Issues Paper for

Research Into Institutional Pathways Outcomes Against Technology Based National Training Packages

October 2002

Project Manager

This Issues Paper has been prepared on behalf of the ElectroComms and EnergyUtilities Qualifications Standards Body of Australia located at Suite 501, 1 Rosebery Avenue, PO Box 481 Rosebery, NSW, 2018. Internet: http://www.eeqsba.com.au

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Validity of Information

This paper has been prepared as a discussion paper in advance of a major report that will be validated by members of various industries. The information contained in this report has been gathered from various industry sources and approved by the National Steering Group.

Copyright Statement

This final version created 8 November 2002. V2

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Executive Summary

This project seeks to provide industry and VET administrators with information regarding the range of emerging technologies that are likely to be shared across the automotive, building and construction, engineering, information technology and telecommunications industries. The purpose is to ensure that sufficient information is in place to plan for training in these areas to meet the skill required.

This project will use data collected from individual interviews with industry representatives, written submissions and reports from the industries themselves. This data will be assembled into a report and made available for comment by contributors. The final report will be submitted to the Australian National Training Authority through the ElectroComms and EnergyUtilities Qualifications Standards Body of Australia.

The use of the emerging technologies discussed in this Issues Paper are technologies which have "crossed boundaries" from other industries and are being used in new applications. While the use of these technologies in these industries appear as novel inventions, they are mature technologies with broader applications than had previously existed. For example the use of Global Positioning Systems in agricultural equipment is new but the technology has been in use in the aeronautic and maritime industries for many years.

In light of these "crossed boundaries", there is the need for new entrants to receive training that will allow them to contribute to the productivity of the modern workplace. Additionally, existing workers will also need to have the opportunity to up-skill in these areas. The research to be carried out by this project will also investigate the pathways through which this may occur.

This Issues Paper proposes that there are three main areas in which technology is to be shared across the targeted industries. One is the increased use of voice and data communications that form an integrated physical network that allows for increased efficiencies in the workplace and personal lives. The second is the increased use of a range of wireless communication technologies and equipment that feed into the physical networks and provide greater mobility than currently exists. The third area is that of the increased data processing capacity of equipment connected to these networks and the ability to alter the functions and activity levels that can be performed.

The Project Manager, the Western Australian Information, Electrotechnology and Utilities Industry Training Council (IEU-ITC), welcomes contributions from all members of the industries subject to this research. Enquires should be directed to Andrew Lindhjem, Research Officer, IEU-ITC on 08 9240 2688 or via the Internet at http://www.sharedtechnology.net.au.

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Purpose of the Project

The purpose of the project is to identify technological convergences relationships across the industries involved with a view to their impact on Training Package content and subsequent delivery.

Governments across the country have identified the importance of new technology skills for their respective economies. From the point of view of training outcomes, there is a need to get a clearer picture of the various directions that the convergence of technology is taking. The purpose of this project is to build a better picture of that.

The capacity of the training system to deliver to meet new or different jobs emanating from convergence is also on issue. The project will also investigate in broad terms what options exist for on-the-job or institutionalised pathways to effectively meet industry's needs.

Scope of the Project

The project involves understanding convergence as it impacts across the Information Technology and Communications technologies, Electrotechnology, Construction, Engineering and Automotive industry sectors. The key issue is not what is specific to any of these sectors but what is peculiar to any combination of them. The scope of this project primarily involves new industry workplace relationships that are evolving from technology that no longer relate to one industry but to several.

The research will involve each of the States and Territories through a survey/informal approach based upon the recommendations of the National ITAB CEOs involved.

The scope of the project will not extend to identifying solutions or making recommendations form sector to sector, but the provision of a convergence picture by which decisions can be taken either individually or across sectors.

Research Plan

The agreement between EEQSBA and the IEU-ITC for this research sets out a detailed activities schedule with time lines for the completion of various parts of the research.

This document, the Issues Paper, is a starting place for this research and consists of a desk-top review of existing and emerging technologies with the detail listed in the "Overview" section of the document. This paper is meant to provide the Steering Committee with a starting point for further direction for the study.

Methodology

The approach for this research is three-fold. The first being to review the emerging technologies in each of the industry areas and develop possible scenarios as to how these technologies may affect the requirements for training and development within these industry areas. The second

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aspect is to access the opinions of a wide range of individuals involved in these industries to gain an understanding of their points of view and beliefs regarding the impact of these emerging and future technologies. Thirdly, there will be the rationalisation of this objective and subjective data into a common understanding that can then be compared to existing Training Packages and an assessment as to the appropriateness of the qualifications in light of the emerging data.

For the first aspect, the use of existing data will be sought to establish a wide range of technologies and the influences that may be placed on the industry areas as a result. This data will be sourced from Australian and international sources such as journal articles, industry magazines, industry-body publications, conference papers and other sources. The scope of the data collected in this part of the research will include not only the technical issues but the likely influence of economic policy and activity; likely investment activities and market acceptance; and, the resulting effect that these factors may have on education, training and professional development.

The second part of the research will involve canvassing the opinions of relevant stakeholders through a number of qualitative and quantitative methods. Stakeholders may include but are not limited to industry associations, professional bodies, trade unions, Industry Training Advisory Bodies, Registered Training Organisations, State Training Authorities, independent industry practitioners, vendors, students and parents. Data gathering will include questionnaires (paper or web-based), focus groups, formal meetings and individual contributions. Questionnaires will be developed based upon the direction of the National Steering Group (NSG) to address those areas relevant to this research project. The use of focus groups, formal meetings and individual interviews will be scaled on the basis of direction from the NSG. Documentation of such meetings will be made and a database of participants will be created and maintained for later reference.

In the third part of the research an industry-by-industry review will be made of the data that may be used to judge the suitability of existing Units of Competency and qualifications for future technologies. The draft of this review will be made available to the NSG for comment and to those who have participated in the data collection process. Responses to this draft review will be included in a penultimate report for review by the NSG. The final report will be based upon the comments from the NSG.

The use of electronic communications will be encouraged to allow for ease of documentation from contributors, document control and for general communications throughout the project. An Internet Web site will be established for the purposes of managing this process. The project manager has secured the URL http://www.sharedtechnology.net.au for this purpose.

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Evaluation Process

As outlined in the section Methodology, there will be a number of opportunities for contributors to comment on the content of the report. Firstly, all comments received from the National Steering Group (NSG) will be documented, with encouragement for this to be supplied in writing either through email or hard copy. Written notes from voice conversations with NSG members will be made. All meetings of the NSG will be minuted.

Contributors to the research will be given the opportunity to comment on the content of the draft report. Contributors will be contacted using the database to advise of the availability of documentation. Contributions from individuals or groups will be collected at each stage of the evaluation process; analysed; and, where pertinent, included in the following documentation.

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General Overview

This section will deal with some of the overarching concepts that influence how the project will be interpreted. In any expectations of the future, we arrive at these beliefs through a process of extrapolating from past and present experiences. However, sometimes those aspects of technology and human nature that seem least likely to influence the future have the greatest impact in practice, with the future being greatly different from what we may have imagined. The ready adoption of technology by humanity often requires concrete examples of the application of the technology and that the benefits of these are clearly understood by individuals. Without this understanding and support, there is no purpose in considering the future use and utility of the technology.

Technology

The modern use of the term "technology" often carries with it an assumption that the technology being referred to supersedes or combines other devices or protocols to provide an improvement (or perceived improvement) upon the original. Few innovations today are actually discontinuous where the device utilises a previously unutilised aspect of physics. Examples of discontinuous technologies are Samuel Morse's telegraph, Guglielmo Marconi's radio or John Atanasoff's electronic computer. Each of these devices were exceptional in their development and had no predecessor upon which one could compare their value. Therefore the great majority of devices that are developed are continuous technologies, for which technicians have a long history upon which to draw.

In the next section, Overview of Industry Areas, this Issues Paper examines some of the continuous technologies that are likely to be presented by developers in the coming period. While these technologies appear to be new, discontinuous and may by some be considered to be science-fiction, these technologies are actually derivations from familiar themes. What is discontinuous is the application of these technologies within the various industries. For example, continuous technologies are employed in the use of Global Positioning Systems (GPS) in motor vehicles, short-distance radio communication in computing equipment and commercial/domestic building infrastructure that are controlled over the Internet.

One of the issues facing a number of the industries subject to this study is the question of whether a line can be drawn between the technology used in one industry and another. For example, is automotive electronics more about information technology than electrical systems? Is telecommunications more about data delivery systems than voice communication? Will the electrical trades be more about network construction and integration than wiring and cabling? These questions seem to present a case for the re-examination of applied electrotechnology within the various industries in this study.

During the progress of this research it will be important to place to one side the perceived limits of the historical application of technology. That is, assumptions regarding "what goes where" in the cataloguing of technology and industry need to be left unresolved as the dividing lines between industries are broken by continuous technologies being applied in discontinuous ways.

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Cohort Transition

As indicated in the previous section, Technology, there is the in the electrical and electronics industries a never ending stream of new applications. Electricians who were working in the 1980's are familiar with the introduction of Programmable Logic Controllers (PLCs) and the addition of those new skills that were required to be able to use this technology. Within the cohort of electricians at that time there were those who saw the advantages of this application and actively sought out professional development. There also were those electricians who resisted involvement in professional development and left the application for others to manage.

The hesitancy of some of the existing cohort of industry professionals and industry trainers to engage in professional development is a continuing problem in the electrical and electronics industries as well as nearly every other area of endeavour affected by change. The difficulty faced by many individuals is choosing which application of technology is likely to be paramount within their speciality and then choosing to invest the time and mental energy in professional development. The concern of many professionals is not so much not being able to "teach old dogs new tricks" as it is in allocating limited resources such as time, money and intellectual capacity on those technologies that are likely to be of immediate and tangible benefit to the professional. In other words, what is the point of learning about something that will never be able to provide additional income?

Investment advisers warn of the risky practice of speculation on the share market equating this to the practice of gambling. Long term strategies with risk spread across a number of investments is encouraged. While we have a long history of wise investment practices, choosing the "next big thing" is always much more difficult. The pace of change in these target industries is unlikely to slow and is encouraged through globalisation and the instant access to information in any country on products and protocols through the World Wide Web. Niche manufacturers can bring products to the market within months rather than years and staying up-to-date on every technology is clearly impossible. It is for this reason that this project is being conducted.

Business practices

As will be seen in the section that deals with each industry area, use of computer technology will become more integrated in business practices. Accounting software has recorded business activity for some years generating job specifications, delivery slips, invoices, statements and a number of other documents of the business process. In the future, the integration of job scheduling, business processes and reporting will become a feature of productive and profitable businesses.

This integration will require those working in the enterprise to be able to use these technologies as part of the business process. Some examples of the skills required are email communications, web-based ordering procedures and use of hand-held computing devices. Field work will be sent via wireless communications to operatives using "Palm Pilot" style devices with job specifications including data such as floor plans and site history. Parts will be able to be ordered on-site through hand-held computers connected to the supplier's database. Business practices of the future will require the professional to document activities electronically rather than through the use of physical record books or job sheets.

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Overview of Industry Areas

In the previous section, General Overview, a suggestion was made that technologies should not be divided into industry areas. However, in order to be able to describe some of the discontinuous applications of technology in the various industries and to assist the reader in understanding the possible pathways outcomes within these industries, the following overview is industry-based rather than technology-based.

Automotive

Early introduction of emerging technology in the motor industry has been in the field of industrial equipment such as earthmoving, transport and agriculture equipment. This equipment is using technology such as Global Positioning System (GPS) to place the vehicle in the correct position for activities such location, monitoring or seeding. Modern earthmoving equipment uses laser-based systems for the control of surface levels thus releasing operators from having to use external survey measures to check their work. The Swedish manufacturer Volvo has released prime movers that have systems on-board to increase performance and be controlled by a service centre through radio communications that can adjust the fuel/air mix and other critical aspects without a physical service centre being involved. The application of these technologies are now being included in new vehicles, particularly in the high-value European automobiles.

Some of the features of new vehicles include computer controlled management systems for engine performance and braking systems. Infra-red sensors in the front of the vehicle are being introduced to measure the distance between a preceding object and the systems then adjust the speed of the vehicle accordingly. Internet communications and GPS provide for enhanced navigation within cities or location of the vehicle if stolen. Entertainment systems will become more advanced with Internet connections for downloading music and video files and the more traditional uses of the World Wide Web. Even keyless entry into vehicles is available in some lower priced product offerings.

Although Federal Government in Australia has not seen the need to participate actively at this time in the environmental agreements such as Kyoto, Australia is one of the world's largest contributors *per capita* of CO_2 emissions. Manufacturers such as Toyota and Ford have developed production vehicles known as hybrids in order to meet the increased pollution standards internationally and allow them to remain in markets such as California. These power systems are based upon interactive electronic controls and will require appropriately trained technicians to maintain them.

A review of speakers and papers at various automotive electronics conventions show that large software manufacturers such as Microsoft and Sun Microsystems are actively involved in setting standards for new production vehicles. This seems to make sense when we consider that the motor car is used frequently for business purposes and integration with an office may be a welcome feature. Additionally, these speakers are focusing on wireless radio communications within the vehicle and with other vehicles. What we may expect to see is the automobile become a mobile Wireless Local Area Network (WLAN) that functions more like an integrated computer system than a metal cage for transporting people. This scenario places the motor vehicle squarely in the information technology industry.

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Building and Construction

A term being used in the building and construction industry is IBS. There are two definitions for this acronym – one is an integrated building system and the other is intelligent building system. In terms of this Issues Paper, the former relates to the coordinated use of power, back-up power systems, lighting, climate control, communications systems, security and other electrical and electronic systems in use in buildings. The latter refers to the building as a entity that is to be controlled and managed through the use of automated sensors and equipment that gather information on the performance of the building.

Modern dwellings are being equipped with integrated power and communications systems. Although adoption of this technology in new single dwellings is determined by the purchaser, in high density housing these systems are seen as part of a strategy for competitive advantage for higher sale values or rental prices. Integrated systems in these buildings can provide for security through audio and closed circuit television (CCTV); entry security systems based on biometrics or voice recognition; fire alarm systems; cable and satellite television links; and, "always-on" Internet connection for the World Wide Web. Other emerging features of personal dwellings will include wireless local area networks (WLANs) that can register the presence of inhabitants and redirect communications to the occupant or allow web-surfing from anywhere in the house without cables and include the use of mobile handsets within the network at local call rates. Also within these buildings will be the creation of personal area networks (PANs) and virtual private networks (VPNs) that allow individuals to see who is ringing the doorbell on their mobile phone while they are at work or viewing web-based camera data of their home from anywhere in the world.

In commercial and industrial buildings the use of sensors and equipment will be increased to allow for the control of the efficiency of the use of networked power; passive solar energy; water and air flow; pollutants; and other apects. Intelligent devices will use this wealth of data to ensure optimal building performance by controlling building systems and recommissioning these systems using automated tools that detect and diagnose performance anomalies and degradation. These systems will optimise operation across building systems, inform and implement energy purchasing, guide maintenance activities and report on building performance.

Security will continue to be an issue of increasing importance not only physical security within buildings but also security of data. Sensing equipment such as CCTV; keyless entry systems; biometric systems will become commonplace requiring an increased level of skills from those installing these systems. The increase of the use of wireless communications will require an understanding by designers and engineers of the aspects of RF leakage outside of the specified environment and the appropriate materials to be used. Importantly those installing and commissioning these systems will also need to be aware this situation. These installers will need to be able to check that the system is internally robust and that no leakage is present that would allow individuals to eavesdrop on the data network or use this network without permission.

Smart buildings are to become much smarter and will involve much more than just the use of integrated power, data and audio visual cabling systems.

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Electrical

In a research project carried out into the telecommunications industry by the Western Australian Information, Electrotechnology and Utilities Industry Training Council, electricians were found to be providing for the majority of data cabling in private dwellings and commercial projects. However those participating in the study had left the commissioning of the telecommunications system for others believing that this activity was beyond their skill levels. Interestingly, the Australian National Electrical Contractors Association (NECA) has changed its name to the National Electrical and Communications Association retaining its acronym but including this new focus on communications technicians. NECA has been investigating the possibility for dual pathways. The need seems to stem from small to medium sized companies requiring flexible work practices, so that they can use tradespeople in a number of areas rather than having specialists. There are a number of dual Systems Electrician/Instrumentation models currently operating across Australia, including one to implement Systems Electrician plus Data Communications over a four year apprenticeship in both NSW and Victoria in 2003.

The US National Electrical Contractors Association has reported on a national survey of 700 respondents in the June 2002 issue of the *Electrical Contractor*. Obviously there will be some differences between the US electrical trades and Australian electricians but some of the results from this survey are interesting. While this section is dealing primarily with technology it may be interesting to highlight the age of US electricians and compare this to our understanding of the cohort problem described earlier in this Issues Paper. Amazingly 62% of electricians in the survey are between the ages of 45 and 64 years with another 11% over 65 years. These figures leave 22% of electricians between the ages of 35 and 44 years and only 5% are aged 34 years or less. This seems to paint a picture of a very mature workforce. The authors intend to investigate this aspect in the course of the research project.

Two of the sections in the US survey of electrical contractors included growth potential and emerging opportunities. The main areas of expected growth was in integrated building systems with communications/data systems and building automation ranking fourth and fifth place behind the staples of lighting, power and back-up power systems. For large and medium sized contactors, growth potential was expected to exist in building automation and industrial controls activity over the next three to five years. For smaller contractors, home automation featured predominantly after the basic staples of lighting, power and back-up systems. Throughout each of the contractor groups, communications has featured heavily. Just as a footnote, US electrical contractors also expect to become involved in more work with renewable energy through solar cells, fuel cells and wind generation.

The report from the *Electrical Contractor* goes on to say that "across all groups, 4 percent have served in an IT/programmer role and 2.6 percent configured routers, (and this) indicates tremendous strides by electrical contractors who have dedicated themselves to learning new markets. Gone are the days where electrical contractors were seen only as mere cable pullers. This information also illuminates a commitment to training and hiring better-educated technicians who are skilled in low-voltage areas."

In Australia, Electricians also are migrating across many allied vocations because of their training base, technological currency and adaptability. Increased levels of contracting out has contributed and seen historically based Electrical Contractors expand their businesses opportunities to concomitant technology areas such as security, fire, data/voice, building

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automation, communications, renewable energies, refrigeration and air conditioning, megatronics, and instrumentation. All these technical areas are underpinned and use similar technologies, which give rise to those with a relevant base of skills to readily migrate to new technologies.

In the next section, Electronics, a review will be made on one of the emerging areas of PLC development where computer chips will be able to be re-programmed to meet new requirements. This will mean that if changes are to be carried out to lighting or equipment within a premise and based upon the original design limitations, computer programming will be used to effect these changes rather than the alteration of cables or connections. The result is that the electrician of tomorrow will also need to be able create computer software to be able to make basic changes. These changes will certainly require a more highly skilled electrician.

Electronics

It is difficult to attempt to summarise the use of electronics in a paper as short as this. It would be presumptuous to believe that all of the aspects of the electronics industry and the resulting application and impact on the industries in this Issues Paper could be summarised in so few words. Perhaps all that can be done is to attempt to outline some of the more disruptive aspects of the impact of technology on this field.

One of the most predictable aspects of electronics has been the miniaturisation of componentry. The drive for this miniaturisation leads to a more ubiquitous use of digital electronics requiring less space in the product, providing more processing power and allowing for greater integration between devices. Components as small as one half of a micron are currently being brought to the market for population on circuit boards. This presents challenges for the electronics industry in terms of design, manufacture, population and testing. Certainly repair at this micro-sized component level is questionable and specialised equipment will be required.

The industry is familiar with population techniques such as surface mount and through-hole processes but an emerging area is the Ball Grid Array (BGA) method of mounting chips. This method is providing for greater reliability in soldering and allows for a less critical remove-and-replace process of processor silicon chips than the other methods. While some components may not be worth repairing, the BGA process allows for circuit boards to be up graded with replacement silicon chips or up-graded silicon chips reasonably easily.

The move within the hardware and software industries is for software to be “hard wired” within the silicon chip. Rather than load operating system or application software on to hard disks within the device, the software is resident on the computer chip providing for further reduction in the size of computing devices and faster start times. A progressive development of this concept is a microchip that is programmable. These chips work in a similar way to a Programmable Logic Controller (PLC) but consist of a single or multiple chip circuit board. These chips are known as Field Programmable Gate Array (FPGA) and may have as many as 10 million programmable gates.

Applications of the FPGA technology are vast and include the ability to re-configure equipment remotely using a computer. Advantages to hardware manufacturers is that the processor can be

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improved over time without the need to replace the actual processor or through the use of redundant systems that may provide for continued operation of the devices if failures occur in other components. Advantages to software manufacturers are that applications can be upgraded through Internet downloads without expensive physical distribution. These features are one of the more important aspects that will make portable computing more efficient and acceptable. Electricians will be able to make changes to equipment or building systems either on-site or remotely through cable or wireless communications. While there is some renewed interest in electronics at the component level, systems will continue to be dominant in the overall design and functioning of electronic equipment.

Diagnostics of electronic equipment are already involving computer-based software systems and provide for a quicker and more accurate methods of fault finding. When we consider the move towards the interconnectedness with electronic equipment, fault finding will not require an initial on-site visit by a technician. Repairs can be made in a low-skilled remove-and-replace process providing savings to the owner of the equipment and maintenance manager.

Engineering

Early investigations into this area have not yielded the same breadth of available material as in the other parts of this section. Most references to engineering as a broad area relate to the organisation of engineers and the discipline itself. Industry or technology specific references are usually included in the particular discipline. It is important for the National Steering Group to provide greater direction and definition regarding the research that is to be undertaken in this area.

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Information Technology

In the preparation of this Issues Paper, a number of industry observers were interviewed. When the area of how information technology was likely to be affected by the introduction of enhanced technology, one person became perplexed and stated that information technology is mostly about creating and managing a system of networks that use devices, software and people. His view was that these people were primarily sales people and support technicians of new and existing products and were only able to react to technological developments rather than influence them. This contributor is a electronics engineer involved in research.

What may be helpful here is to examine the areas of information technology as defined in the Information Technology Training Package to see where information technology in general terms affects the electrical and electronics industries. When the Information Technology Training Package is examined, it is possible to see a number of major themes coming from the qualifications included in this Package. These relate to computer literacy; network support and management; programming; web development; user support, systems analysis and design; data security; and, management of the information technology environment. The competencies in these qualifications include activities such as the connection of hardware to a network; loading of software; and, the management of the information technology infrastructure to ensure that the system and network is operating to the standards set by the client. There is only one qualification in this Training Package that relates to activities involved replacing the internal components of hardware.

In an unemotional analysis of the information technology industry, it might be able to be claimed that information technology is not about electrical or electronic issues but more about meeting client requirements. One Unit of Competency in this Training Package that seems to provide a beacon of inspiration for operatives in the electrical and electronic industries is “Migrate to new technology”. This Unit of Competency requires the student to be able to demonstrate the ability to engage in dialogue with the client and provide tangible and rational reasons for change or retention of equipment. This is necessary to allow the client to use the strategic advice provided by the electrical or electronic operative in assessing the upgrade or replacement of capital equipment in light of impending technological changes expected in the next period. In this sense, the electrician or the electronic repair operative becomes an information technology adviser. Operatives in these industries have known for many years that the advice given to clients faced with costly repair estimates is that the client “should buy a new one as this old one is not worth fixing”. As honest as this advice may be, there still needs to be a rational argument offered where the client has a choice of alternatives.

The electrical and electronic operative of the future is faced with the requirement to be aware of the future impact of technology on particular products. The encouragement of those seeking to reduce consumption and waste within our current profligate economies is four-fold. These are to encourage the reduction of consumption, the re-use existing products, and recycling those items that can be recycled. Replacement of a product is the forth encouragement and while it is difficult to rationalise the replacement by one energy consuming product for another, it is possible to imagine the encouragement from these operatives to advocate for replacement of less polluting or power-hungry technologies when these technologies provide for tangible cost savings. In this sense, the electrical and electronic operative becomes an IT specialist.

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Telecommunications

In general terms, telecommunications technology can be divided into two parts. One is cable-based networks that rely upon copper or fibre optic networks with physical exchanges for the transfer of data and the other is the use of radio frequencies to send data from a transmitter to a receiver. The specific technologies and protocols used are becoming increasingly varied. Cable-based network operators are seeking to increase the data load within an existing physical and high-cost infrastructure using increasingly sophisticated methods to increase data traffic on this limited infrastructure. Operators of wireless networks are seeking to maximise traffic volumes using narrow radio spectrums that are expensive and heavily regulated by national governments.

In Australia, the cable-based network is primarily controlled by Telstra but other entrants have developed their own networks within high density population areas. These networks include not only copper cables but fibre optic and coaxial cabling. Construction of these networks have suffered from a lack of predicable and consistent work due to Federal Governmental control and regulation of Telstra and market-influenced investments in independent networks through private enterprise. Apart from the commissioning of new protocols designed to increase data traffic, the physical network technology is unlikely to change with training remaining unchanged.

However when wireless technologies are considered, there is greater scope for new training requirements. Some of the emerging areas here are very exciting technologically but lack market acceptance at this time due to the perceived utility of such technologies to the individual. Within wireless communication technologies there are two main areas. One is wireless telephony operated by an enterprise where consumers use mobile communication devices such as mobile handsets, Personal Digital Assistants (PDAs) or motor vehicles to connect to the network. These enterprises may use base stations with directional antennae, Global System for Mobiles (GSM), General Packet Radio Service (GPRS), Code Division Mulitplex Annexing (CDMA), satellites, or microwave towers. The newer Third Generation (3G) technology is planned that will allow for web-browsing, music downloads or video streaming. 3G is widely in use in Japan and expected to be in wide use worldwide and in Australia in the next few years. Although there is a great deal of interest in a digital mode of operation in telecommunications, there will be the continuing presence of analogue in some electronic communication technology.

The other area of emerging growth in wireless technologies is the low frequency spectrums that provide for short-distance wireless communications. These lower frequency spectrums allow devices send and receive data over short distances and are likely to be used in Wireless Local Area Networks (WLANs) or Personal Area Networks (PANs). Examples of the application of this technology can be seen in supermarkets, restaurants and warehouses. Nearly all of the major hardware and software manufacturers have given support to two main protocols. One is termed "Bluetooth" after a Danish King who united Denmark and the other is the IEEE 802.11*x* standard. Each of these technologies is available now and with increased adoption, systems commission and support personnel will also be increasing in demand.

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Education and Training

Highlighted in the section Cohort Transition is the very real difficulty in forecasting the future dominant technologies. Trainers in private or public organisations will need to be able to scan the horizon for approaching technological change. Fortunately the Training Package format allows for the rapid adoption of change in workplace competency however the existing mode of delivery approach to training provides for less flexibility. As described in the section above on Technology, many of the new applications are continuous and therefore the basic underlying principles of electrical and electronic theory (including safety) will not need to be altered and the current system will continue to provide for appropriate training. However this framework does not allow for training in emerging technologies to be easily developed and be placed within the existing structure and processes of the recognised training system.

The initial training (above that of the generic base) in the emerging technologies has always been done by those who are faced with having to undertake professional development to meet a specific client demand through their own pro-active research. Training organisations are likely to be able to provide training in these early stages through specially arranged, one-off training sessions. For large, process-driven training to be able to be offered, the technology will need to be approaching main stream if the current model of delivery is to be used. There does need to be appropriate strategies put in place so that the future training structure and mechanisms meet industry requirements. That is, should there be other methods of delivery other than existing modes of delivery for emerging technology in electrical and electronics training.

A more rapid and responsive recognition system that is industry based (industry panel) is needed. One that allows National Training Packages fast track continuous improvement processes that encourages technology and Training Package relevance and matching to market needs and cycles. A possible option it to confer NTQC responsibility for minor/technology maintenance to specially established and approved Training Packages Maintenance Panels comprised of key stakeholders and chaired by an NTQC member.

More importantly however, is to recognise that for those migrating or taking up emerging technologies there is an underlying “base training” component and structure required. Without this base individuals could not absorb the new technologies without increased front-end training.

An analogy is that of a house. The individual must acquire the knowledge and skills of the fundamental house construction, principles and technologies; foundations, roof, floors, and ceilings in order to then explore and utilise new building materials and technologies.

Critical to the responsiveness of Training Organisation meeting the emerging technologies to market are sufficient funds and access to training resources, consumables, equipment and suitability skilled staff (including PD). Constantly, continuous emerging technologies require Training Organisations to have at their disposal current or access to (ie. on-site) the latest equipment. For Training Organisations, particularly Public institutions to meet client needs caused by the speed and cycle of product to market are an issue, as many are faced with continual and severe reductions/cuts is funds and constrained expansion opportunities. A possibility is that the Training Organisations of the future will need fewer infrastructures and more access to current and relevant equipment/technologies that are used in workplaces. How this affects students who are not in work will require further consideration.

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Summary

This Issues Paper has discussed the application of continuous technologies in non-traditional areas and the proposition that these applications will require the development of new pathways for training new entrants and existing technicians. These technologies are not new in themselves but require greater underpinning knowledge of those entering the industries and further professional development on the part of existing workers.

This Issues Paper has also highlighted the difficulties that individuals face when confronted with increased demands placed upon them through the expanded application of technologies into industries that have not previously utilised this equipment. There are other issues to be resolved that relate to the motivation of individuals to seek out and engage in further training as well as how this training is to be delivered.

The examples of the new technologies has revolved around three main areas. These are data networks, wireless communications and increased processing capability of connected equipment.

While these three areas have been identified as being the main emerging technologies within these industries, the research will continue to test this assumption to ensure that other important technologies are not overlooked.

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Appendix 1

Training Packages likely to be involved

Automotive Industry Retail, Service and Repair Training Package - AUR99
Developed by Automotive Training Australia Ltd, Building NR2, La Trobe Uni Bundoora VIC 3086. Telephone: 03 9479 3494. Internet: http://www.automotivetraining.org.au/

General Construction Training Package - BCG98
Civil Construction Training Package - BCC98
Developed by the Construction Training Australia, PO Box 576, Carlton South VIC 3053, Telephone: 03 9654 1333. Internet: http://www.nbcitc.com.au

Electrotechnology Training Package - UTE99
Lifts Training Package - UTL98
Developed by the ElectroComms and Energy Utilities Qualifications Standards Body of Australia Ltd, Suite 501, 1 Rosebery Avenue, PO Box 481 Rosebery, NSW, 2018. Telephone: 02 9290 2533. Internet: http://www.eeqsba.com.au

Information Technology Training Package - ICA99
Telecommunications Training Package - ICT99
Developed by the Information technology & Telecommunications ITAB, Suite 3 139 Queensberry Street Carlton South Victoria 3053 Telephone: 03 9349 4955. Internet: http://www.ittitab.com.au

Metal and Engineering Training Package
Developed by the Manufacturing, Engineering and Related Services Industry Training Advisory Body Ltd., PO Box 289 North Sydney NSW 2060 Telephone: 02 9955 5500 Internet: http://www.mersitab.com.au

Asset Security Training Package
Developed by Property Services Training Australia, PO Box 314 Hall ACT 2618 Telephone: 02 6230 2907. Internet: http://www.pstrain.com.au

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Appendix 2

Stakeholders

The organisations mentioned in this Appendix are only a preliminary indication of the list of Stakeholders. This list will be further developed through consultation.

Training System

National ITABs

- Automotive Training Australia Limited
- Construction Training Australia ElectroComms and EnergyUtilities Qualifications
- Standards Body of Australia Ltd
- Information Technology & Telecommunications ITAB

State and Territory ITABS for each of the National ITABs

- Australian Capital Territory
- New South Wales
- Northern Territory
- Queensland
- Tasmania
- Victoria
- Western Australia

Australian National Training Authority

State and Territory Training Administration bodies

- Australian Capital Territory
- New South Wales
- Northern Territory
- Queensland
- Tasmania
- Victoria
- Western Australia

Group Training Organisations

- Australian Capital Territory
- New South Wales
- Northern Territory
- Queensland
- Tasmania
- Victoria
- Western Australia

Registered Training Organisations with Scope for the target Training Packages

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Industry Stakeholders (This is a dynamic list and contributors will be listed on the Shared Technology web site: http://www.sharedtechnology.net.au)

Automotive
Federal Chamber of Automotive Industries
Major Vehicle manufacturers

Building and Construction
Master Builder's Associations

Electrical, Instrumentation and Refrigeration and Air Conditioning
National Electrical and Communications Association

Electronics/Computer Systems
Australian Electrical and Electronics Manufacturing Association
Surface Mount and Circuit Board Association

Engineering
The Institution of Engineers, Australia (IEAust)

Information Technology/Computer Systems
Australian Information Industry Association
Australian Computer Society
IT Skills Hub
Vendors of hardware and software

Telecommunications/Communications
Australian Telecommunications User Group
Major telecommunications carriers (Telstra, Optus, Vodaphone, AAPT, Hutchinsons, etc.)
Vendors of telecommunications equipment

Trade Unions
Australian Manufacturing Worker's Union
Communications, Electrical and Plumbing Union

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Appendix 3

Steering Group

Mike Quade	Australian National Training Authority
Michael Littlechild	Automotive Training Australia
Ray Hutt	Construction Training Australia
Robyn Thorpe	Western Australian Department of Training
Tony Palladino	ElectroComms and EnergyUtilities Qualifications Standards Body of Australia
Leo van Neuren	Information Technology & Telecommunications Industry Training Advisory Body
Bob Paton	Manufacturing, Engineering and Related Services Industry Training Advisory Body Ltd.
Alan Ross	Property Services Training Australia

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