

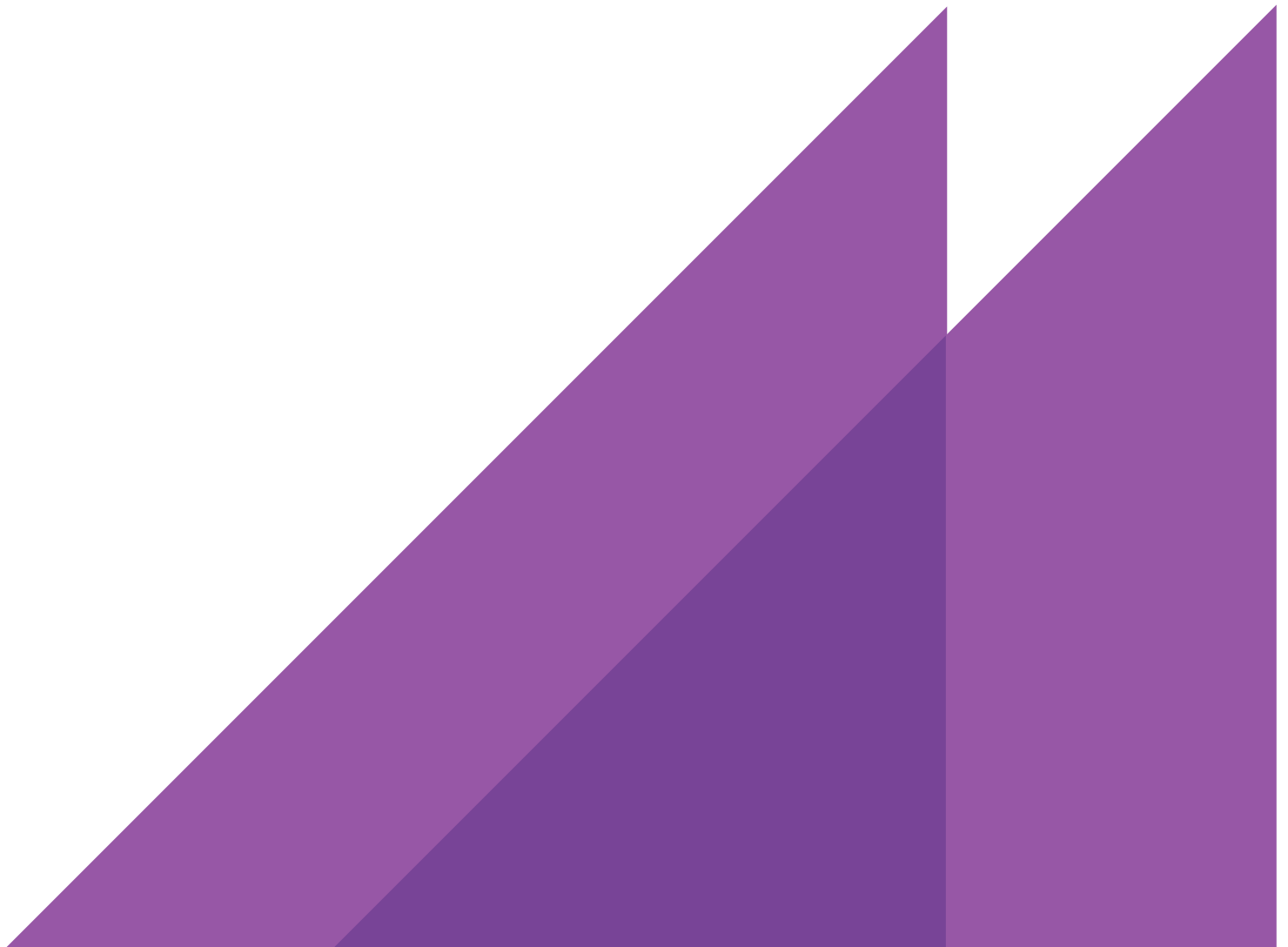
REPORT TO
THE STATE TRAINING BOARD

OCTOBER 2016

INNOVATION AND TECHNOLOGY PROJECT



ISSUES PAPER





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INTRODUCTION

While the resources boom has been an once-in-a-lifetime event that has led to a permanent increase in the size and scale of the WA economy, in the background there have been significant innovation and technology forces that are continuing to permanently reshape the State's economic and industrial landscape. As Western Australia adjusts to conditions post-resources boom, the economic climate has become more competitive and challenging, necessitating the need for businesses to be focussed on ways to be more innovative and productive to survive and prosper over the longer term.

ACIL Allen Consulting has been engaged by the State Training Board (STB) to examine the current and emerging innovation and technology forces on Western Australia's key industries, and their implications for education, training and workforce development over the short, medium and longer term. The first stage of this project has been to develop this Issues Paper, which draws together some key themes regarding innovation and technology, as part of an initial consultation process with business, industry and academic leaders. More information on the project, ACIL Allen Consulting, and the STB, can be found in Appendix A.

The adoption of innovation and technology is crucial to sustain business success and economic progress. Innovation and technology will change every sector of the economy. It will change the way that all businesses and all workplaces will function, and the way that all people will live and work.

While there are many definitions of innovation, for the purposes of this Project, ACIL Allen has defined **innovation** as the process by which new and existing businesses create new products, processes and business models. From this definition, **technology** is seen as an enabler of innovation in a business and across an economy. However, innovation extends much further than this simple definition, as highlighted in this word cloud that ACIL Allen developed based on a key word search from the STB literature review and the Commonwealth Government's *National Innovation and Science Agenda*.



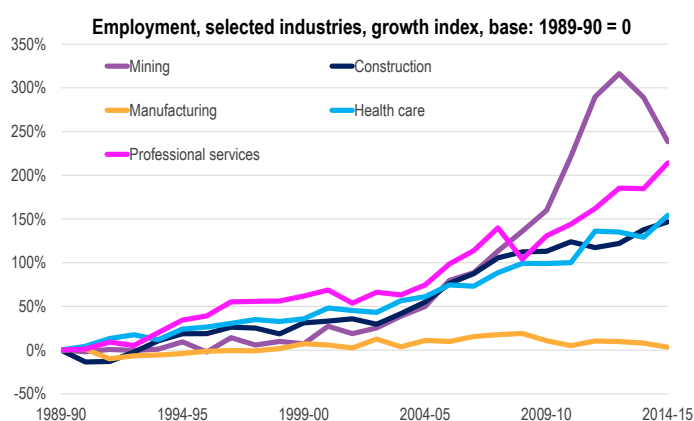
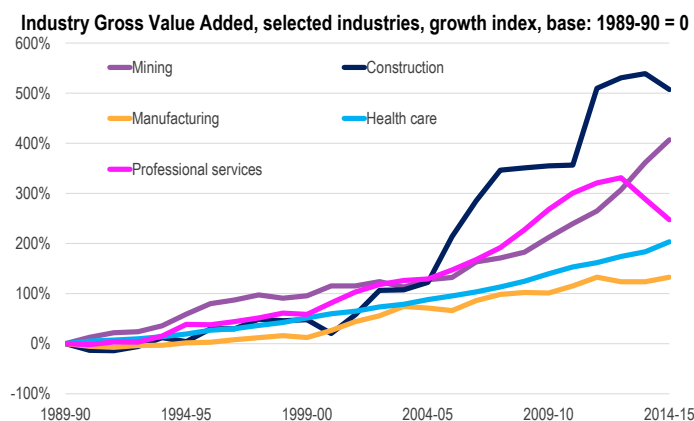
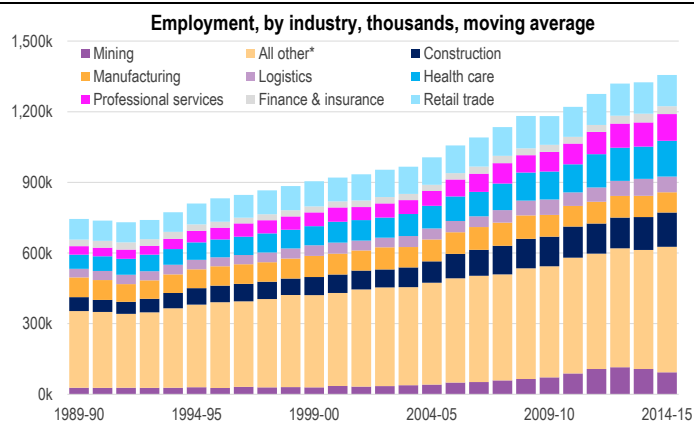
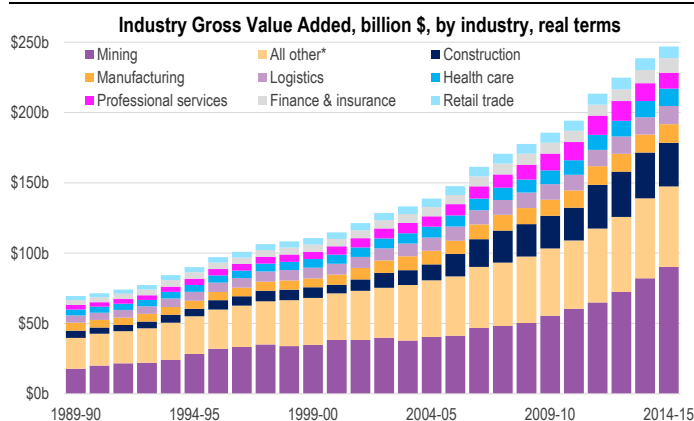
ECONOMIC CONTEXT

Industry Trends

The WA economy has undergone significant growth and transformation over the past 25 years. From a relatively small and narrow economic base, WA's economy has grown by 218 per cent over the past 25 years to generate output of over \$276 billion in 2014-15. Driving this growth has been the State's globally competitive resources sector, with total output from the sector increasing four-fold to \$90.3 billion, and its share of the WA economy growing to a high of 37 per cent in 2014-15. This has been the catalyst for growth in other sectors, such as in the construction industry (which has experienced an increase of over 500 per cent in output over the past 25 years) and professional services (an increase of almost 250 per cent).

Of the other key sectors in the WA economy, manufacturing has remained resilient despite the competitive challenges from lower cost manufacturing nations, with the sector increasing by 133 per cent over the past 25 years to generate output of \$13.2 billion in 2014-15. The healthcare and social assistance sector has also been a strong performer as a result of the emerging demographic challenges, growing by 203 per cent over the past 25 years to generate output of \$12.4 billion in 2014-15.

WESTERN AUSTRALIAN INDUSTRY COMPOSITION, REAL TERMS



Note: All other: agriculture, utilities, wholesale trade, hospitality, information technology, real estate and rental services, administration and support services, public administration and safety, education services, arts and recreation services, and other services.

SOURCE: ACIL ALLEN CONSULTING, ABS CAT. 5220.0, ABS CAT. 6203.0

Industry employment trends follow closely the broader growth trends across key industry groups. Industries that have experienced the strongest growth in employment over the past 25 years have been:

- mining (up by 238 per cent or 65,800);
- construction (up by 147 per cent or 86,500);
- professional services (up by 214 per cent or 77,300); and
- health care and social assistance (up by 154 per cent or 92,000).

Against these trends, the manufacturing industry has not generated any additional employment opportunities, but the increased output generated from the sector has meant that worker productivity has increased significantly over the past 25 years.

Overall, the total persons employed in Western Australia has increased by 82 per cent from 745,000 in 1989-90 to over 1,356,000 in 2014-15. Reflecting the growth in key industries, the largest employing industries in 2014-15 were:

- health care and social assistance (152,000);
- construction (145,400); and
- retail trade (132,800).

By comparison to the above employment trends, in 1989-90, the largest employing industries were:

- retail trade (87,600 workers);
- manufacturing (83,600 workers); and
- health care and social assistance (59,800 workers).

QUESTIONS FOR DISCUSSION

1. What are the key changes to the WA economy that you have observed in recent years?
2. What will be the growth sectors of the WA economy in the future?
3. What are the key types of innovation that have been observed in your organisation/industry in recent years, and what has been the scale and magnitude of these innovations?
4. What are the key types of innovation that you expect to observe in your organisation/industry in the coming years, and what do you think the scale and magnitude of these innovations will be?



Workforce Trends

Workforce trends have also changed significantly over the past few decades as the WA economy has grown and diversified. Across the broad occupation classifications, the most significant growth has been recorded in the number of:

- community and personal service workers (an increase of 212 per cent or 107,600 jobs since August 1986);
- professionals (an increase of 145 per cent or 178,200 jobs); and
- managers (an increase of 134 per cent or 83,200 jobs).

More modest growth has been recorded in:

- clerical and administrative occupations (up by 32 per cent or 55,600 jobs);
- labourers (38 per cent or 42,500 jobs); and
- technicians and trade workers (up by 45 per cent or 91,100 jobs).

A closer look at occupations at sub-category levels revealed that farmers (decrease of 41 per cent) and farm managers and factory process workers (decrease of 13 per cent each) have exhibited the largest falls since August 1989 (in moving average terms). By contrast, strong growth was recorded in occupations such as:

- carers and aides workers (up by 344 per cent);
- ICT professionals (up by 279 per cent); and
- design, engineering, science and transport professionals (up by 222 per cent).

Professional occupations now represent the largest occupation classification in WA, accounting for 21 per cent of all employed persons in the State. Sitting behind the professionals grouping are:

- technicians and trades (16 per cent of all employed persons);
- clerical and administrative occupations (13 per cent); and
- managers (12 per cent).

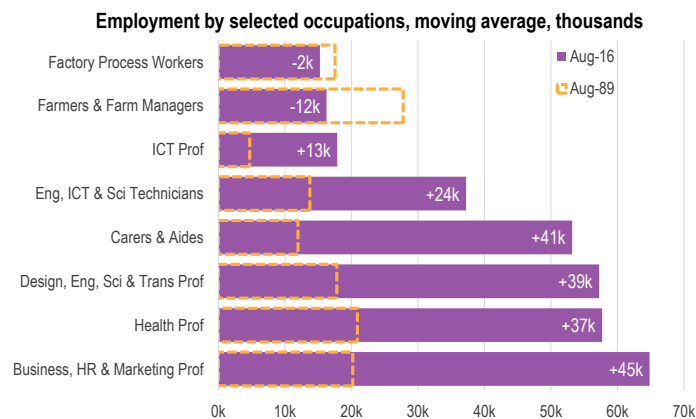
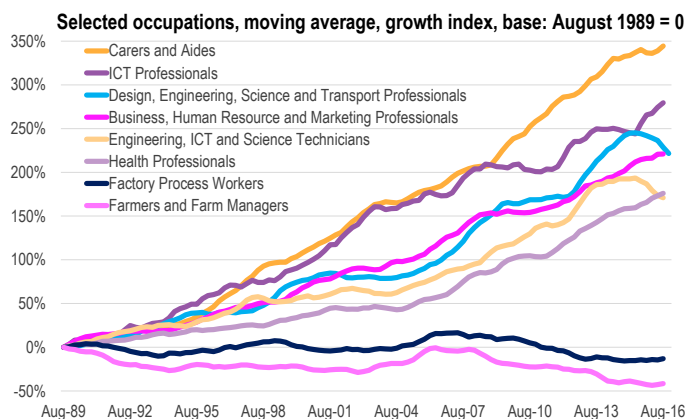
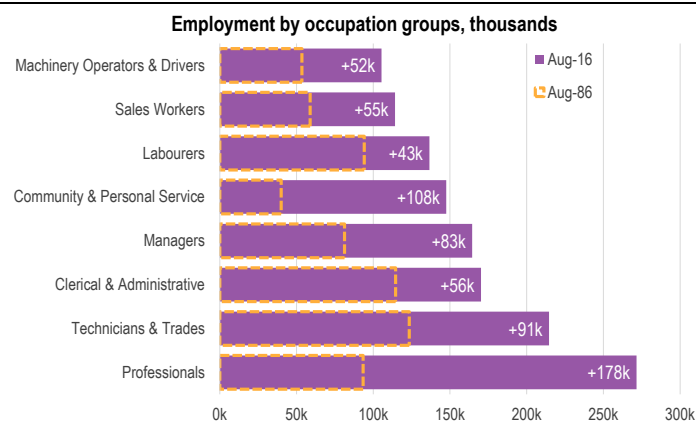
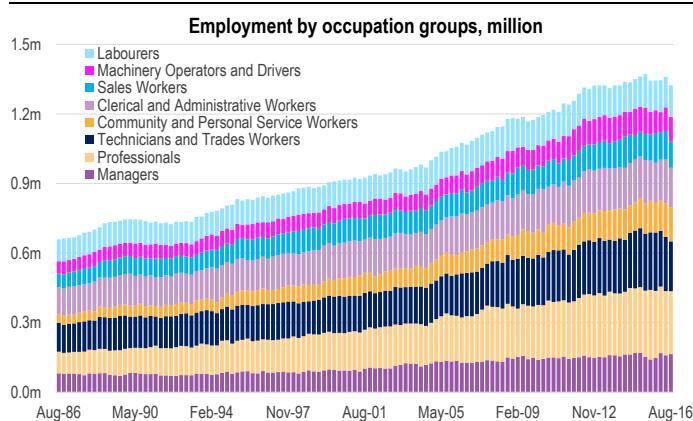
Highlighting the changing nature of the WA economy, in 1986 professionals was the fourth largest occupation classification (accounting for 14 per cent of all employed persons), with technicians and trades (19 per cent), clerical and administrative occupations (17 per cent) and labourers (14 per cent) all representing larger proportions of the WA workforce.

The above industry and workforce trends highlight a shift in WA over time from a blue to a white-collar workforce, with the skills required by workers moving from those synonymous with hard working and repetitive labour, to skills that require social, caring and creative elements. For example, skills like verbal communication, emotional intelligence, complex judgement and advanced reasoning.

QUESTIONS FOR DISCUSSION

1. What are the key changes to your workforce (and across the economy more broadly) that you have observed in recent years, particularly in relation to:
 - a. the types of roles required by your organisation/industry; and
 - b. the types of skills required by workers in your organisation/industry?
2. What key changes to your workforce (and across the economy more broadly) do you expect to observe in the coming years, particularly in relation to:
 - a. the types of roles required by your organisation/industry; and
 - b. the types of skills required by workers in your organisation/industry?

EMPLOYMENT BY OCCUPATION GROUPS AND SELECTED OCCUPATION TYPES, WESTERN AUSTRALIA



SOURCE: ACIL ALLEN CONSULTING, DEPARTMENT OF EMPLOYMENT

Education and Training Trends

The benefits of tertiary education have been well explored and are universally considered to be broad ranging, benefiting not only the individual but also the community and economy. The primary benefit of tertiary education for individuals is the greater range of labour force and income opportunities provided to them, which arise through the high value that employers place on the key skills developed during tertiary study. The application of these skills in the workplace not only has the potential to have a positive impact on the quality and quantity of output generated in an individual organisation, but also – through the development of new technologies to address key issues such as poverty and health care and to increase productivity – has the potential to have a lasting positive impact on a community and the global economy.

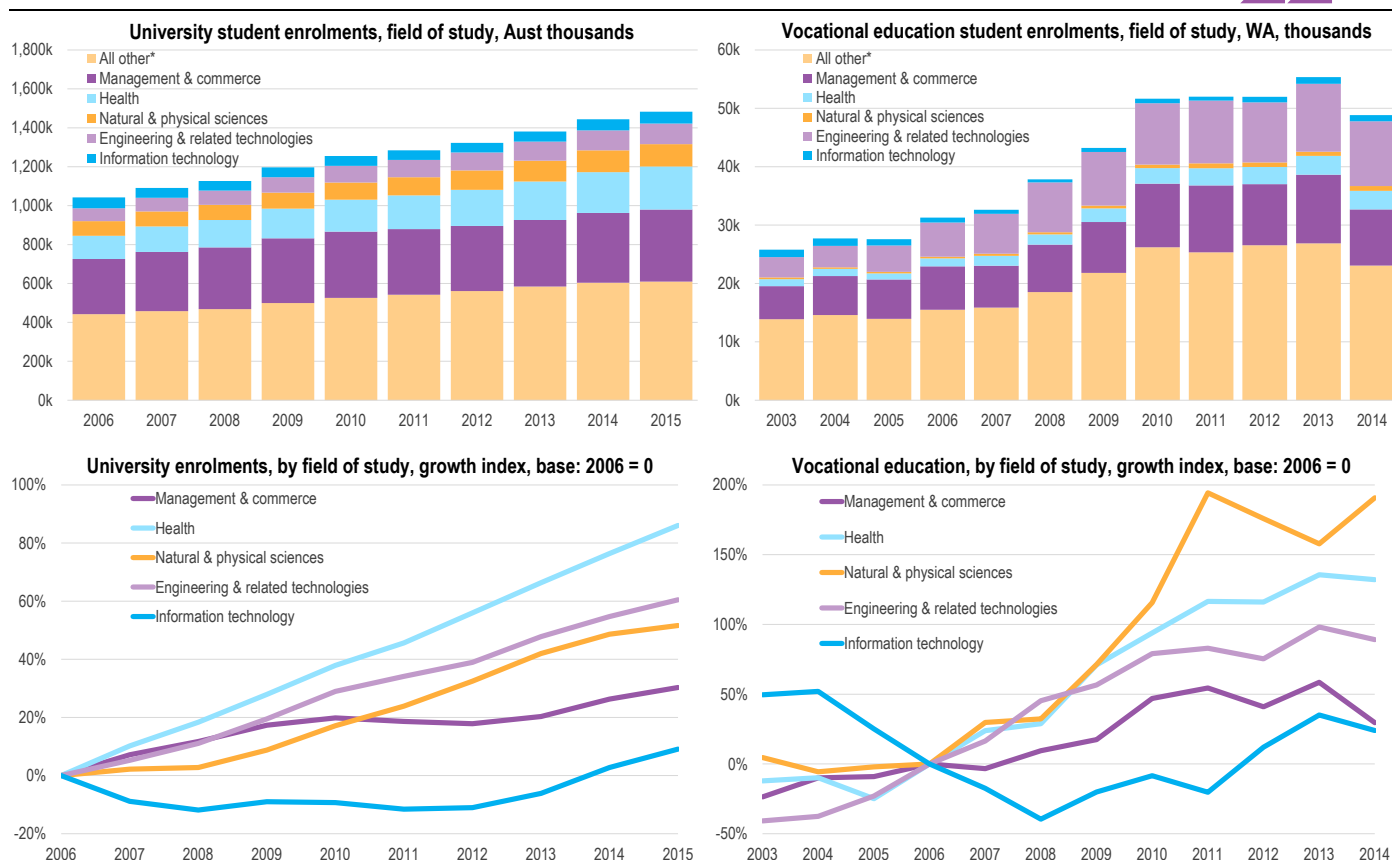
In terms of the types of tertiary degrees being undertaken, university and vocational education trends demonstrate growing demand for STEM related degrees or courses. The number of Australian university students undertaking health related studies has grown from 119,000 in 2006 to 222,000 in 2015 – an increase of 86 per cent. Strong growth has also been recorded in engineering and related technologies (by 60 per cent) and natural and physical sciences (by 52 per cent) over the same period. By contrast, the number of students undertaking information technology related studies fell between 2006 and 2012, but have picked up since then, increasing by 23 per cent between 2012 and 2015.

Enrolments in vocational education in WA follow a similar trend to university enrolments nationally. Since 2006, the number of students enrolled in STEM related subjects have shown the strongest growth, with:

- natural and physical sciences increasing by 525 (or 191 per cent);
- health by 1,965 (or 132 per cent); and
- engineering and related technologies by 7,628 (or 89 per cent).

Enrolments in information technology courses fell between 2004 and 2008, but have picked up since then, increasing by 105 per cent between 2008 and 2014.

EDUCATION TRENDS, UNIVERSITY AND VOCATIONAL EDUCATION FIELDS OF STUDY



Note: All other: architecture and building, agriculture and environmental, education, society and culture, creative arts, food and hospitality, mixed filed, and non-award program.

SOURCE: ACIL ALLEN CONSULTING, UNIVERSITIES AUSTRALIA, NCVER VOCSTATS

QUESTIONS FOR DISCUSSION

1. Does the current education and training system develop the necessary skills that are required of your organisation's/industry's workforce now and in the future?
2. What are the primary labour sources for your organisation/industry now, and what do you expect them to be in the future?





DRIVERS OF INNOVATION

In market based economies, it is competition that is the perpetual spur for businesses to innovate in order to survive and prosper over the long term. Competition can be the result of, or the response to, a number of factors that are driving businesses to adopt innovation and technology. A summary of the key drivers of innovation from the STB's literature review are presented below.

Globalisation

Increasingly, businesses are operating at a global level. It is not just multinational firms that operate in the global market. The global marketplace is more accessible than ever, opening up opportunities to expand into new markets, and to source supplies globally.

Even in the construction industry, the use of global supply chains is creating new approaches to construction, with the use of modular units and components that meet Australian Standards being manufactured overseas and then being shipped back to Australia and installed in reduced build times.

Innovation and technology is creating a platform for an interconnected global economy that eliminates many of the traditional barriers to entry for members of the demand and the supply side of the value chain.

Productivity

Growing competition that has resulted in cost pressures, competition for labour, and reduced barriers to entry, is driving companies to become more efficient and more effective in the way that they do business. New technologies have enabled businesses to improve productivity, and meet the challenges and opportunities associated with competition. For example, cloud computing, artificial intelligence, and big data are allowing the development of innovative new business models and the creation of new products and processes.

A number of companies have also adopted new technologies to undertake traditional roles, which has resulted in reduced labour requirements and significant economies of scale. Remote controlled and automated systems are examples of this in the resources and agriculture sectors, including sensor technologies, database and data fusion technologies, logic software technologies, visualisation and simulation technologies, collaboration technologies, networking technologies, and mechatronic technologies.

In the construction industry, the use of driverless trucks and excavators are perceived as some of the most important technologies impacting on the sector in the future.

However, productivity enhancing technology and innovation is not commonplace across business and industry. The Committee for Economic Development of Australia (CEDA) found small and medium businesses more broadly did not recognise the benefits of applying such technology to their business.

Power of the Consumer

The consumer must be at the centre of everything that business does. Consumers are more empowered than ever. They have more choice than ever. They will be the innovator, the regulator. They will overwhelm business models. Companies that do not relentlessly pursue a deeper understanding of the consumer will fail. (Jennifer Westacott, CEO Business Council of Australia).

Today's markets are consumer driven. Innovation and technology allows companies to better meet the expectations of their clients. In every industry, customers' digital expectations are rising, both directly for digital products and services and indirectly for the speed, accuracy, productivity, and convenience that digital makes possible.

Part of understanding the consumer must be a serious investment in data analytics. Companies that work with their customers, and use big data to tap into trends, will have a comparative advantage.

Technology and innovation will also help to improve the reach of existing services. An example is in the health sector where patients are increasingly able to self-manage their health needs from their homes. In the aged care sector, clients are able to be more independent and remain in their homes for longer.

Changing nature of work

Changing workforce demographics, the decentralisation of populations, and changes in family values and structures are driving a demand for a more flexible workplace.

Innovation and technology allows flexibility in how and where people work. More people are working from home or in hot desk arrangements. Flexible work hours are now more common-place in organisations, and changing employment contracts are commonly characterised by part time work, contract work and freelancing.

The global workplace allows companies to more easily recruit staff from anywhere in the world. This assists in a more efficient allocation of resources, the sharing of best practice, and the transfer of ideas, which results in even greater change.

Other workplace benefits include improved safety and wellbeing in the workplace, with technology allowing reduced time on-site, and less exposure to hazards such as the weather and workplace hazards.

Risks

The adoption of innovation and technology presents new operating risks that industries have not had to face in the past. These include identity theft, reputational damage, social media bullying and harassment, and internet fraud. The globalisation of the supply chain presents risks such as supply disruptions and theft of intellectual property.

Some risks are not yet known. For example, the quality and safety risks arising from automated processes and offerings are largely undefined as are the legal and regulatory consequences. McKinsey Global Institute raises the question of who is responsible if a driverless school bus has an accident? (McKinsey Global Institute, (2015), *Four fundamentals of Workplace Automation*).

Rates of adoption

The rate of adoption of innovation and technology is, and will be, different for different industries and businesses. Advances in technology are already reshaping businesses and workplaces. Some industries such as resources and health are advanced in the implementation of innovation and technology; however, the uptake in other industries is far lower.

There is potential for new technologies to spread rapidly. CEDA estimates that around 40 per cent of the Australian workforce face the high probability of being replaced by computers in the next 10 to 15 years (CEDA, (2015), *Australia's Future Workforce*).

Other studies estimate that more than half of the Australian workforce will need to be able to use, configure or build digital systems in the next 2-3 years. (Foundation for Young Australians, (2015), *The New Work Order: Ensuring Young Australians have skills and experience for the jobs of the future, not the past*)

CSIRO estimates that 73 per cent of jobs are likely to be significantly impacted by automation and artificial intelligence by 2035 (CSIRO, (2016), *Tomorrow's Digitally Enabled Workforce: Megatrends and Scenarios for Jobs and Employment in Australia in over the coming Twenty Years*).

There is a need for education and training to keep pace to make sure our current and future workers are skilled to meet the needs of the future operating environments. In the health sector, protection of professional boundaries and the continued reliance on models of health service delivery and health education, which are based on existing professional roles, are seen by many as being largely responsible for the slow pace of reform (HealthWorkforce Australia, 2011, National Health Workforce Innovation and Reform Strategic Framework for Action 2011-2015).

QUESTIONS FOR DISCUSSION

1. What have typically been the primary drivers of innovation in your organisation/industry?
2. What do you expect to be the primary drivers of innovation in your organisation/industry in the future?



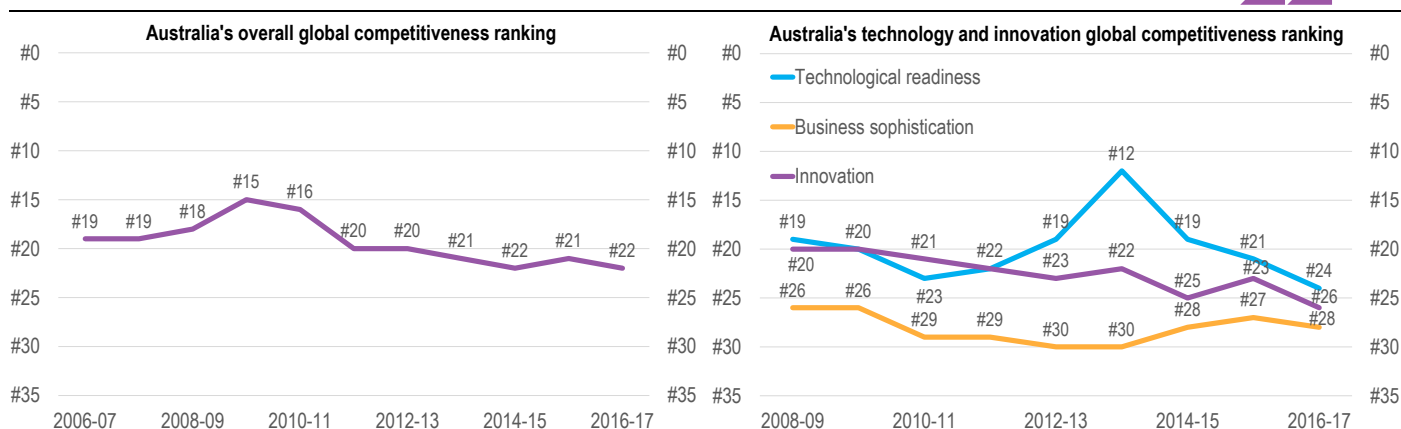
How Does Australia Compare?

The *Global Competitiveness Report (GCR)*, compiled by the World Economic Forum, assesses the competitiveness landscape of 140 economies around the world, providing insights into the drivers of their productivity and prosperity. The 2016 GCR, which was released in September 2016, reported that Australia's overall competitiveness slipped one spot to 22nd in the world.

There are a number of factors that have influenced Australia's overall competitiveness, including infrastructure quality, the macroeconomic environment, social outcomes, labour market outcomes, and factors related to innovation and technology.

In the context of innovation and technology, Australia's overall ranking has been weighed down by its relatively low scores in relation to technological readiness (such as internet bandwidth and business' availability of the latest technology), business sophistication (such as production process sophistication and local supplier quality) and innovation (such as business' capacity for innovation, spending on R&D, quality of local research institutions and university-industry collaboration on R&D).

AUSTRALIA'S GLOBAL COMPETITIVENESS RANKING



SOURCE: ACIL ALLEN CONSULTING, WORLD ECONOMIC FORUM GCI INDEX

Australia is not an innovation leader globally. However, if Australian businesses are to remain globally competitive, there will be a need to continually push and drive innovation, and look to technology solutions in the workplace to drive productivity improvements and reach out to new markets.

This has significant workforce implications, including the skills and occupations that will be in demand, and the changing nature of work – all of which is not well understood. Some of the key implications are discussed briefly in the next section.

QUESTIONS FOR DISCUSSION

1. What are the policy issues that should be addressed in order to drive further innovation, and ultimately increase Australia's competitiveness now and in the future?



WORKFORCE IMPLICATIONS

The adoption of innovation and technology has implications for the entire WA workforce. There will be a demand for new skills which will create the need for a new approach to education and training to upskill and cross skill the workforce. As highlighted by McKinsey, automation will affect portions of almost all jobs to a greater or lesser degree, depending on the type of work they entail. (McKinsey Global Institute, (2015), *Where machines could replace humans—and where they can't (yet)*).

A summary of some of the workforce implications that have been explored in the STB's literature review are discussed below.

Loss of traditional roles

The move toward greater innovation and technology will result in a redundancy of some traditional roles and skills or at least a reduction in their demand. Other roles will need to be redesigned. The jobs most likely to be affected are those where technology allows simple and routine tasks to be performed faster and more accurately (PWC, (2015), *A Smart Move*). These new jobs will be higher skill, higher paying and make a bigger contribution to the economy.

An example is the construction industry where pre-fabricated walls and roofing products will require specialised skills to manufacture and may in the future reduce the demand for trades such as bricklayers and roof tilers (Construction Training Council, (2014), *The Impact of New Technologies on the Construction Industry*).

Shift towards specialised skills

Innovation and technology adoption will see a shift toward greater use of technology and a model of service delivery that results in a shift toward new and specialist roles. This will create a demand for high level specialist skills. This is evident in the resources sector where the transition to operations is increasing the demand for specialised skills such as those in electronics, computing, and precision manufacturing.

In the health sector, innovation and technology is expected to see nurses performing roles such as diagnosing and prescribing, which have traditionally been undertaken by specialists.

Big data will result in an increasing demand for analysts with skills in areas such as machine learning, automation, cyber security, encryption, statistics, pure mathematics, computational chemistry and distributed (cloud based) systems.

Multiskilling

New business models, which have a focus on a services-based economy and on the consumer, are driving the need for workers with cross sectoral skills. While automation, robotics and artificial intelligence are heightening the demand for technical skills such as programming and equipment operation and control, these skills will need to be supplemented by 'soft skills', such as creativity, problem solving, advanced reasoning, persuasion, complex judgement, social interaction and emotional intelligence (CSIRO, (2016), *Tomorrow's Digitally Enabled Workforce: Megatrends and Scenarios for Jobs and Employment in Australia in over the coming Twenty Years*).

Good communication skills and basic management skills will become part of the core skill set of the workforce of the future to ensure that services are delivered to meet essential standards of efficiency, quality and safety. Multi-disciplinary teams will require workers with a high level of people skills to maximise the benefits of working together.

Education and training

The CSIRO predicts that higher education and a greater range of skills will become increasingly important. Employability will be directly related to education outcomes for those new to the labour market and those looking for career advancement or change.

Upskilling and cross skilling is required at all levels of the career pathway in order to realise the benefits of innovation and technology. It is likely that workers will need to obtain multi-disciplinary skill sets as the shift towards a more focussed approach to

service delivery requires employees to work in more than one occupation. Workers will need to hold several qualifications in order to adapt to new roles and will require lifelong learning to keep up with the pace of change.

Education and training institutions will need to be flexible and adaptive in order to help people to adapt to evolving skill requirements. New or redesigned education and training programs will be required and a fresh approach to service delivery will be needed. The introduction of multi-disciplinary courses, short course skills training, or in-house training for existing workers, are ways in which specific needs could be addressed.

Future skill needs must be addressed at school level in order to prepare students for the jobs of the future. Over 50 per cent of jobs will require significant digital skills and yet there is a slower uptake of STEM related studies in schools. The Australian Workforce Productivity Agency notes that this trend is impacting the number of students who can take up innovation and technology related subjects at the tertiary level.

Regulation

The implications for workforce regulation is significant. The regulatory, legislative, industrial, policy, and remunerative setting will require change in order to keep up with the rapid change in the marketplace. For example, trade classifications will change as roles will change to reflect new innovation and technology in the workplace.

Industries and businesses will need to adapt policies to reflect the new operating environment, and to ensure that the benefits of innovation and technology are maximised.

QUESTIONS FOR DISCUSSION

1. How has technology and innovation impacted on the nature of your organisation's/industry's workforce, including the roles and skills required?
2. How do you expect technology and innovation to impact on the nature of your organisation's/industry's workforce in the future, including the roles and skills required?





PROJECT INFORMATION

A

ACIL Allen Consulting has been commissioned by the STB to undertake the *Technology and Innovation* project, which aims to work with employees, managers and employers, parents, industry practitioners and advocates, education and training providers and Government to:

1. Appraise how current and emerging innovation and technology advances are changing the nature of work in some of WA's key industries, particularly in relation to:
 - i. Skills needs (existing and emerging) that will be demanded by industries;
 - ii. New types of jobs that are expected to be in high demand;
 - iii. Existing jobs that are expected to change in design;
 - iv. Specific VET products (skills, qualifications and training package design) required to close the gap between the supply and demand for skills in the short, medium and long-term; and
 - v. The pathways from VET to higher education qualifications required to meet the skills needs demanded by industries.
2. Reference how supply side and other broader environmental factors (e.g. migration patterns, ageing demographic, global business supply chains) are likely to change the demand for skills and new types of jobs, and affect the work landscape;
3. Identify foundational skills that will enable people to participate productively in the knowledge-economy of the future, as job-seekers, entrepreneurs, business owners and innovators. These foundational skills include, but are not limited to: Science, Technology, Engineering and mathematics (STEM) skills; Digital Literacy Skills; Enterprise Skills; Communication; Creativity and Innovation; Financial Literacy; Analytical and Critical Thinking Project Management; Change Management and Adaptability;
4. Develop education training and other strategies to increase the supply of local talents to meet the new and existing skills identified and embed and encourage these and foundational skills as appropriate at the primary, secondary, and tertiary levels; and
5. Identify the changes in policy necessary to ensure an appropriate response to these skills needs and strategies.

ABOUT ACIL ALLEN CONSULTING

ACIL Allen Consulting specialises in the use of applied economics and econometrics with emphasis on the analysis and development of policy and strategy. ACIL Allen has offices in Melbourne, Brisbane, Canberra, Perth and Sydney.

The firm has built a reputation for quality research, credible analysis, and innovative advice on economic, policy and strategic matters over a period of more than twenty years. ACIL Allen operates across a select range of industries including energy, mineable resources, water and other infrastructure, transport, health and human services policy, education, tourism and provides specialist advice to companies, governments, regulators and industry associations. ACIL Allen has been at the forefront of analysis of changes and policy issues in these sectors. We have helped governments to develop a number of policy mechanisms applied in response to these changes and policy issues. We have also helped many private corporations to develop the responsive business strategies in this dynamic environment.

Our consultants are drawn from a wide variety of disciplines including public policy, economics, finance, statistics, geology, physics, environmental science, engineering and mathematics. We also offer a diverse range of professional backgrounds in state and federal government, academia and business.

Further information about ACIL Allen Consulting can be found at our website, <http://www.acilallen.com.au/about>.

ABOUT THE STATE TRAINING BOARD

The State Training Board is a statutory body established by Part 3 of the *Vocational Education and Training Act 1996*.

The Board is the peak industry training advisory body to the Minister for Training and Workforce Development in Western Australia.

The role of the Board is to provide high level expert advice to the Minister on matters relating to vocational education and training (VET) in Western Australia including: the existing and anticipated supply and demand for skills in various industries; strategies to support industries which are experiencing skill shortages; policy which aims to improve the links between specific industry developments and VET so as to gain optimum employment opportunities for people and ensure the availability of appropriately skilled labour in the State; strategic directions, policies and priorities for the State training system; emerging international, national and State training issues; the extent to which training services meet the current and future requirements of industry and the community, including the requirement for equal opportunity of access to those services; and any other matters as directed by the Minister.

The Board has a legislated function to provide advice and make recommendations to the Minister on the establishment and/or variation of apprenticeships and traineeships in Western Australia.

A key function of the Board includes the preparation of the State Training Plan that provides a four year outlook into Western Australia's skills needs and priorities. The Profile ensures that the State Government is provided with the information needed to address the training needs of all West Australians.

The Board's market intelligence is provided by the Training Council network in Western Australia.

The 10 Training Councils provide high level, strategic advice that involves analysis, research and consultation with various industries.

More information about the State Training Board can be found at <http://www.stb.wa.gov.au>

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