

Critical Improvements in the Welding and Fabrication Trade



Dushan Slavovic

Higher Education and Skills Group / International Specialised Skills
Institute Overseas Fellowship



Department of Education and
Early Childhood Development



**International
Specialised
Skills
Institute**

ISS Institute
Level 1
189 Faraday Street
Carlton Vic
AUSTRALIA 3053

T 03 9347 4583
F 03 9348 1474
E info@issinstitute.org.au
W www.issinstitute.org.au

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i. Executive Summary

Regardless of the ups and downs in the economy, buildings and bridges and a myriad of other structures still need to be built, refurbished and repaired. Manufacturing and repair of everything from cars to aeroplanes, to bikes and lawnmowers is also going to be a necessity, irrespective of the economic climate. Welding and fabrication will always be a sought after trade but Australian education institutions need to be teaching our students the latest and most in demand skills if the Australian industry is to remain competitive. The welding trade offers a world of possibilities, making it a highly desirable career choice for anyone looking for their first job, or even a new career. This Fellowship will help to bring the latest technology and methods of training to Australia from the USA's most respected welding schools.

The main emphasis of the Fellowship has been to determine how training is conducted in the USA with the aim of informing the Australian education institutions to keep students coming back to trade schools, to provide the best possible training to keep students happy with courses and to reduce the amount of students leaving early and not completing trade qualifications.

We are living in an age of data, raising our children as the "Play Station generation", as stated by Adam Webb of Lincoln Electric. New medical and scientific equipment, even welding equipment, is used now for generating massive amounts of data. Groundbreaking analysis is being used to transform data to make new discoveries in welding. The possibilities for building on these advances in welding and fabrication as an advanced skill are immense. This is what the Fellow has learned at Lincoln Welding Institute and Hobart Welding Institute in the USA.

While the opportunities arising from more sophisticated applications of welding and fabrication technologies are significant, there is also a critical shortage of educated professionals in America who can effectively manage and analyse data to create new knowledge, and to pass on the skills that are essential to industry. The USA has a population of 300 million and still suffers from this shortage; Australia has barely 22 million, and unless immediate action is planned and implemented our shortage will be more difficult to manage.

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ii. Abbreviations/Acronyms

FCAW	Flux-Cored Arc Welding
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
MAG	Metal Active Gas welding
MIG	Metal Inert Gas welding
SMAW	Shielded Metal Arc Welding
TIG	Tungsten Inert Gas welding
WTIA	Welding Technology Institute of Australia

iii. Definitions

Design

Design is problem setting to meet human needs and wants. Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product – in business, government, education and training and the community in general.

'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007

ABB

ABB is a multinational corporation headquartered in Zurich, Switzerland, operating in robotics and mainly in the power and automation technology areas.

FCAW

Flux-cored Arc Welding (FCAW) is a semi-automatic or automatic arc welding process. FCAW requires a continuously-fed consumable tubular electrode containing a flux and a constant-voltage or, less commonly, a constant-current welding power supply. An externally supplied shielding gas is sometimes used, but often the flux itself is relied upon to generate the necessary protection from the atmosphere. The process is widely used in construction because of its high welding speed and portability.

FCAW was first developed in the early 1950s as an alternative to Shielded Metal Arc Welding (SMAW). The advantage of FCAW over SMAW is that the use of the stick electrodes used in SMAW is unnecessary. This helped FCAW to overcome many of the restrictions associated with SMAW.

SMAW

Shielded Metal Arc Welding (SMAW), also known as Manual Metal Arc (MMA) welding, flux shielded arc welding or informally as 'stick welding', is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

GMAW

Gas Metal Arc Welding (GMAW), sometimes referred to by its subtypes Metal Inert Gas (MIG) welding or Metal Active Gas (MAG) welding, is a welding process in which an electric arc forms between a consumable wire electrode and the work piece metal(s), which heats the work piece metal(s), causing them to melt and join. Along with the wire electrode, a shielding gas feeds through the welding gun, which shields the process from contaminants in the air. The process can be semi-automatic or automatic. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed-spray, each of which has distinct properties and corresponding advantages and limitations.

GTAW

Gas Tungsten Arc Welding (GTAW), also known as Tungsten Inert Gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by a shielding gas (usually an inert gas such as argon), and a filler metal is normally used, though some welds, known as autogenous welds, do not require it. A constant-current welding power supply produces energy, which is conducted across the arc through a column of highly ionized gas and metal vapours known as plasma.

Skills deficiency

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas.

Directory of Opportunities. Specialised Skills Courses with Italy. Part 1: Veneto Region', ISS Institute 1991

There may be individuals or individual firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass away. Firms likewise come and go.

Sustainability

The ISS Institute follows the United Nations NGO on sustainability, "Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

1. Acknowledgements

The Fellow, Dushan Slavovic would like to sincerely thank the following individuals and organisations that gave generously of their time and expertise to assist, advise and guide him throughout the Fellowship.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the ISS Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 200 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.

International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.

In this context, the ISS Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see <http://www.issinstitute.org.au>.

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1. Acknowledgements

Fellowship Sponsor

The Victorian Government Higher Education and Skills Group (HESG) formerly Skills Victoria, is responsible for the administration and coordination of programs for the provision of further education and training and further education, adult community education, and employment services in Victoria, and is a valued sponsor of the ISS Institute. The Fellow, Dushan Slavovic would like to thank HESG for providing funding for this Fellowship.

Employer Support

A specific acknowledgement is extended to Kangan Institute, in allowing and supporting the Fellow's application and enabling him to participate in the Skills Victoria / ISS Institute Overseas Fellowship program.

In doing so KI, permitted Panozzo to undertake travel to Germany and the UK in order to conduct a detailed study program for the RV manufacturing industry and its associated suppliers.

Supporters

- Craig Brittle, Manager Engineering, Swinburne University of Technology
- Sir James Gobbo AC, CVO; Patron in Chief, ISS Institute.
- Ken Greenhill, Fellowship Adviser, ISS Institute.
- Bella Irlicht AM; CEO, ISS Institute.
- Shane Infanti, CEO, AMTIL Australian.
- Joe Kolasa, Manager, Lincoln Electric Welding School, USA.
- Scott Muzzula, Supervisor, Hobart Institute of Welding, USA.
- Bob Paton, CEO, Manufacturing Skills Australia (MSA).
- Shayne Vander Heide, Senior Educator, Swinburne University of Technology.
- Robert Vernon, Welding inspector, Welding technology institute of Australia.
- David Wilson, Senior Educator, Chisholm Fabrication Department.

Employer Support

The Fellow would like to acknowledge Swinburne University Management John Cawley, Craig Brittle, Stuart Hoxley and Shayne Vander Heide, for their support. Not only for supporting the Fellow's application, but also for their assistance in the preparation and duration of the Fellowship.

1. Acknowledgements

Organisations impacted by the Fellowship

Government

- Higher Education and Skills Group
- Skills Australia
- DEEWR
- Defence
- Resource sector

Industry

- Welding Technology Institute of Australia
- Downer Engineering
- John Holland
- Transfield Services
- Thiess
- CBH resources
- Centennial Coal
- Anglocoal
- Superpit
- Rio Tinto
- BHP

Professional Associations

Education and Training

- Swinburne University of Technology
- Chisholm Institute of TAFE
- Lincoln Electric Welding School, USA
- Hobart Welding College, USA
- Monash University

2. About the Fellow

Name

Dushan Slavovic

Employment

Welding and Fabrication Instructor, Swinburne University

Qualifications and Accredited Courses

- Diploma of Vocational Education and Training, 2011
- Diploma Engineering Technology, 2010
- Certificate IV Assessment & Workplace Training, 2010
- Accredited welder WTIA, 2002–2010
- Certificate III Fabrication Trade, 2000

Achievements

- Achieving the highest level of welding through Welding Technology Institute of Australia, and using these skills to operate successfully in industry as a subcontractor.
- Applying skills and knowledge and having the opportunity to pass this on to students as a teacher and mentor.
- Working alongside some of the best welders and fabricators in Australia. Travelling extensively and working within the food and pharmaceutical industry on incredible projects.

Memberships

- Member of Victorian Fabrication Senate
- Member of the Berwick Balcara Lodge

As a young man Dushan Slavovic was always fascinated with tools and making things particularly with metal. His grandfather migrated from Europe in the 1950s and proceeded to work as a skilled migrant at Port Kembla, NSW, where the Fellow's father also worked soon after. The Fellow's earliest memories are of all the fantastic things that the craftspeople would be making and how these things had an influence on our lifestyle. An aeroplane, a ship, a skyscraper, a submarine and the humble car; all of these fantastic feats of engineering resulted from the skill level of these talented men and women. These master craftspeople were the first inspiration for the Fellow, along with the skills on display – skills that took many years to master.

Some years later, after completing high school, the Fellow decided to settle back in Melbourne and took on an apprenticeship and that was where it all began. Having worked in the fabrication industry for over 15 years, he looks back on all the various places that he worked from light fabrication workshops where he learnt about CNC brake press work, turret punch, and laser cutting operations, to other companies where he worked with heavy structural steel working on such icons as the Southern Cross station in Melbourne.

Eventually the Fellow found his real calling, his fascination with stainless steel and gas tungsten arc welding, in his final year of his apprenticeship. He came to know a gentleman who would introduce him to the incredible work involved in food and pharmaceutical welding plant installs and basically everything stainless steel.

2. About the Fellow

The company TIG Weld Australia was the Fellow's first taste of true fabrication and welding. He was exposed to such a vast array of work from working at Coca Cola production plant in Eastern Creek to the XXXX Brewery in Milton, Queensland. The skills that he attained over this time that were passed on by his mentors stay with him to this day.

The Fellow honed his skills along with some of the best welders in Australia that had such a vast array of fabrication and welding skills that all had colourful backgrounds stemming from people who worked on oil rigs to aeroplanes. The Fellow saw potential in this trade, he saw that he was being rewarded for his work compared to the typical ideals that have been imposed upon the welding trades: that welding is a dirty job and it cannot make money. He used his hands and his newfound skills to create some of the most amazing work that produces the food and medicines that we take for granted and consume each day.

In 2010, the Fellow decided to turn his career from contracting and travelling to settling down and with his wife in Melbourne and take on a position as teacher of welding and fabrication at Chisholm Institute of TAFE in Dandenong. He felt that he wanted to pass on the things that he had learned over the years to the younger generation of tradespeople who have the same passion as he for the metal industry. The Fellow believes that what is made from steel will always last the test of time.

In 2011 the Fellow was offered the chance to join the team at Swinburne University in Wantirna, and he took the step eagerly. 2011 and 2012 have been challenging in their own right; the Fellow has been working hard along with Shayne Vander Heide, Senior Educator, to raise people's awareness of the shortage of skilled welders and fabricators in the metal industry. At the moment they have also been working hard to build up the reputation of Swinburne's capabilities as a driving force in welding and fabrication training in the area.

3. Aims of the Fellowship Program

Regardless of the ups and downs in the economy, buildings and bridges and a myriad of other structures still need to be built, refurbished and repaired. Manufacturing and repair of everything from cars to aeroplanes, to bikes and lawnmowers is also going to be a necessity, irrespective of the economic climate. Welding and fabrication will always be a sought after trade but Australian education institutions need to be teaching our students the latest and most in demand skills if the Australian industry to remain competitive. The welding trade offers a world of possibilities, making it a highly desirable career choice for anyone looking for their first job, or even a new career. This Fellowship will help to bring the latest technology and methods of training to Australia from the USA's most respected welding schools.

The Fellow travelled to obtain a new range of comprehensive skills in welding and fabrication, and looked at the many ways that our international compatriots facilitate and deliver the base and advanced methods of training for our trade. He also investigated how new technology has been used to boost production and quality for all welding and fabrication needs. He believes that in bridging the distance between organisations here in Australia and the world-renowned facilities in the USA, leaders in fabrication and welding, Australia can take the next step in positive advancement in this integral field.

The Fellow's main focus was investigating the formal ways that other schools deliver welding training to students; he looked closely at the resources, tools and methods instructors use to pass on and build up the skills of the welders they train. He attended an educators program facilitated by Lincoln Electric Welding School. This course is geared for welding instructors. It is also open to end users and distributors who want a comprehensive overview of the main arc welding processes and an update of the latest technologies in each method of welding.

The main aim of the Fellowship was to research and receive training about new technologies in welding and fabrication and to focus on teacher training methods of delivery and new resource development so that Australia can align with our international competitors and be able to rank ourselves at the top of the world ranking for training the best welders and metal fabricators.

Irrespective of any business slow-down that may come as a result of the Global Financial Crisis, the Australian welding skills shortage in the metal trades industry will be with us for many years. The current slow-down may release some of the stress in the short term, but the reality is that the average age of the welding workforce is rapidly increasing. The fact is that welders are getting older and young people are not entering the industry as fast as they are leaving and, sadly, this has been the reality for quite some time. A key focus of this Fellowship was to directly link up with other training facilities regarded as the world's best for welding and fabrication, investigate and report on the fundamentals of the methods that are being used currently for training.

In particular, the assistance provided by ISS Institute will help to bring to light the main issues facing the welding and fabrication industry. While attending the welding educator program, which has been established by the Lincoln Electric Welding School in Cleveland Ohio, it was the Fellow's aim to investigate current methods of delivering training for people in welding. The emphasis lies in comparing methods of delivery and being able to compare methods, resources, tools and technology. If we can collate enough information by visiting these training facilities we can ascertain whether or not we are doing everything we can in Australia to keep up with industry demands for welders and welder training. The educator program is a great way for current teachers to get back to grass roots training; for instance the delivery of hands-on welding skills. The course focuses on welding safety and the four basic welding processes (SMAW, GMAW, GTAW and FCAW). The objectives are to improve attendees' process knowledge and skills, both in the classroom and in the lab, as well as provide an update on the latest welding technologies for each process. Emphasis was placed on Lincoln Electric Welding School's Nextweld® advanced technologies. Other topics included the oxy fuel process, plasma arc cutting, basic metallurgy, and welding of aluminium and stainless steel. With such a large and regular variety of training workshops and courses in all aspects of fabrication and manufacturing, the school keeps its students and staff at the forefront of technology.

4. The Australian Context

The Australian welding industry has dealt with no situation quite as complex as the one it now faces with the shortage of skilled welders. The pulse of the welding community beats strongly and overall outlook for the future is generally optimistic, but a few gray clouds currently loom over the horizon. These clouds appear in the form of a shortage of workers with the necessary skills required by the profession and by the lack of attraction and retention of students undertaking welding training courses. These concerns have been expressed by industry for many years now. To get a feel for that pulse and the future conditions in the world of welding, which include producers of a variety of welding products, providers of research and most importantly welding training schools, the Australian industry has to lift its game in these areas to stay competitive with a constant need for improvement in up skilling, development of better products and better ways to use them.

Welding will continue to be used more in the future because it has proven to be a productive and cost-effective way to join metals. To speculate that the consumer welding market will continue to provide opportunities for growth, with home improvement and the retail infrastructure to support it becoming a 'dead trade', Australian industry needs to be informed of the difficulties currently facing training providers and how they can better improve methods for training future welders. One would feel that for cost-competitive reasons, industry will continue to replace mechanical joining with semiautomatic and automatic joining processes, giving a definite boost to welding. Welding is the most effective way to join materials for structural integrity. Growth will be in alternative materials such as plastics, composites and new alloys such as those used in the aviation industry. Some specialised segments, such as aluminium, will grow faster than others as new technology, reducing its production cost, would make it a more viable product, while the continuing developments in non-metallic materials will slow some segments.

The recruitment and labour hire sectors currently monitor skill shortages and how they affect employers in Australia. The published results of research and surveys conducted in Australia offer valuable resources to recruitment organisations when planning for the future. Advanced Recruitment watches these results with keen interest and contributes whenever possible. So far we know that 61 percent of employers in Australia are struggling to source qualified job candidates. This is not unique to Australia; globally the situation is the same. In New Zealand approximately 52 percent of employers experience the same problem in finding suitably qualified workers; in Mexico this number rises to 82 percent and in Costa Rica it is 93 percent.

Where, if anywhere, is the situation less problematic? In China only 19 percent of Chinese employers are struggling to source qualified job candidates and this drops to 17 percent in Ireland. The statistics mentioned within the following web pages identify a number of jobs on the most wanted list internationally. Although they do vary from country to country, clearly welders are in the top ten globally.¹

In a recent conversation between the Fellow and Robert Vernon of WTIA, the feeling that growth will be in specialised areas was repeated often. Areas that were mentioned included welding automation; GTAW welding because of the increasing need for accuracy and precision in welding new metals; GMAW welding with mixed gas shielding; sheet metal industry; construction industry; infrastructure repair; transportation industry; marine structures; aerospace; and automotive, especially its use of aluminium alloys.

Some feel the growth among industries will primarily be in countries with emerging economies, while the growth in Australia will be relatively stagnant. Labour shortages in Australia will contribute to a steady growth in the robotic welding market.

The perspective of some, though, is that welding will be used less in the future. The Fellow believes this to be incorrect as hand skills in trades should never be obsolete. In fact a better understanding of joining metals with manual welding skills will always be a critical aspect of industry. These integral skills

4. The Australian Context

create pathways to other skills and new technologies. The basic hand skills needed for the use of all welding processes are something that can only be improved by hands-on training. The latest budget cuts have made it more difficult for students to get adequate training based on the increase in school fees and lack of funding to organise latest equipment for training facilities.

SWOT Analysis (concentrating on the importance of high quality welding across the manufacturing, and construction industries).

Strengths

Welding has always been an integral part of the manufacturing industry and manual welding will always be the best process for most applications of joining metal. With the correctly trained individual, most welding applications can be satisfied.

As businesses downsize, those individuals who know a welding trade remain in high demand. This level of job security is appealing to young people.

Weakness

Reliance on human welders can dramatically increase a manufacturer's labour costs.

When planning for labour costs, manufacturers must consider the time that welders spend producing assemblies.

A semiautomatic system has at least twice the output of a skilled welder.

Opportunities

Qualified welders are an integral part of many industries. Welders work on ships, cars, design and construction projects, allowing Australia to use our own workforce to get the job done.

A certified welder will never be without job opportunities even in the worst times.

There is a growing need for welders as many countries begin the daunting task of rebuilding their infrastructures of highways, bridges and public buildings; while at the same time improving advancement in other areas of the ship building, aviation and automotive industries.

Threats

Industry looking at cheap labour from overseas competitors to fill skills gaps.

Reliance on under-skilled tradespeople to keep the industry running.

The global recession, the advanced maturity and growing decline of markets such as shipbuilding and electronics, and downward pressure on prices are increasing the intensity of competition and the bargaining power of end-users.

5. Identifying the Skills Deficiencies

1. Investigate how to improve the attraction rates of students to the welding industry.

- Examine content of international welding qualifications.
- Identify strengths, weaknesses, opportunities and threats for Australian welding qualifications.
- Make recommendations for changes to current welding qualifications.

Aim: examine content of international welding qualifications for possible implementation in Australia to improve the attraction and retention of students in welding courses and to increase the number of skilled students who will then populate the workforce in Australia.

2. Investigate new delivery methods for training welders and welding engineers.

- Focus on actual welding applications for all welding processes.
- Look at ways to adopt automation in welding.
- Investigate better ways to improve on OHS within the industry.

Aim: Improve the standards of welder training in Australia.

3. Investigate how to improve retention of students in the welding fabrication industry.

- Determine how training is conducted in the USA.
- Specific areas need to be improved for all welding process.
- New resources for students.
- Modern ways of delivering online learning and distance education.
- Flexible learning and delivery.
- Modern infrastructure.
- Planning and fee structure.
- Cost and spending within training departments in the welding field.
- Sustainability - new methods, less waste

Aim: Determine how training is conducted in the USA with the aim of advising the Australian education institutions about how to keep students coming back to trade schools, to provide the best possible training to keep students happy with courses and to reduce the amount of students leaving early and not completing trade qualifications.

5. Identifying the Skills Deficiencies

4. How to better improve relevant skill and training of all welding processes including hands-on welding.

- Reduce the amount of non relevant training being delivered with feedback from industry.
- Look at ways to improve training resources online and on the job training.
- Greater emphasis on hands-on training, not just academic.
- New methods for actual techniques in the welding process.
- New demonstration techniques to pass on to other trainers.
- Look at setup and safety improvements for machines and processes.
- Time saving ideas that work for welders.
- Improved methods in utilising welding machines' full capabilities.
- Reducing wasteful practices.

Aim: Look at ways to improve training resources online to enable the Australian education industry to engage the best possible methods of training in the field of welding and fabrication. It has long been recognised by many educators that we need to revise the public education system in Australia to acknowledge the trades as an acceptable alternative for students. This echoes the need for radical change in education at all levels. However, as stated by David Wilson, Senior Educator, Chisholm TAFE, "This is not likely to happen without strong leadership and commitment".

"In fact, we need to touch on a variety of aspects related to training all with an eye toward welding's future. The level of cooperation between manufacturers and schools must improve so that manufacturers' needs are met. Most welding instructors agree that the welding industry needs to do two things: enhance ease of use through technical training and technological advancement, and concentrate on making welding the low-cost, best-performance choices for material joining. The main question is 'how do we take the step to improve on comprehension of welding skills and what is necessary to sustain growth and to fix welding weaknesses within training methods?' For the question regarding welding's weaknesses, it's often not scientifically applied, which leads to overdesigned weldments and process parameters that are not optimised. The main topic again in answer to the above question, we must continue to educate students on the basics of the process and how to implement it. We must teach the economics of welding to designers so they understand the costs of a weld and the basic skill involved in all welding process." — David Wilson, Senior Educator Chisholm TAFE.

6. The International Experience

We are living in an age of data, raising our children as the “Play Station generation”, as mentioned by Adam Webb of Lincoln Electric. New medical and scientific equipment, even welding equipment is used now for generating massive amounts of data. Groundbreaking analysis is being used to transform data to make new discoveries in welding. The possibilities for building on these advances in welding and fabrication as an advanced skill are immense. This is what the Fellow has learned at Lincoln Welding Institute and Hobart Institute of Welding in the USA.

While the opportunities arising from more sophisticated applications of welding and fabrication technologies are significant, there is also a critical shortage of educated professionals in America who can effectively manage and analyse data to create new knowledge, and pass on the skills that are essential to industry. The USA has a population of 300 million and still suffers from this shortage; Australia has barely 22 million, and unless immediate action is planned and implemented our shortage will be more difficult to manage.



Lincoln Electric welding school with Adam Webb Vertex 360 future in teaching Welding

New techniques are needed to deal with huge quantities of unskilled workers that characterise this environment that is lacking in skilled workers able to perform to industry demands within Australia and the USA, as decades-old methods that work with small amounts of materials in small workshops typically do not transfer to larger areas in demand of skilled welders and fabricators. Highly specialised knowledge is needed to ensure that workers are managed and that they learn about safety and are able to perform their work reliably. American schools designed specifically to cater for welding and fabrication, such as Lincoln and Hobart, have taken the first step of providing the specialised training needed for industry in all processes including gas tungsten arc welding, sub arc gas metal arc welding and manual metal arc welding. Lincoln have been at the forefront of new technologies needed by industry as automation and training aids such as the Vertex 360, a virtual reality system where a student can experience welding without the safety issues associated with an unskilled worker running a welding process.

In order for Australia to reach a decent benchmark, we need to follow suit and start investing in these areas. More funding has to be made available at least to purchase the basics. Lincoln have excelled at this, as Adam Webb from Lincoln stated, “It’s not about the quantity, it’s the quality we want to provide customers, be it industry or training providers, the latest information on technology for welding and fabrication, such as the Vertex 360 or the torch mate automated cutting system. But also give them the latest in training aids to make



Lincoln Teach the teacher Program Bob Gardner

6. The International Experience

our product run the way it is supposed to". Lincoln also backed up all their products with 100 percent customer service with new online software like power connect technology that allows the user to connect welding machines to a computer and produce welding procedures and hard data each time a weld is produced; also check point production monitoring unprecedented production visibility and predictive analysis. Industry standards for mobility check point is viewable on smart phones and tablets allowing real time information on production and use of welding processes.

Hobart Welding Institute, on the other hand, has a system that had been set up to focus on the basics of welding for any process; they have unlimited resources and only keep teachers with current welding experience. Gone are the days of teaching outdated skills that industry does not use. Scott Muzulla from Hobart stated, "I have a background in automation working for companies such as ABB here in America, which is huge in this field, but we tend to forget that we need to focus on the core, giving students a chance to build their skill level with as much support during their training as possible. We stick by them until they get it".

Matt Albright from Lincoln Electric during his demonstration of improved welding technologies mentioned third generation welding equipment that will make training easier, such as the new machines produced now. "Once people see this they won't go back a customised arc for every application, this will make guys who are really good even better at welding and the ones that are learning would find it easier as operators."

Joe Kolasa from Lincoln Electric during his presentation on the importance of understanding basic metallurgy mentioned, "The more you know about a metal the better you will be able to weld; this is the problem that most people have with understanding how difficult it is to weld. It's not as simple as just hitting a button. Failures happen due to lack of training. The old way of thinking teaches a lot of good stuff but some bad too - undo the bad without losing the good and offending those who taught it in the first place".



Subject matter experts with expert facilities



Lincoln welding museum

7. Knowledge Transfer: Applying the Outcomes

Within Australia there is an education and training gap in these vital areas for fabrication and welding. There are more jobs within engineering and fabrication, particularly welding, that are important for innovation than there are skilled workers to fill them. What we have seen, over decades, has been a gradual deterioration in the attention that our primary and secondary schools give to certain trade skills—a long term issue that was compounded by the burst bubble of the manufacturing industry in Australia, which saw many thousands of students turn away from careers in engineering and being left with the overhanging idea that it is a difficult, dirty and low paying career.

The promise of welding and fabrication technologies is so great that we need a national effort to reinvigorate interest in these fields, starting with our schools.

Promoting welding concepts in schools is noticeably absent from national discussions. The Office of the Chief Scientist has recently produced two reports, 'Health of Australian Science and Mathematics' and 'Engineering & Science in the National Interest'. The first report considers enrolments in engineering courses at university and investment in engineering research. It notes that interest in engineering courses has dropped substantially over the past decade, offset by modest improvement over the past two years.

Other engineering courses also have the highest percentage of international students—a direct reflection of the shortage of Australian students emerging from our schools with interests in these areas. The second report makes almost no mention of fabrication and welding and the importance of promoting this area in schools has also been overlooked. While it could be argued that welding and fabrication technology fits within the broad rubric of science, the reality is that this area is not linked with mathematics and science education in our schools.

The training provided by Lincoln and the information that has been brought back to Australia, will be added to existing programs here in Australia. The biggest focus is updating older resources that are currently being used by training providers and updating them with the new information provided by Hobart and Lincoln. Bob Green from Lincoln Electric states, "There is no such thing as a bad student, only a bad teacher". The Fellow believes this to be true in the sense that in order for Australian teachers to pass on the latest technologies that industry is using they should be up-to-date with the latest in training and technology themselves.

During the course at Lincoln nearly a dozen different objectives were touched on from safety to newest technologies. Next year the Fellow hopes to return to Lincoln to attend another course as he had found the teacher education program to be the best source of networking and information gathering, as well as a great personal development tool, not only to test his own skill and capabilities but to make sure the information that has been provided to his students is not only up to date but at the forefront of training in Australia for welding and fabrication.

While spending the day with Scott Mazzulla at the Hobart Welding Institute, the Fellow had time to discuss many areas of training for welding and fabrication. What could be seen as the first impression walking through the doors of this establishment was that everything seemed to have its place; everything was well organised, the students were working away even though it was incredibly hot outside. The biggest difficulty that we face in Australia is that if it gets hot the students don't want to work, as welding is usually associated with heat. Yet the students at Hobart could be seen working away disregarding the heat. This passion was a sign that commitment is still a driving factor for the students in the USA. Scott mentioned, "most of our students are here because they want to be. They can see the potential in what they are doing, they can see what industry can offer them and they work hard to get a foot in the door to better jobs while building on skills in their craft". This is a positive objective.

7. Knowledge Transfer: Applying the Outcomes

Hobart also have a great system in that they don't just teach basic skill in welding but they also offer students assistance that goes a long way to finding a job. Upon completion of their course, a database is made available showing current jobs with appropriate industry facilities in the industry. They also offer assistance to write resumes and application letters for these jobs. This is a great way for industry across the country to choose from well-trained and eager candidates. Scott also mentioned that 85 percent of the training was hands-on, which is fantastic, as after all it's the skills that the students are there for. He said, "while they are burning they are learning" and the Fellow believes this is a true analogy; the more time a student sits behind the arc they are learning. Scott also explained how Hobart have fantastic ties with industry and this is something that the Fellow believes needs to be done in Australia. The Fellow believes that industry should be approaching schools and giving them direction telling them what they need, such as large industries in the USA are doing. For instance, aviation ship building and construction automotive industries are working closely with education providers that provide the best possible training in order to fill jobs throughout their industry. Australian schools have been stretched with regards to little support from State Governments recently. Without cooperation between schools and industry there will always be a shortage in this trade.

Another main issue is for schools is marketing. Hobart and Lincoln both have exceptional reputations, hence the reason why they attract students in such numbers. Australian schools have to spend some of their budgets on specific targeting to make the trade a more acceptable prospect for future students. Without specific marketing, such as what Hobart and Lincoln offer, the Fellow believes the future of Australian welding and fabrication will be totally reliant on international workers to run the economy, meaning that the skills shortages will never be filled. The future seems bleak, but if we take the words from a great inventor Nikola Tesla, Australian welders and fabricators just may have something positive to look forward to:

"Let the future tell the truth and evaluate each one according to his work and accomplishments. The present is theirs; the future, for which I really worked, is mine." (Cheney, M., et al)².

8. Recommendations

Industry

Getting the national curriculum right is a vital first step if Industry is going to address knowledge and skills deficits in any of the engineering trades, particularly fabrication and welding. Australia needs to ensure that engineering concepts and welding and fabrication are seriously considered within the renewed emphasis on mathematics and science education.

Education and Training University, TAFE schools

The Fellow believes too much of the current focus on engineering literacy in secondary schools is not even touched on, as schools are poorly funded or choose not to establish practical workshops in order to give students an idea of what is out there. The Fellow recommends that there needs to be a design and technology subject in the national curriculum to increase visibility of this area and provide greater opportunity to teach even the most basic concepts. The Fellow also recommends that investigation takes place into bringing back graded delivery at trade levels as was seen at the USA schools. Graded delivery was observed by the Fellow overseas in the institutions that he visited and as a result it was observed that students not only do what they have to but strive to do things well. The Fellow believes that graded delivery can be used to drive students to strive more, to make them better to achieve a greater result.

Government - Federal and State and Local

The Fellow believes that government needs to put priority in supporting fabrication and welding trades. Infrastructure cannot be built and serviced by relying on outsourcing the work to a foreign workforce, such as what is happening in Australia at the moment with large companies either taking the work overseas or bringing in semi-skilled workers to save on labour costs. The Fellow recommends bringing the focus back on Australia and its people and allowing Australians a chance to be trained in these skilled jobs instead of allowing big industry to outsource the work.

Professional association

With the support of ISS Institute, other teachers can have the chance to further their own training in this field by going to visit these and other schools abroad and furthering Australia's curriculum to provide constant updates as to where fabrication and welding skills need that improvement. Being a skill- and technologically-driven trade, constant input is necessary to stay ahead.

Community

At the same time, we need to make efforts to direct more of our entrepreneurial and scientifically inclined students towards these powerful new engineering technologies. One place where welding and fabrication concepts can be promoted in schools is through the World Skills Australia competitions which focus on skills across all trades, not just engineering to solve difficult problems, where the most basic engineering knowledge used within fabrication and welding, and even other areas as sheet metal and structural steel work, is paramount. Without these basic skills the Fellow believes Australia will never be competitive against international competitors. Currently we are behind the pack, if one was to look around and see buildings, bridges, power plants, wind turbines, pipelines, cars, aeroplanes, trains, the simple parts of a computer, and not just manufacturing but repair, one would then understand the importance of welding and fabrication in growing a more productive and successful Australia.

8. Recommendations

Further skills deficiencies

Since returning to Australia, the Fellow believes that things look grim for most technical training providers. While small training providers are tapping into the training market, large registered training providers, such as Swinburne and Chisholm, have been hit hard with the state governments taking 300 million dollars off the budget for spending. Across the board there has been an enormous amount of job losses and massive amounts of spending cuts that inhibits most departments to have access to upgrading machinery in order to provide the latest in training. The situation looks bleak at the moment; for the most part we hope to see some positive change in the future.

Another important recommendation is to introduce a better induction program for universities and technical schools with more information for schools and individuals interested in pursuing a welding career. Currently the information most training providers provide is limited by only a basic concept of what is possible. The Lincoln and particularly the Hobart approach is fantastic and unique, just in the short time that was spent at both these establishments so much information was passed on to the Fellow. Not only information on courses but also opportunities with regards to job prospects, which made it clear that more can be done by training providers to work closer with industry to get the students out of the schools and into the right jobs. Not only should we be providing students with all the training to build their skill level but also giving them a good strong positive pathway, so that they would stay on and further their careers in welding and fabrication.

9. References

Endnotes

1. <http://www.weldingandgasestoday.org/index.php/2009/12/welding-trends-for-2010-and-beyond/>>

<http://www.advancedrecruitment.com.au/index.php/news/40-latest-news/54-skill-shortages-in-australia-we-are-not-the-only-ones>>.
2. Cheney, M., Utu, R. and Glenn, J., Tesla, Master of Lightning, 1999, p.73

10. Attachments

Attachment 1: Excerpt from Lincoln Electric web page.



Lincoln Teach the teacher Program Bob Gardner

Lincoln Electric Company are based in Cleveland Ohio in the United States of America, they were founded in 1895 and are the current world leader in the design, development and manufacture of arc welding equipment. Recognition as world leaders has led the company to develop and provide technological solutions to the welding and fabrication industry. Lincoln has a dedicated in house welding school used to develop welding skills for its range of clients. Lincoln's clients have a broad industry representation from aerospace, and the nuclear industry to motor sport.

Attachment 2: Excerpt from Hobart Welding School web page,

Hobart Institute of Welding:

The welding school was started in 1930 as a department of the Hobart Brothers Company. In 1940, the school was granted a charter by the State of Ohio as a 501(c)3 non-profit corporation governed by a board of directors and became known as the Hobart Trade School. As welding became more popular, the demand for trained welders increased and larger school facilities were required. In 1940, a new all-welded steel building was designed and built to house the welding school operation. Hobart Institute trained thousands of welders for World War II production in 1942-45.



Hobart Welding School

Hobart Institute is committed to helping individuals develop marketable welding skills through quality training at minimum cost. We are also committed to making industry more competitive by conducting training to solve welding related problems. Hobart Institute strives to develop new and better welding training methods and training materials, and to make welding training available to all. The Hobart Institute of Welding Technology does not discriminate on the basis of disability, race, colour, religion, sex, national origin or age.

