining the ICT equipment and courseware to state of art was also seen as a constant challenge for educational institutions (AIIA, 2008).

To address the ICT skills gap the ACS and AIIA submissions called for enhanced collaboration between the universities and TAFE/VET sectors to assist in opening up better articulation pathways for students within ICT courses. The ACS also called for more short term, postgraduate courses targeted at ICT professionals that could serve to upgrade qualifications and skills. They have already proposed courses such as a "Computer Professional Education Program" (CPEP), which is a postgraduate course based on "mentored and collaborative learning" (ACS, 2008b). Also the ACS Diploma of Information Technology, a course designed around a common core curriculum but offered via a number of participating universities.

The ACS called for a coordinated approach between government, industry and the various levels of educational institutionto tackle the ICT skills shortage in a systematic way. This would include restructuring of the VET/TAFE to University accreditation and articulation frameworks designed to achieve enhanced congruency between the two systems. More cross-disciplinary courses with more work experience components were also recommended, along with more postgraduate coursework programs targeted at ICT industry specialists.

A further submission to the Federal Higher Education Review was by the Australian Council of Deans of Information and Communications Technology (ACDICT, 2008) made similar observations to those of the ACS and AIIA. They identified three priorities for future action to address the ICT enrolments drought. The first was the need for increased investment in teaching and learning facilities at Australian universities and colleges to allow ICT to fall within the same band as engineering and science (e.g. higher on physical infrastructure). It needed to shake off its continuing association with mathematics.

The second priority identified by the ACDICT (2008) was to provide students enrolling into ICT courses to have up to 50 percent of their HECS fees waived (while still paying the full allowance to the universities), which is currently being done in the fields of mathematics and science. Finally, the ADCICT (2008) proposed offering tax incentives to industry to engage with education providers in the provision of internships, mentoring and project supervision.

In summarising the findings from this report as they address the issue of supply side provision of ICT graduates, the general pattern that emerges is one of a short term crisis within the local education sector which has experienced major declines in ICT enrolments over the past five years. This has placed pressure on those faculties which specialise in ICT courses, particularly the fields of computer science and electronic engineering. As noted in this study the outlook within the majority of these faculties remains optimistic.

The causes of this ICT enrolment drought have been explored in great detail by other groups such as the ACS and AIIA. This study has only confirmed these earlier investigations, and issues such as the low participation rates amongst women have been recognised since at least the 1990s. Strategies to address this ICT enrolment drought have been the subject of discussions since 2006 via the Industry Leadership Group on ICT skills. This group has identified areas of priority for better research into ICT labour markets, ICT workplace skills development, ICT careers development and identification, and the enhancement of ICT teaching in schools. While some of its momentum appears to have slowed since the change of Federal Government in 2007, the overall thrust of its activities remains a logical approach to addressing the problem.

An issue that has emerged from this study is the need for a much longer term strategic rethinking of the way in which ICT is approached within the education and training sector. Put simply, the pace of change in technological terms has moved ICT from a peripheral subject area in a few highly specialised areas, to the main area of focus for all but a few industries. The convergence of mobile telephony, computing, robotics and multimedia digital content has resulted in few jobs not requiring the use of and support for ICT. As noted by the ADCICT (2008):

> The very breadth of ICT, stretching across Engineering and manufacturing, Science and Economics, and contributing substantially to health and global business, illustrates both the scope and foundational role that ICT plays in our current and future knowledge society. Furthermore, ICT will play an increasing and vital role in addressing sustainability and climate change issues including its monitoring and management as we move forward.

Educational institutions will need to adapt to these future challenges. Courses will need to be reconfigured to embrace the technological convergence. There will also need to be a greater integration of engineering and science disciplines with economics and commerce, resulting in an erosion of traditional inter-disciplinary and inter-faculty boundaries. Current organisational and professional structures within the universities and TAFE systems do not fit well into this future.

The other trends that are likely to emerge in the future are the emergence of more postgraduate level coursework programs at the postgraduate certificate, diploma and masters level. These are already emerging in some institutions, but their recognition by industry as “of value” qualifications remains a potential bottleneck. Initiatives such as the ACS C-PEP and Dip IT are potentially positive contributions in this regard; however, there must be support within industry for employees already engaged in ICT fields to upgrade qualifications and skills.

Employers appear to be critical of university ICT graduates understanding of business processes and lack of “real world” experience (Hagan, 2004). To address these problems will require greater collaboration between institutional faculties and between industry and academe.

The Demand for ICT Skills in WA Industry

Turning now to the final of the three research questions we can address the issue of forecasting future demand for ICT skills in WA industry. As noted earlier in this report, the ACS has undertaken a modelling exercise seeking to forecast the demand for ICT skills in Australia over the medium to long term (CIIER, 2008). This work identified three scenarios.

The first of these assumed a “status quo” approach, with graduate output holding at 2007 levels and the level of skilled migration remaining steady. This scenario forecast a nation wide short fall of around 14,567 ICT workers by 2010, growing towards 20,000 in 2015 and 25,994 in 2020.

The second scenario involved a significant increase in the number of ICT students graduating via the local education system, and the maintenance of existing levels of skilled migration. This would seek ICT skills shortages of around 12,111 in 2010, 10,065 in 2015 and only 4,995 in 2020.

The third scenario or “best case” was to see both an increase in ICT graduates and a slowing of outbound ICT migration or “brain drain” as Australians saw fewer attractive options in North America or Europe. Under these conditions the ICT skills shortfall was estimated to be around 10,923 by 2010, but down to 6,723 by 2115 and virtually non-existent by 2020.

As with any forecasting the results are only as good as the assumptions upon which they are made and the quality of the data used. The ability to predict the future industry requirements for ICT workers in Australia over the next twenty years remains problematic. There might be a significant change in migration patterns, government policy towards migration and the level of investment in education and training. There may also be significant changes to the use of ICT within Australian industry, driven by technological convergence, climate change issues and the need to remain internationally competitive. All these variables are likely to impact on the future forecasts made by the ACS.

Despite these cautionary observations, there seems sufficient evidence to suggest that the current national demand for ICT workers will fall short by around 10,000 to 15,000 in the immediate future. What is noticeable from this current study is the finding that while 54 percent of employers surveyed for the demand side perspective reported a general decline in the number of ICT skilled workers recruited locally, 76 percent reported that the flow of overseas migrants with ICT skills was either holding steady or increasing. Furthermore, only 35 percent reported being dissatisfied with their current ability to satisfy their recruitment needs.

This suggests that while there is a decline in ICT enrolments and graduations in the education sector, the needs of local industry appear to have been reasonably well met by overseas migration. However, there remain gaps in the supply of specific types of occupation, and this study suggests that there may be a miss-alignment between the supply and demand sides in filling such gaps.

The demand side survey undertaken as part of this study found that 42 percent of respondents anticipated increases over the next 3 to 5 years in the demand for ICT Professionals, 22.5 percent forecasting increases in the demand for ICT Engineers, 31 percent expecting increased demand for ICT Technicians and 21 percent forecasting increased demand for ICT Sales, Designers and Trainers. Only a few felt that demand would decline.

These findings support those of the ACS cited above, and suggest that there will continue to be significant demand for ICT skills, particularly in the ICT Professional, Engineering and Technical fields over the medium term if policy and practice does not change.

ICT Producing versus ICT Using Industries

Research undertaken by the OECD highlights the distinction between ICT-producing industries and ICT-using industries. Interestingly it concluded that Australia and the United States were the only OECD countries that saw significant evidence during the 1990s of ICT use serving to strengthen labour productivity and economic growth at the industry sectoral level. This appears to be related to the need for other labour productivity reforms to occur in conjunction with ICT adoption (Pilat, Lee & van Ark, 2002).

ICT-producing industries can include both manufacturing and services. In the first instance it includes manufacturers of products designed to fulfil ICT functions, or must use electronic systems to detect, measure or control physical processes. In the case of services, the service must be designed to enable ICT activities via electronic means (OECD, 2002). ICT-producing comprise manufacturers of hardware and software including computers, telecommunications equipment and a wide range of products for domestic or industrial use. Service firms can include wholesalers of ICT goods, computer and data management services, telecommunication and ISP providers and ICT consultancies.

The ICT-producing industries can be broadly aligned with the "ICT specialist industries" identified by the ABS. Within WA these firms are typically small in size and their contribution to the overall economy, while significant, is not a large as that of major sectors such as mining and resources. For example, in 2006 WA was estimated to represent around 5 percent of national ICT exports and less than 1 percent of national imports. Most of the ICT equipment exported from WA was sent to Singapore, the USA, New Zealand, the United Kingdom and the United Arab Emirates (Houghton, 2007).

These are direct measures from ICT-producing industries, but if the role of ICT-using industries within the wider economy were to be considered, the overall contribution of the sector would be greater. This is illustrated in the case of what is now identified as the Mining Technology Sector (MTS), a collection of industries that make use of ICT systems and services to enhance the operations of the Australian mining and resources sector. While most firms in the MTS are small, they are high on innovation and R&D. Most work closely with the large mining firms to provide goods and services to exploration, extraction and processing operations (OVUM, 2003).

A study into the MTS and the use of ICT within the Australian Mining and Resources sector undertaken in 2002/03 found that most mining firms were somewhat limited in their understanding of the strategic value of ICT and only 33 percent applied any systematic measurement of the impact of such technologies on their operations. ICT was viewed as an operational rather than a strategic driver within their business (OVUM, 2003).

However, this situation is rapidly changing, with ICT now emerging as a key mechanism for productivity enhancement within the mining and resources sector. The use of such technologies in exploration and processing is already well established with spatial science, 3D computer modelling and computer controlled, automated plants becoming the norm. The next decade is likely to see the greater use of ICT within mining extraction with computer controlled rail and loading systems. An analysis of the role of ICT in the creation of a knowledge-based economy and society (KBE/S) undertaken by the ABS (2002) observed that:

> Information and communications technologies (ICTs) are enabling technologies of a KBE/S. They are vital tools for knowledge workers, allowing them to take full advantage of technology's capacity to access, manipulate and process information. ICTs are also an integral part of education, offering students access to information as well as a range of IT based learning tools.

This report also noted that it is the pervasiveness of ICT rather than the existence of industries that produce ICT products or services, that is essential for a KBE/S. Of importance is the ability of all employees within a workforce and all people within the economy to access ICT and to have efficient ICT infrastructure. The development of electronic commerce and the level of ICT use within business and households are therefore key measures for future assessment.

In addition there must be measures of the ICT skills base and overall strength of the ICT industry. The first of these measures the proportion of ICT workers within the labour force and their level of skills and qualifications. The second is a measure of the annual sales turnover, profitability, contribution to value adding and employment, as well as trade and investment in R&D undertaken within the ICT sector.

Groups such as the ACS and AIIA suggest that ICT is now an integral part of most occupations, with enhanced benefits to overall productivity, innovation and employment growth as a result of investment in these technologies. However, there is a need for more independent and quantifiable measures of the overall contribution of ICT. While there is evidence that Australia and the United States enjoyed significant productivity gains from the use of ICT during the past decade, this was not the case for most other OECD countries (Pilat, Lee & van Ark, 2002). Better measurement is needed.

Where to next – the development of a digital economy?

Let us now seek to draw together the findings from this study into a series of recommendations for future action. In doing so we will offer three strategic options:

1. **Status Quo** – the first option is to do nothing. In this case the supply of ICT graduates will continue to remain lower than requirements and any unmet demand will need to be filled via skilled migration;

2. **Changes to one side only** – in this second option the supply and demand elements remain independent of each other, with initiatives aimed at addressing largely short term skills needs within industry, and equally short term enrolment problems within the education sector; and

3. **An integrated approach** – a third and preferred option is for an integrated approach that would see both supply and demand side actors collaborating with the active participation of government to introduce change.

If the first option is followed the skills shortage within the ICT field is likely to grow along the lines forecast by the ACS. In the short term this will risk constraints to the growth of the ICT-producing industries in WA. While many of these are small firms the overall impact on the state's economy is unlikely to be felt in the short term. However, over the longer term there is the risk of a loss of such industries within the state as firms move elsewhere in Australia or overseas. For many of these companies, their market is global and labour is a significant input factor. The lack of an adequate ICT workforce is also likely to impose constraints on the successful development of many ICT-using industries within WA.

Adoption of option two may see a resolution but such independent and uncoordinated efforts by supply and demand side actors will prove less effective than a more integrated approach. It is also clear from this study that the supply and demand side actors are now increasingly interdependent.

The most desirable option is an integrated approach along the lines pursued via the Leadership Group on ICT Skills. The formation of the ICT Industry Collaboration Centre in WA is a positive step. However, there remains a need for additional industry engagement, particularly from larger firms. The focus should be upon engaging the ICT-using industries and match them to the often smaller locally based ICT-producing firms.

While the broad strategic thrust of these existing initiatives is to be supported, this study has identified several areas that should be addressed in future research, policy and practice:

1. **Develop a robust understanding of the size and impact of the ICT sector in WA** – as this study has shown there is a continuing problem in fully identifying the size of the ICT industry. ANZSIC coding frameworks hide much of the ICT-producing industries within areas such as property and business services. Future research should seek to extract these ICT specialist areas from within the current industry analysis frameworks and build a more complete picture of the size, structure and scope of the ICT industry in WA. This should separate activities into ICT-producing and ICT-using sectors, and identify supply chain and other strategic inter-relationships between them. An industry clustering approach should be followed in the methodology for such a study.

2. **Establish more precise annual measures of the size of the ICT skills supply chain** – a reliable measure should be undertaken on an annual basis of the number of students enrolled within the postgraduate education and training sector in WA. This should separate the cohorts into fields of study, year of enrolment, gender and whether or not the student is local or international. This data should be readily available from the universities and TAFE/VET colleges. It would not seek to identify individual students, but would aim to provide a reliable measure of the number of students transiting through the ICT skills supply chain. Over time longitudinal data analysis will prove highly beneficial as a mechanism for evaluating the effectiveness of other initiatives targeted at boosting ICT enrolments.

3. **Develop a K-12 ICT School Curriculum** – while there are already initiatives designed to enhance awareness of ICT courses and careers within the schools, much of these are relatively short term in focus. Over the longer term a K-12 ICT Curriculum for WA schools should be developed. This is recognition of the central role ICT now plays in the work and life of the community. Rather than a separate program, the courseware should be targeted at embedding ICT across existing fields of study. For example, ICT can be used to enhance the teaching of maths, science, English, social science and languages. The aim of such a curriculum would be to ensue that students understood not only how to use ICT products and applications, but to understand more about how they operate and how they are changing the world of work, family and community. It is also most important that attention and resources be applied to teacher in-service training and support.

4. **Provide an agreed ICT careers pathway model** – the recent adoption of the ANZSCO framework provides an opportunity for the development of a well defined ICT careers pathway model. Students considering courses in ICT should be able to readily identify the type of occupations available upon graduation, what entry qualifications are required for them, and how these occupations interlink with other jobs in the ICT sector. The use of ICT specialists in ICT-producing and

ICT-using industries should also be clearly defined with appropriate information about pay, conditions and vacancies.

5. **Develop appropriately recognised postgraduate and vocational short courses targeting skills upgrades for the existing ICT workforce** – the opportunity for upgrading the existing skills and qualifications of the current ICT workforce is something that should not be overlooked. As shown in this report, there are a relatively large number of ICT workers who have either no formal qualification or relatively limited education. University faculties seeking to sustain faculty and facilities should seek to target this market with postgraduate courses. In a similar manner the TAFE/VET sector could collaborate with industry offering appropriately accredited courses to upgrade skills. This initiative will require greater integration between the education and training providers and industry. A potential bottleneck in achieving this outcome is the lack of formal accreditation across much of the ICT sector. To this end the efforts of the ACS to expand the level of industry accreditation is to be encourage, however, employers will need to participate in this process if it is to succeed.

6. **Review the existing approach to teaching ICT within the post-secondary education system** – a longer term initiative is the need to reshape the way in which ICT courses are configured and taught within the universities. The ICT field is changing significantly with technological convergence. The overlapping of what were previously separate disciplines into new areas such as mechatronics is an example. There is also the need for a strengthening of the relationship between ICT technical and engineering skills with business and commerce skills.

7. **Strengthen the resources for facilitative mechanisms** – finally, there needs to be recognition of the need for the creation of facilitative mechanisms that can serve as a catalyst for encouraging enhanced connectivity between the supply and demand sides of the process. As noted above, the Leadership Group on ICT Skills and the national level, and the ICT Industry Collaboration Centre in WA, are potentially important actors in this area. The creation of industry clusters that can be both effective and sustainable depends on the existence of this type of entity. An observation from this research is that the level of funding for these facilitative mechanisms is inadequate to allow them to fulfil their potential. It must be recognised that the ICT-producing industries in WA are comprised largely of small firms who do not have the resources to devote to industry building activities. The industry representative bodies such as ACS and AIIA at the state level are also largely run by volunteers. Investment in facilitative mechanisms such as the ICT Industry Collaboration Centre of WA to provide administrative resources and related personnel will be important if the ICT sector and its workforce is to be grown.

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Appendix A – ICT Professionals

Chief Information Officer	Plans, organises, directs, controls and coordinates the ICT strategies, plans and operations of an organisation to ensure the ICT infrastructure supports the organisation's overall operations and priorities.
ICT Project Manager	Plans, organises, directs, controls and coordinates quality accredited ICT projects. Accountable for day-to-day operations of resourcing, scheduling, prioritisation and task coordination, and meeting project milestones, objectives and deliverables within agreed timeframes and budgets
ICT Business Analyst	Identifies and communicates with users to formulate and produce a requirements specification to create system and software solutions.
Developer Programmer	Interprets specifications, technical designs and flow charts, builds, maintains and modifies the code for software applications, constructs technical specifications from a business functional model, and tests and writes technical documentation.
Systems Analyst	Evaluates processes and methods used in existing ICT systems, proposes modifications, additional system components or new systems to meet user needs as expressed in specifications and other documentation.
Analyst Programmer	Analyses user needs, produces requirements documentation and system plans, and encodes, tests, debugs, maintains and documents programs and applications.
Software Engineer	Designs, develops, modifies, documents, tests, implements, installs and supports software applications and systems.
Database Administrator	Plans, develops, configures, maintains and supports an organisation's database management system in accordance with user requirements ensuring optimal database integrity, security, backup, reliability and performance.
ICT Security Specialist	Establishes, manages and administers an organisation's ICT security policy and procedures to ensure preventive and recovery strategies are in place, and minimise the risk of internal and external security threats.
Systems Administrator	Plans, develops, installs, troubleshoots, maintains and supports an operating system and associated server hardware, software and databases ensuring optimum system integrity, security, backup and performance.
Computer Network & Systems Engineer	Plans, develops, deploys, tests and optimises network and system services, taking responsibility for configuration management and overall operational readiness of network systems, especially environments with multiple operating systems and configurations, and provides troubleshooting and fault-finding services for network problems.
Network Administrator	Installs and maintains hardware and software, documents diagnosis and resolution of faults, manages user passwords, security and inventory documentation, ensures the efficient performance of servers, printers and personal computers, and attends to other operational tasks. May also perform tasks such as help desk support and user training.
Network Analyst	Researches and analyses network architecture, and recommends policies and strategies for designing, planning and coordinating an organisation's network such as the total system environment and architecture. May also perform operational tasks such as monitoring system performance, software and hardware upgrades, backups, support and network maintenance.

Source: (ABS http://www.abs.gov.au)

Appendix B – ICT Engineers

Electronics Engineer	Designs, develops, adapts, installs, tests and maintains electronic components, circuits and systems used for computer systems, communication systems, entertainment, transport and other industrial applications. Registration or licensing may be required.
Telecommunications Engineer	Designs and develops telecommunications systems, devices and products.
Telecommunications Network Engineer	Plans, designs, and monitors complex telecommunications networks and associated broadcasting equipment.
ICT Quality Assurance Engineer	Creates, maintains and manages technical quality assurance processes and procedures to assess efficiency, validity, value and functional performance of computer systems and environments, and audits systems to ensure compliance with, and adherence to, accredited internal and external industry quality standards and regulations. May supervise the work of ICT quality assurance teams.
ICT Support Engineer	Develops support procedures and strategies for systems, networks, operating systems and applications development, solves problems and provides technical expertise and direction in support of system infrastructure and process improvements, and diagnoses and resolves complex system problems.
ICT Systems Test Engineer	Specifies, develops and writes test plans and test scripts, produces test cases, carries out regression testing, and uses automated test software applications to test the behaviour, functionality and integrity of systems, and documents the results of tests in defect reports and related documentation.

Source: (ABS http://www.abs.gov.au)

Appendix C – ICT Technicians

Electronic Engineering Draftsperson	Prepares detailed drawings and plans of electronic engineering work in support of Electronics Engineers and Engineering Technologists. Registration or licensing may be required.
Electronic Engineering Technician	Conducts tests of electronic systems, collects and analyses data, and assembles circuitry in support of Electronics Engineers and Engineering Technologists. Registration or licensing may be required.
Radio Communications Technician	Installs, maintains, repairs and diagnoses malfunctions of microwave, telemetry, multiplexing, satellite and other radio and electromagnetic wave communication systems.
Telecommunications Field Engineer	Plans, designs, commissions and monitors complex telecommunications networks and associated equipment, provides technical advice and information, and identifies complex problems and initiates action to resolve them.
Hardware Technician	Supports and maintains computer systems and peripherals by installing, configuring, testing, troubleshooting, and repairing hardware.
Telecommunications Network Planner	Plans the development of customer access telecommunications network infrastructure.
Telecommunications Technical Officer or Technologist	Carries out specialised design and support functions in telecommunications engineering including optimisation and performance monitoring of telecommunications networks, diagnosis and repair of faults, and the selection and installation of equipment.
ICT Customer Support Officer	Provides support, education and guidance in the deployment and maintenance of computer infrastructure and the diagnosis and resolution of technical problems and issues. May work in a call centre.
Web Administrator	Designs, builds and maintains web sites, and provides web technology solutions and services.
Cabler (Data & Telecommunications)	Installs internal telecommunications and data cabling, equipment and peripherals for computer networks, telephony, cable television and monitored security and fire alarms.
Telecommunications Cable Jointer	Joints, terminates and repairs copper and fibre optic telecommunications cables installed in underground pipes, trenches and overhead systems.
Telecommunications Linesworker	Installs, maintains and repairs external telecommunication equipment such as aerial lines, conduits and underground cables, radio and mobile phone antennae, and limited items of terminal equipment.
Telecommunications Technician	Installs, maintains and repairs telecommunications equipment and appliances, such as telephones, mobile telephones, switchboards and data transmission equipment, in homes, businesses, telephone exchanges and other network sites.

Source: (ABS http://www.abs.gov.au)

Appendix D – ICT Sales, Designers and Trainers

ICT Account Manager	Manages sale of computer hardware, software and services to existing account clients and identifies further sales opportunities within these accounts, builds new account clients, manages customer satisfaction and retention, and coordinates the preparation and presentation of ICT sales proposals and tenders.
ICT Business Development Manager	Identifies and generates new ICT business opportunities to further improve market share and awareness by gaining an understanding of customers' ICT needs and promoting goods and services to these customers. May manage some key customer accounts.
ICT Sales Representative	Develops and converts sales opportunities into sales of computer hardware, software and ICT services.
Technical Writer (Journalist)	Researches and writes technical information-based material and documentation for articles, manuals, text books, handbooks, or multimedia products, usually for education or corporate purposes.
ICT Trainer	Analyses and evaluates information-based system training needs and objectives, and develops, schedules and conducts ICT-based system training programs and courses.
Multimedia Designer	Plans, designs and develops the production of digitally delivered information, promotional content, instructional material and entertainment through online and recorded digital media using static and animated information, text, pictures, video and sound to produce information and entertainment tailored to an intended audience and purpose.
Web Designer	Plans, designs, develops and prepares information for Internet publication with particular emphasis on the user interface, ease of navigation and location of information using text, pictures, animation, sound, colours, layout and data sources to deliver information tailored to an intended audience and purpose.

Source: (ABS http://www.abs.gov.au)