

Fire Safety Engineering

Fire Safety Education,
Training, Professional
Development and
Skill Constraints

Report 6 of this Series



THE
WARREN
CENTRE

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AUTHORS

The list of authors for this task are:

- Dr David Lange, UQ
- Mr Peter Johnson, ARUP
- Prof Jose Torero, UCL
- Dr Juan Hidalgo, UQ
- Dr Cristian Maluk, UQ
- Dr Felix Wiesner, UQ

AUTHORS ACKNOWLEDGEMENTS

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The Warren Centre hosted presenters from industry, government and academia at a conference at the University of Sydney Business School in February 2019.



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FIRE SAFETY ENGINEERING PROJECT

This is the second research project of The Warren Centre at the University of Sydney relating to Fire Safety Engineering. The first project in 1989 paved the way for the creation of the Fire Code Reform Centre to co-ordinate fire research nationally in 1994 and gave major impetus to the development of the performance-based Building Code of Australia, published in 1996. This current Warren Centre Project on fire safety engineering will address many of the major challenges facing governments, regulatory authorities and practitioners in relation to fire safety engineering and community safety in buildings.

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The Warren Centre thanks our project sponsors who made this research and these reports possible. This report represents the technical judgment and opinions of expert authors in the field of Fire Safety Engineering and the building design industry. These views are not necessarily endorsed or adopted by the sponsors.



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Executive Summary



THIS SIXTH REPORT OF THE WARREN CENTRE SERIES ON PROFESSIONALISING FIRE SAFETY ENGINEERING ADDRESSES RESOURCE AND SKILL CONSTRAINTS THAT MUST BE ADDRESSED TO ACHIEVE EFFECTIVE IMPLEMENTATION OF ALL OF THE RECOMMENDATIONS OF THE OTHER REPORTS IN THIS SERIES AND TO TRANSITION THE OCCUPATION INTO A FULL AND PROPER PROFESSION.

This report sets a path of commitment among academia, government and industry to deliver a sustainable provision of professionals. Without a sustainable provision of professionals, it will not be possible to professionalise Fire Safety Engineering.

Taking into account the needs, constraints and limitations of all stakeholders, the report emphasises that at the core of a sustainable provision of professionals are universities. Thus, the development of programs aimed at providing these professionals needs to take into account the operating constraints of universities. To develop sustainable Fire safety Engineering programs that guarantee the supply of professionals, it is essential to develop a framework and resources that make the development of these programs attractive to universities.

The report first discusses the background to the current state of Fire Safety Engineering in Australia, which largely points to a need for greater competence in the existing practitioners and increased demand in the future for Fire Safety Engineering graduates. A more adequate set of competency needs has been evidenced by issues such as the Lacrosse building fire, the consequences of that in terms of damages awarded against fire safety engineering practitioners, the Shergold / Weir enquiry, the non-conforming building products audit taskforces across the various states in Australia, and changing legislation. The future need for graduates is predicated around the fact that greater competency implies exclusive and greater involvement of Fire Safety Engineers in all stages of the design, building and approvals process. The result of these different contributing factors is

This report sets a path of commitment among academia, government and industry to deliver a sustainable provision of professionals.

that Fire Safety Engineering finds itself in a unique position at present to implement real change and elevate its status to that of a full and proper profession.

Based on various entry points to a career in Fire Safety Engineering, the report lays out the anticipated career journey and identifies the resources required to enable entry. These entry points include those starting out in the profession with an accredited degree in Fire Safety Engineering and those starting out without an accredited degree in Fire Safety Engineering. The latter includes those transitioning to the field from other disciplines, whether they are engineering disciplines or not. All of these entry points to the profession require a range of resources to be put in place that enable the acquisition of necessary competencies, their review and a rigorous process of acceptance.

For existing practitioners, which should be incorporated in the proposed process, the report also reviews the possible backgrounds from which they have come to be in the profession.

Based on the requirements for educational programs to support upskilling and to be able to deliver graduates with the required competencies to market, a number of recommendations are made. These include the development of micro-credentialing opportunities in the short term, the development of master's programs in the medium term,

and the development of co-operative teaching programs leading to sustainable development of Fire Safety Engineering teaching capacity in the tertiary education sector in the long term.

Additional recommendations are also made with regards to the need to review the expected outcomes from the period of supervised professional practice and the need for the profession to develop a program of outreach activities to attract people to enter the profession.

While these recommendations are targeted towards variously the universities, the professional organisations and the profession itself, it is important to stress that without broad support from the profession at large they will not achieve their intended aim. Government has always been perceived as the enabler, through regulation, legislation and resources, but it is the profession who needs to inform, encourage, support and, in some cases, drive government decisions to improve public safety outcomes. Implementation of these recommendations without strong industry support will lead Fire Safety Engineering along the same path that it has been on for the past two and a half decades. This would yield further impact of the failings of the profession in the future, negatively affecting private and public productivity and investment as building stock is introduced into the built environment that is not fit for purpose. The financial impact of this on the public and

private sectors will be huge. The impact on the profession will be devastating. There is a very real and tangible opportunity to properly professionalise the industry today, and it must be taken. The ultimate implementation of these recommendations must therefore be industry led, to ensure that the resulting courses meet the current and future needs of the industry. This must come with the full support and financial backing of the profession as well as state governments to avoid future crises.

A busy construction site in ACT, Australia.



1. Introduction

While the activity of Fire Engineering dates to the 19th century, it has mostly been associated with fire brigade activities. Many of these activities have been technical in nature and in many cases closely related to engineering. Nevertheless, Fire Safety Engineering as a distinct engineering discipline is only a few decades old. In Australia, prior to the first performance-based building code, Fire Safety Engineering was to all intents and purposes non-existent before 1996. However, upon the introduction of the performance-based building code, a market for “fire engineered” solutions was created, and the ABCB set the objective of increased market penetration of buildings based around the concept of performance-based design.

“Fire engineered” buildings and “performance-based design” were clearly stated as alternatives to prescriptive solutions, and while the need for proficient practice was articulated, there was never a precise

statement on who was entitled, or had the necessary competencies and attributes, to develop these “fire engineered” solutions. Furthermore, no professional accreditation process was described or implemented. As a result, the different states permit individuals to practice Fire Safety Engineering and to deliver fire engineered solutions based on widely varying levels of competence, according to the Warren Centre accreditation report.¹ Further, mutual recognition of registration or accreditation between states means that those engineers registered to practice in one state with lower requirements are permitted to practice in other states whose education requirements are higher. The result is that there are at present minimal requirements for Fire Safety Engineers to have any kind of formal training in the subject, and at best it can be expected that practitioners will have only a graduate certificate qualification.

1.1 DRIVERS FOR CHANGE IN THE PROFESSION

The profession is currently undergoing significant change. The regulatory environment is changing in terms of both accreditation of fire engineers in the different states, as well as the roles that fire engineers are expected to play in the building industry. As a result, the way in which fire engineering is treated in the National Construction Code² and in state and territory legislation has to evolve. The drivers of this change are complex. However, some

of these are highlighted below, as well as the evidence of this ongoing change.

1.1.1 THE LACROSSE FIRE

Three years before the Grenfell tower event in London in June 2017, the Lacrosse fire in Melbourne occurred³, prompting introspection into the building industry in Australia. This fire was followed recently by other events, for example, the Neo200 fire in 2019.⁴ The

¹ Kip S., Wyn-Jones M., Johnson P. (2019) The State of FSE Regulation, Control and Accreditation in Australia; The Warren Centre for Advanced Engineering, Sydney.

² Australian Building Codes Board, Building Code of Australia 2019.

³ Giuseppe Genco; Lacrosse Building Fire 673 La Trobe Street, Docklands on 25 November 2014; City of Melbourne April 2015 (DM ref# 8989066).

⁴ Cox, L., (2019) Apartment Fire In Melbourne's Spencer Street Prompts New Fears Over Cladding, The Guardian, <https://www.theguardian.com/australia-news/2019/feb/04/apartment-fire-in-melbournes-spencer-street-prompts-new-fears-over-cladding>.

1. Introduction

Lacrosse fire resulted in the instruction by the Building Ministers Forum (BMF) to Peter Shergold and Bronwyn Weir to undertake a review of the building industry in Australia.

In addition, a Victorian Civil and Administration Tribunal ruled that in the case of the Lacrosse fire, the Fire Safety Engineer responsible was liable for 39% of \$12.7 million in damages awarded to the building owners.⁵ The court ruled that the Fire Safety Engineer had failed to exercise due care and skill in conducting their engineering assessment of the Lacrosse tower. It was ruled that the quality of assessment conducted by the Fire Safety Engineer was not in accordance with the requisite assessment level.

1.1.2 BUILDING CONFIDENCE REPORT

The Shergold / Weir enquiry, published a report to the BMF titled, “Building Confidence”, which documented the state of the building industry across Australia.⁶ The report, which was published in 2018, made 24 recommendations. All of these are of significance to Fire Safety Engineering. However, the following specific

recommendations are highlighted as being of relevance to this Warren Centre project:

- Registration of building practitioners
- Consistent accreditation of building practitioners
- Continuing professional development
- Collaboration with fire authorities
- Approval of performance solutions for constructed building work
- Inspection and certification of fire safety system installation
- Building product safety

1.1.3 NON-CONFORMING BUILDING PRODUCTS

Also, against the backdrop of the Lacrosse fire, each of the states and territories across Australia undertook a detailed assessment of their exposure to combustible cladding. In Queensland, for example, the Non-Conforming Building Products Audit Taskforce was led by the Department of Housing and Public Works.⁷ The Taskforce was established to identify and make recommendations with regard to non-conforming building products and to prioritise the identification and subsequent

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⁵ Owners Corporation No.1 of PS613436T, Owners Corporation No. 2 of PS613436T, Owners Corporation No. 4 PS613436T & Ors v Lu Simon Builders P/L, Stasi Galanaos, Gardner Group & Ors [2019] VCAT. Decision released by Judge Woodward, 28 February 2019.
⁶ Peter Shergold and Bronwyn Weir; Building Confidence: An Action Plan for Building Regulatory Reform. Submission to the Building Minister Forum– April 2018, Building products innovation council. https://www.industry.gov.au/sites/default/files/July%202018/document/pdf/building_ministers_forum_expert_assessment_-_building_confidence.pdf.
⁷ Non-Conforming Building Products Audit Taskforce And Safer Buildings, Queensland Government Department of Housing and Public Works, <https://www.hpw.qld.gov.au/about/initiatives/ncbp-audit-taskforce#taskforce>





A lead author and collaborating partner in the FSE Project, Dr David Lange, University of Queensland.

investigation of buildings using a risk-based approach. To meet this requirement, the Taskforce initially investigated buildings identified as having non-conforming cladding and focused on high-risk buildings such as hospitals, education and public buildings. The Taskforce identified several hundred public buildings with potentially hazardous cladding, as well as a risk for potentially thousands more in the private sector. Whilst many states banned combustible cladding products resulting in significant costs for remediation, the Queensland government invested in a program of upskilling the existing Fire Safety Engineering workforce.

This program of upskilling was based on Recommendation 6 of the Taskforce Status Report⁸ and was achieved by means of developing a CPD course to give existing fire engineers the skills to confidently and skilfully assess the risk posed by combustible cladding and to provide remediation solutions that minimised the overall financial impact without compromising safety. This course included a rigorous assessment leading to a Certificate of Completion. This approach was based on an investment in training practicing engineers to deal with the issues presented themselves, but it did not compensate for the need for a growing number of Fire Safety Engineers in the future to deal with the many hundreds of buildings affected.

⁸ Queensland Non-Conforming Building Products Audit Taskforce Status Report, Queensland Government, https://www.hpw.qld.gov.au/__data/assets/pdf_file/0022/5719/claddingtaskforcereport.pdf.

Whilst many states banned combustible cladding products resulting in significant costs for remediation, the Queensland government invested in a program of upskilling the existing Fire Safety Engineering workforce.

1.1.4 THE WARREN CENTRE PROJECTS

Beginning in 2018, The Warren Centre for Advanced Engineering at The University of Sydney started work on its second Fire Safety Engineering project.⁹ The original Warren Centre project in Fire Safety Engineering took place in 1989¹⁰ and made a significant contribution ultimately to the introduction of the performance-based building codes in Australia. The aim of the current Warren Centre project is to elevate the level of the Fire Safety Engineering profession beyond the deficient levels of competence that result from the current licensing regulations across different states. This project has delivered advice on requirements for educational and licensing reform^{11,12}, provided input to regulatory changes to the NCC of Australia^{13,14} and provided input regarding the competency standards that should be expected of Fire Safety Engineers to satisfy new roles based on the recommendations of the Shergold / Weir report as well as input from leading fire engineers throughout Australia.^{15,16}

1.1.5 OTHER IMPORTANT EVENTS

In 2019 the VBA evacuated a building in Melbourne as a result of both building quality and fire safety concerns.¹⁷ According to the Lord Mayor of Melbourne, Sally Capp, speaking at the recent conference of the institution of fire engineers, they expect more to follow.¹⁸

On the back of all of the above, the BMF has charged the ABCB with implementing all 24 of the recommendations from the Shergold / Weir report.¹⁹

In late 2019, the regulations in Victoria around the registration of practitioners changed.²⁰ Victorian legislation is now more closely aligned with Queensland legislation and will require practitioners to be educated to degree level to achieve licensing to practice. This is a major step in regulatory reform in response to the above, and other states are expected to follow suit. A similar bill was approved by the New South Wales Parliament in June 2020.²¹

⁹ Fire safety engineering, The Warren Centre, <https://thewarrencentre.org.au/project/fire-safety-engineering/>.
¹⁰ Vaughan Beck, Claude Eaton, Peter Johnson, Ted Merewether, Caird Ramsay, John Richardson, Ross Freeman, Ray Lacey, Hamish MacLennan, Lawrence Reddaway, Ian Thomas (1989) Fire Safety and Engineering Project Report, the Warren Centre for Advanced Engineering, Sydney.
¹¹ Torero J., Lange, D., Horasan, M., Osorio, A., Maluk, C., Hidalgo, J., Johnson, P., (2019) The education report: Current Status of Education, Training and Stated Competencies for Fire Safety Engineers; The Warren Centre for advanced engineering, Sydney.
¹² Kip S., Wyn-Jones M., Johnson P. (2019) The State of FSE Regulation, Control and Accreditation in Australia; The Warren Centre for Advanced Engineering, Sydney.
¹³ Lange, D., Torero J., Lobel, N., Osorio, A., Maluk, C., Hidalgo, J., Johnson, P., (2019) The methods report: Comparison of International Fire Engineering Guidelines, Fire Safety Verification Methods and Practice Notes; The Warren Centre for Advanced Engineering, Sydney.
¹⁴ Comparison of FSE Guidance Documents and Assessment Criteria, The Warren Centre for Advanced Engineering, Sydney.
¹⁵ Lange, David; Torero, Jose; Maluk, Cristian and Hidalgo, Juan: Fire Safety Engineering competencies report; The Warren Centre for Advanced Engineering, Sydney.
¹⁶ Johnson, Peter; Role of Fire Safety Engineers, The Warren Centre for Advanced Engineering, Sydney.
¹⁷ Melbourne Apartment Block Unsafe To Live In Due To Cladding And Fire Safety, Residents Told To Leave. ABC News, 2019. <https://www.abc.net.au/news/2019-08-23/cladding-and-mould-forces-residents-out-of-apartment-block/11443976>.
¹⁸ Sally Capp, Keynote presentation at IFE Annual conference, Melbourne, August 2019.
¹⁹ BUILDING MINISTERS' FORUM COMMUNIQUE – 18 JULY 2019; <https://www.industry.gov.au/sites/default/files/2019-07/bmf-communique-18-july-2019.pdf>.
²⁰ Professional Engineers Registration Act 2019 (VIC).
²¹ Design and Building Practitioners Bill 2019 (NSW), Second Print.

1.2 AFAC COMMITMENTS AND THE SWEDISH MODEL

As part of the identified future role of Fire Safety Engineers in Australia,²² the Australasian Fire Authorities Council (AFAC) has committed its members to employing Fire Safety Engineers in fire brigades who have a level of skill commensurate with the Fire Safety Engineers in the private sector. This also means engineers who are educated to degree level and able to achieve the status of chartered engineer. These engineers installed in the fire services will serve as reviewers, acting in the public's interest. This also requires greater competence of the fire engineering profession to meet the new expectations in terms of quality and aptitude in the development of fire engineered solutions.

It still remains for AFAC to comment on structural changes that will empower these Fire Safety Engineers within the fire brigades to make decisions that affect the outcome of a building design as well as firefighting operations. An appropriate structure, and related hierarchies, are essential to deliver a model such as the Swedish model. Without these structural changes a relation of subordination prevails. Subordination diminishes the role of Fire Safety Engineering and as such does not deliver the desired outcomes.

Sweden, a country with a population of around 9 million, has two universities engaged in the education of Fire Safety Engineers, Lund University and Luleå University of Technology. Both run bachelor's level and master's level programs. Graduates from this program find employment in positions of authority within

the fire brigades. Lund University, the larger of the two, graduates between 45 and 50 Fire Safety Engineers a year. Lund also attracts 15 students per year on average from the International Master of Science in Fire Safety Engineering. Yet, Sweden has no requirements for continuous professional development of Fire Safety Engineers, as opposed to the model that is being proposed in Australia. This means that the role of universities in Australia, as a fundamental part of the proposed professional culture,²³ will potentially be more significant if the fire brigades choose to change their structure to enable a position of responsibility for these engineers.

New Zealand, with a population of around 5 million, also has a Fire Safety Engineering program at the University of Canterbury (UC), which graduates on average 25 students per year. UC's fire safety program is not accredited. NZ is going through a similar process of reform to Australia, although less extensive.²⁴ While the relationship between the UC and the New Zealand fire brigades is close, there is no structure that requires Fire Safety Engineers to fill specific positions of responsibility that not only serve the purpose of design review but also influence decision making within the fire brigades.

No other country globally has established any form of structure that embeds certified Fire Safety Engineers within the fire brigades and/or delivers an appropriate hierarchical relationship for Fire Safety Engineers within the fire brigades.

²² Johnson, Peter; Role of Fire Safety Engineers, interim report; The Warren Centre for Advanced Engineering, Sydney.
²³ MC Hui, Nate Lobel; Professional Accreditation, National Registration, and Regulatory Reform; The Warren Centre for Advanced Engineering, Sydney.
²⁴ Fearnley, Trent; Vocational pathway to becoming Fire Professionals – How did New Zealand do it?; presentation given at AFAC / IFE conference August 2019.

1.3 A NEED FOR GREATER NUMBERS OF FIRE SAFETY ENGINEERS

All of the examples above demonstrate ongoing regulatory reform that will result in a need for more fire engineers across Australia in the coming years. The work of the BMF implementation team, new state legislation, as well as many of the recommendations of this Warren Centre project critically rely on greater numbers of fire engineers educated to degree level and able to be registered as Fire Safety Engineers on either the NER or against stricter criteria in the individual states than what is currently required. The Victorian government, the Tasmanian government, Engineers Australia, numerous consultancies, insurers, regulators, fire brigades across Australia have all made significant financial investment in this. More states, other government bodies and professional bodies are also now invested in this process.

At present, it is unclear how many practitioners exist in the field of Fire Safety Engineering in Australia. The Society for Fire Safety (SFS) has at the moment approximately 400 members in Australia. The Institution of Fire Engineers has approximately 650. Obviously, there is significant overlap in those numbers. However, for the reasons outlined already in this report and elsewhere in this

project, in particular with regards to licensing, certification and accreditation to practice in the different states of Australia, these numbers are nowhere near representative of the number of practitioners in the country. The changed role of fire engineers, in line with the recommendations from the Shergold/Weir report, that has been put forward to the states and territories will likely result in at least 50% more work, meaning that almost overnight numbers will need to increase by several hundred. This changed role combined with the current trends in the market, particularly the new state legislation in NSW and VIC as well as ABCB initiatives to promote performance solutions in the built environment suggest that demand will be much, much higher in the next few years.

It is to these unique circumstances that this report responds, by identifying the resource requirements for tertiary education institutions to support the current profession in addressing skills shortages of current practitioners, whilst providing a sustainable education base from which the profession can continue to grow. The report in doing so also identifies supporting activities required from both professional organisations and from the profession itself.

At present, it is unclear how many practitioners exist in the field of Fire Safety Engineering in Australia.

2. Methodology



Merryweather chemical fire engine, circa 1905.

The objective of this report is to identify the resources that are required from tertiary educational institutions and others to supply an adequate number of graduates in Fire Safety Engineering and to upskill current practitioners to meet the requirements of the proposed professional framework. In achieving these objectives, a number of different potential scenarios are reviewed which represent the different possible entry points to the accreditation process that is described in both the competencies report²⁵ and the accreditation report²⁶ of the Warren Centre project.

The following scenarios represent the possible entry level to first stage accreditation. In subsequent sections additional issues are identified that must be addressed through features or mechanisms to be introduced to

enable this career journey. Each scenario is therefore reflective of a possible entry gateway to the first stage of the professional accreditation framework for recent and future graduates:

- Recent and future graduates
 - Accredited degree in FSE
 - Un-accredited degree in FSE
 - Accredited first degree in engineering
 - Un-accredited first degree in engineering

Individuals with no engineering degree are specifically not included. While it is always possible for non-engineers to enter the profession, these individuals will have to be treated as exceptions and assessed through a rigorous process (Alternative Assessment of FSE qualifications), thus this is not a recommended entry gateway.

²⁵ Lange, David; Torero, Jose; Maluk, Cristian and Hidalgo, Juan: Fire Safety Engineering Competencies Report; The Warren Centre for Advanced Engineering, Sydney.

²⁶ MC Hui, Nate Lobel; Professional Accreditation, National Registration, and Regulatory Reform; The Warren Centre for Advanced Engineering, Sydney.

2. Methodology

For existing practitioners, the following scenarios reflect the likely possible means that would be made available to evidence first stage competencies.

- Existing practitioners
 - Accredited degree in FSE
 - Un-accredited degree in FSE
 - Alternative Assessment of FSE qualifications (a transition period should be defined)

The Alternative Assessment of FSE qualifications route has to be included initially as a potential gateway throughout a transition period because there has to be a recognition that those currently practicing without meeting the requirements of the new professional framework may be able to evidence competency through alternative means. Through the Alternative Assessment of FSE qualifications, current practitioners will be offered the means to demonstrate the new requirements. The Alternative Assessment of FSE qualifications should cease to be a gateway after a suitable transition period, providing a fair time to meet the requirements for those currently practicing. Once this transition period has lapsed, the gateways will be the same as for new graduates, and individuals not fitting these requirements will have to be treated as exceptions and assessed through a rigorous process (Alternative Assessment of FSE qualifications). Thus after the transition period, the gateway should be closed.

In reviewing these different scenarios and identifying the additional resources required to enable these gateways to accreditation, the following constraints are set:

- An accredited engineering degree at least at the bachelor level should be the preferred route to Stage 1 accreditation.
 - Competencies and attributes required for practice must be clearly defined.

- Acknowledgement should be made that many existing practitioners may need to demonstrate first stage competency through alternative means.
 - An assessment procedure therefore must be established for individuals who have not completed an accredited degree. An appropriate means of assessment therefore follows.
- Procedures will be required to recognise relevant supervised professional practice as a contributor to Stage 2 demonstration of competency based on clear and transparent expectations of all practitioners either currently in or entering the profession.
- Upskilling of graduates in related engineering fields to work in FSE should be possible. There is therefore a need for a coherent upskilling program and assessment approach to be agreed by stakeholders to the profession.
- Grandfathering of accreditation, meaning simply accrediting formerly accredited individuals without review, should be excluded. All individuals seeking to practice FSE should be assessed to comply with the agreed competencies for first and second stage accreditation. Procedures to recognise certain international and national FSE degrees need to be implemented if completion of those degrees can be deemed to streamline compliance with Stage 1 requirements (see Section 3.2).
- Current accreditation processes may not be fit for purpose, and consideration should be given to discontinuation.



Fire testing in a controlled laboratory environment.

3. Recent and future graduates

All individuals seeking to practice FSE should be assessed to comply with the agreed competencies for first and second stage accreditation.

3.1 THE GRADUATE ROUTE

The preferred career journey in Fire Safety Engineering from foundation level to a chartered engineering professional is via a process similar to that outlined by the International Engineering Alliance (IEA), comprising a two-stage accreditation process of an individual that permits them to professional practice. The first stage comprises the education component, and the second stage comprises experience gained over a period of supervised professional practice. Successful completion of both stages is required to ensure that a candidate for professional registration has the required competencies to perform in the role of a fire engineer (ideally as defined in the Roles Report²⁷) with a high degree of efficacy in regard to the expectations of that role.

This first stage accreditation should be achieved through the completion of a degree that is accredited by one of the signatories of the Washington Accord as satisfying the education requirements for practice. The competencies that are expected of a degree exit level graduate from such a degree are described in detail in the Competencies Report.²⁸ Such an educational program should be expected to last for between three and

five years, depending on the jurisdiction and will typically result in either a bachelor's or a master's degree. In Australia the expected period of university study is not likely to be less than four years in order to demonstrate that a graduate possesses the required competence for this first stage.

For this first stage to be successful, there needs to be a sufficient mass of education institutions delivering the required education. This is especially true in Australia where out of state study is relatively uncommon, meaning that students tend to self-limit to the programs and courses available in their home states. Currently there is an accredited integrated master's program in Civil and Fire Safety Engineering available in Queensland. However a critical mass of educational establishments in Australia requires further programs of the required standard to be developed in other states, with a possible initial focus on Victoria and New South Wales (simply because of the population sizes of these states, which is likely to maximise the impact of new programs there), followed by South Australia and Western Australia and the other states and territories.

²⁷ Johnson, Peter; Role of Fire Safety Engineers; The Warren Centre for Advanced Engineering, Sydney.

²⁸ Lange, David; Torero, Jose; Maluk, Cristian and Hidalgo, Juan: Fire Safety Engineering Competencies Report; The Warren Centre for Advanced Engineering, Sydney.

The development of a program in Fire Safety Engineering is a very significant challenge.

Several routes to achieving the required mass of education programs exist. These include the development of individual programs run by one or more of the universities, or alternatively the development of joint or co-operative degree programs which effectively pool the available resources within Australia to deliver the required course content at minimum initial investment from the universities.

The development of a program in Fire Safety Engineering is a very significant challenge. First, any educational program needs to be structured not only around some specific curricular requirements, but it also needs to be implemented using a pedagogy that is suitable to deliver the necessary attributes and competencies for a graduate. While in other disciplines, this is a matter of extensive study and there are many academic institutions delivering such programs, this is not the case

in Fire Safety Engineering. Many universities have as a desirable trait of their faculty that they be chartered or able to become chartered by the national professional bodies. However as opposed to other engineering disciplines, where educators are often a product of other accredited programs, educators in FSE are mostly a product of other disciplines and migrate, through experiential learning, into FSE. This is a much longer process, thus the offer of FSE educators of the required competence level is limited.

The development of new programs will therefore require a careful assessment of the degree proposal but also of those delivering the education. This needs to capitalise on existing experiences, and therefore the process of development should include supervision from professional leaders and educators experienced in Fire Safety Engineering.

Fire safety research has over a century of effort, but new hazards still emerge.



The Adelaide Oval is an example of the use of Performance-Based Engineering.

It is essential also to recognise that these programs will be hosted by universities. Therefore the programs need to be attractive according to university metrics. It is the role of government and the profession to make sure that the means are made available to encourage universities to agree to deliver such programs. Most importantly, the viability of these programs should not be predicated on the basis of student numbers because this inevitably will erode quality. Necessary subsidies need to be implemented, in particular in the short term, to guarantee that, independent of student numbers, the programs remain attractive to universities.

It is therefore important to recognise that the development of joint programs might be the only means to deliver graduates in sufficient quantities.

The second stage of the process is the supervised period of professional practice typically lasting for several years before peer assessment by a professional body. This peer assessment again compares the competencies of an individual against the expected competencies of a profession before admission to the profession.

This second stage importantly requires industry to be able to support the initial professional development of degree exit level graduates through experience supervised by accredited professionals. As noted in the introductory sections to this report, the fire engineering industry in Australia is relatively small. There is evidence that there are a good number of consultancy firms nationally who do not have the numbers of intermediate or senior level staff to be able to fulfill this

supporting role for new recruits. Clearly this creates a bottleneck in the industry's ability to grow in the short term. However, a focus on retaining engineers and renewed attention to FSE career development in the local market should lead to an increase in numbers of intermediate fire engineers, and then to sustained growth in the industry in Australia. This will not happen overnight, and it is clear that growth in the fire engineering programs in Australia needs to be organic and able to respond to the short, medium- and long-term requirements of industry. Growth in industry will be enabled by the delivery of graduates to the market, and demand for graduates will grow as the industry develops the ability to supervise graduates adequately. Sustainable, organic growth is key.

In addition to the supervised period of professional practice, the completion of this second stage also requires a professional review of those professional competencies attained. This professional review requires a clear, consistent and transparent statement of the expectations of an individual before admission to practice through professional accreditation. A proposal for a process to certify these second stage competencies was given in the competencies report. It is important to reiterate that this process needs to emerge from an industry consensus. Once the process is established, the assessment of these for a specific discipline should be done by a professional organisation which represents the interests of the engineering profession nationally and is likely to be recognised by state and territory governments as an appropriate "assessment body" when it comes to assessment of competency and monitoring of CPD. In Australia nationally this would be Engineers Australia. However in the individual states, the RPEQ scheme

administered by the BPEQ in Queensland is a notable alternative which is likely to be similar to pending schemes in both Victoria and in New South Wales as a result of recent legislation.^{29,30}

For admission of an individual to practice, any assessor must be competent in the field of practice in order to make a suitable judgement on the competency of the individual being assessed. This places a need for competency on the assessor which means that, for example, Engineers Australia may need to defer to a third-party professional body of fire engineers (which could be the body of professional FSEs within the EA Society of Fire Safety, although this would require broad consultation and acceptance from the Fire Safety Engineering community), or appoint practicing fire engineers to oversee the process of professional accreditation at this stage. This requires a sufficient group of fire engineers to assume authority over the profession.

It is important to recognise that the current delegations might not be suitable for the framework proposed here. Therefore, a detailed revision of current processes is necessary and should be conducted in an unbiased manner. To achieve such unbiased reform, it will be necessary to establish a high standard international review of the existing second stage professional review framework. It is important to note that this is no different to the typical quality review processes undergone by any university department every 5 to 7 years. Such a review should be a matter of standard approach, not an exceptional one.

²⁹ Professional Engineers Registration Act 2019 (VIC).

³⁰ Design and Building Practitioners Bill 2019 (NSW), Second Print.

There needs to be a special alternative route to professional practice in Australia that admits individuals with a high quality degree that is not from a Washington Accord signatory country.

3.2 THE INTERNATIONAL GRADUATE ROUTE

The career journey described in the preceding section applies to engineers seeking admission to professional practice who have completed a Fire Safety Engineering degree accredited by one of the Washington Accord signatory bodies. It therefore could apply to graduates of an accredited degree program in Australia or from many other countries, including: Canada, China, Hong Kong, India, Ireland, Japan, Korea, Malaysia, New Zealand, Pakistan, Peru, Philippines, Russia, Singapore, South Africa, Sri Lanka, Taiwan, Turkey, the United Kingdom and the United States.

However, there are several very highly regarded fire engineering programs taught at universities that are not located in one of these countries. Notable examples include the bachelor's and master's programs at Lund University in Sweden, the master's program at the University of Ghent in Belgium, and the IMFSE program. The intention with setting the required level of competence for first stage accreditation at the level of competence expected of a Washington Accord degree

graduate is to improve mobility, not to restrict it. Bearing in mind the resourcing constraints of the fire engineering market in Australia, there needs to be a route to professional practice in Australia that admits individuals with a high-quality degree that is not from a Washington Accord signatory country.

The process can consider two options. One is to recognise certain degree programs for their quality and structure equivalence to Washington Accord signatory institutions. Being that the number of programs very limited, this is a natural and simple process. It is clear that there is no reason not to do so, thus a number of programs could be recognised as producing the same quality of graduate as Washington Accord programs, although they are not part of this group. In such instances, where the program is accredited according to one of the other international engineering education accreditation accords then the checks and reviews that form a part of that accreditation process may be taken in lieu of the accreditation process of the Washington Accord, if appropriate.

The second option is to establish a competency assessment. This is a much more complex process that should be maintained to a minimum. The global diversity of higher education programs is such that the focus should be on the individual's competencies and attributes and not on the program. For this to happen there needs to be a competency assessment carried out of the individual seeking first stage accreditation. This process, as with the second stage assessment described above, requires a clear, consistent and transparent statement of the expectations of an individual before admission to practice. These competencies are the same as those required of the degree exit level graduate described above. However, rather than demonstrating possession of these competencies through the completion of the accredited degree program, there should be an assessment of the individual's experience carried out by the professional body administering the profession. This alternative route to first stage accreditation must take the form of a review of the competence of the individual seeking this recognition. Once more, this places a burden of competence on the administering organisation issuing professional accreditation to practice.

Whatever route is followed, the expected level of competency must be the same.

3.3 FIRST DEGREE IN ENGINEERING

For many people starting out on their career in fire safety, it is acknowledged that the current environment admits individuals with no experience in the field or with no first degree in Fire Safety Engineering.

If the first degree is in engineering, then many of the basic elements of competency are expected to be satisfied by this, such as the professional or personal attributes as well as the engineering fundamentals. In such a case, one possibility is to enable these individuals to continue on their career journey through a master's degree in Fire Safety Engineering or the use of a summation of equivalent micro-credentials. Such micro-credentialing may enable individuals to fill gaps in their specialised fire safety engineering competence. If acknowledged by Engineers Australia, then the master's degree or the micro-credentials could also be taken as evidence of satisfying specific elements of competency for Fire Safety Engineering. If such qualified further study is combined with the accredited first degree, then this should directly satisfy the



Barwon Water's headquarters in Geelong used Performance-Based Engineering to retrofit an existing building.

Stage 1 accreditation. Then the candidate would enter the supervised period of professional practice and be eligible for Stage 2 accreditation as described in the process above. This process could be streamlined by means of a set of pre-approved framework of micro-credentials, but it will always have to be subject to a careful review of the individual's complete educational background.

However, great caution needs to be taken if the process described in the preceding paragraph is used. The education of a Fire Safety Engineer requires an understanding of the design process that is unique to Fire Safety Engineering. Different disciplines will

look at design in different ways. Fire Safety Engineers approach design in a manner akin to architecture and closer to civil engineering than to any other engineering discipline. As such, design attributes have to be considered an essential component of Stage 1 accreditation. Micro-credentials are very effective for delivering knowledge-based competencies but need to be very carefully tailored for attributes such as design proficiency.

If this is not combined with a first accredited degree, then there is no alternative but to carry out the first stage competency assessment of the individual.

3.4 NO FIRST DEGREE IN ENGINEERING

Where the first degree is not in engineering, then it is unlikely that micro-credentialing would be an effective way of upskilling an individual to the level of competence required for first stage accreditation. While the option of accrediting someone with no engineering first degree needs to remain open, in such cases completion of an undergraduate engineering degree should be considered to be the most effective way of upskilling.

While it cannot be argued that candidates seeking entry to the profession from non-engineering backgrounds would have no relevant knowledge-based competencies required, it is extremely unlikely that such an education will include any aspects of design

of relevance for Fire Safety Engineering. For example, the sciences including chemistry and physics will have some relevant technical competencies. The fire brigades and construction management will have relevant competencies. Alternatively, while a background in architecture may satisfy the design expertise, it is likely that someone approaching the profession from this direction will lack in the discipline specific knowledge.

Thus, any alternative path of demonstrating attributes and competencies needs to be conducted through an extremely rigorous assessment process that resembles the quality controls of an engineering undergraduate degree.

4. Existing practitioners

Existing practitioners, defined as those individuals who are practicing today but who have not undergone a process similar to that described above to satisfy the elements of competency, must also be incorporated into the new accreditation framework. The unique characteristics of Fire Safety Engineering as a profession mean that these may require further mechanisms to be put in place to enable accreditation to the appropriate level.

Given that stage one set the basic knowledge and competencies necessary to engage with Stage 2, it is most important to focus at this stage on stage one competencies. Therefore, this section focusses on the first stage of competency. If evidence of this can be provided, then the second stage of the accreditation process follows that described in the previous section.

There are two scenarios: one where a currently practicing individual does possess the required competence for first stage accreditation and

one where a currently practicing individual does not. “Grandfathering” of accreditation should not be permitted, and sanction to practice can only be granted without review where evidence exists that any former accreditation is substantially equivalent to evidence required for the accreditation process outlined previously.

In such instances where an individual is being assessed for accreditation then this should be done based on one of the following:

- Where the individual has completed a Washington Accord accredited degree, or a substantially equivalent degree, then the process for accreditation should follow that described in Section 3.1 or 3.2.
- Assessment of alternative evidence of competency, for example through an assessment of reports and career episodes which demonstrate the specific competencies expected for first stage accreditation, or through examination.



Civil engineering students at the University of Sydney.

“Grandfathering” of accreditation should not be permitted, and sanction to practice can only be granted without review where evidence exists that any former accreditation is substantially equivalent to evidence required for the accreditation process outlined previously.

All of the above, with the exception of the Washington Accord accredited degree, require an agreement from the profession and the assessment body that represents the interests of the profession, such as Engineers Australia, as to what form the assessment should take, who will set the assessment requirements, who will administer the assessment and in particular who will be the reviewers.

Where an individual does not have the ability to demonstrate possession of the competencies required for Stage 1, then there must be a transition period during which time the individual is afforded the opportunity to upskill to develop these competencies. While the assessment report should clearly indicate the elements that need upskilling, guidance and the means to acquire the necessary competencies must also be made available.

It is important to note that the development of the required upskilling programs will require a significant investment in educational activities. This is unavoidable because it is not fair to those currently practicing to redefine the accreditation demands without offering the possible means to achieve the new requirements.

This could be done through the micro-credentialing route described above including master's degrees (so long as these could be evidenced as meeting the needs of industry)

which may be partially credited for Stage 1 accreditation in conjunction with other evidence of competence. The completion of an accredited Fire Safety Engineering degree program might be necessary and is the obvious path towards fulfilling Stage 1 accreditation.

In case the individual is not able or willing to upskill over the period of time allotted to them, then their field of practice should be limited based on the level of competence that they have achieved. For instance, this may reflect the role of engineering technician or incorporated engineer as opposed to chartered engineer.



5. Discussion and recommendations

5.1 EDUCATIONAL RESOURCES

Based on the above analysis of routes to accreditation, the following recommendations are made, targeted to degree granting institutions in Australia:

- Firstly, that a program of micro-credentialing is explored to address gaps in competency in the Fire Safety Engineering industry today.
- Secondly, that an industry oriented master's program is developed which allows the upskilling of current engineers to handle specific topics related to the science and practice of Fire Safety Engineering.
- Thirdly, that a co-operative teaching model is explored that draws on the capabilities of universities in Australia that have an interest in Fire Safety Engineering to develop a nationally accessible, homogeneous and representative Fire Safety Engineering educational model. This educational model includes the attributes that those delivering the program must have.
- Fourthly, that universities in Australia develop, alongside the co-operative teaching model, sustainable individual programs in Fire Safety Engineering. These could be run alongside, or independent of, the national program. Nevertheless they have to fulfill the same objectives and deliver the same quality.
- Fifthly, that universities developing these programs, industry and government engage in a collaboration that determines the funding needs of the associated educational, research and outreach activities that make these programs attractive to the host universities independent of the number of students enrolled.

Fire Safety Engineering seminar in February 2019 at the University of Sydney Business School.



In every case, the courses should be designed to meet the competencies for individuals as set out in the Warren Centre "Competencies Report" which have been agreed with Engineers Australia, and the courses themselves should be accredited by Engineers Australia.

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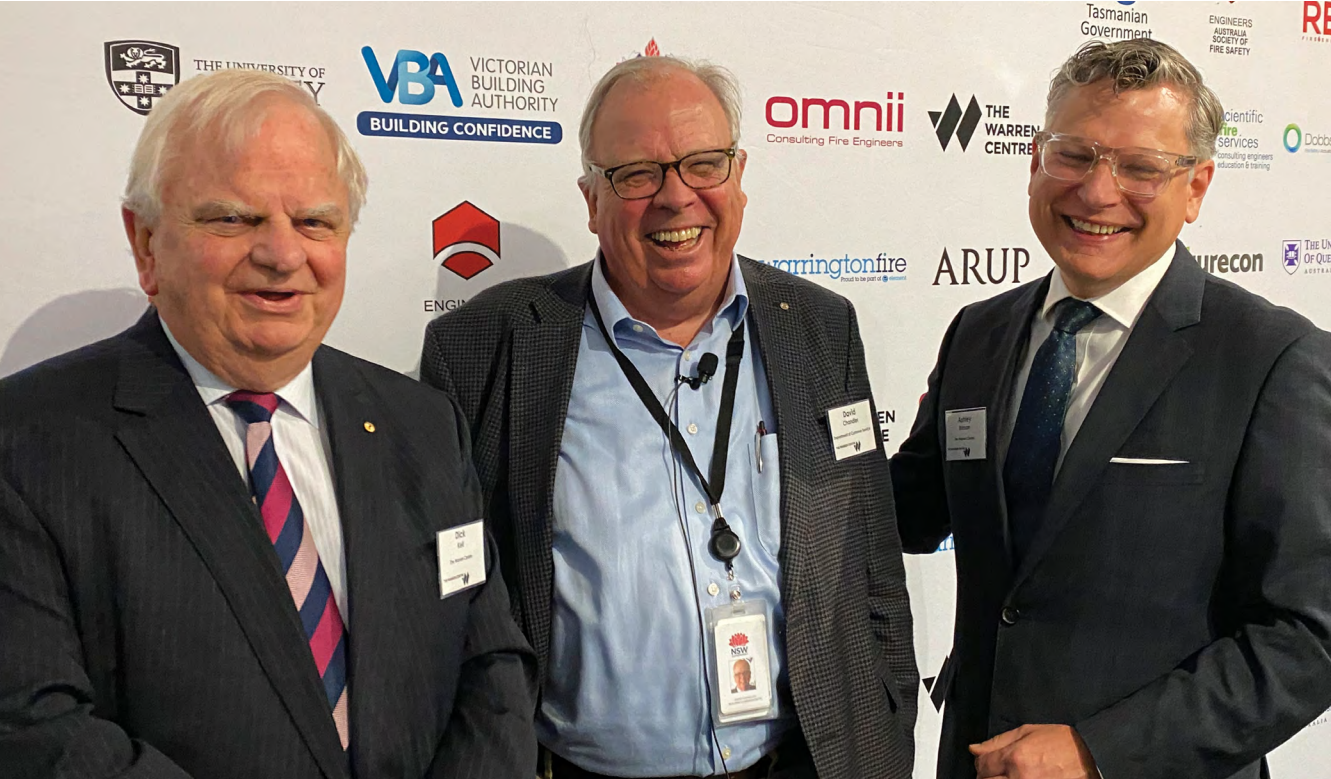
These five recommendations above can be grouped into different activities which must take place in the short, medium and longer term, representing the ease and speed of implementation as well as the period it is expected before the recommendations begin to achieve their intended objectives. The recommendations are discussed in further detail below, grouped according to whether the goals are achieved in the short, medium or longer term.

5.1.1 SHORT-TERM ACTIONS

Micro-credentialing

Micro-credentials are directed at current practitioners or people wishing to enter the industry in the short term and who can demonstrate many of the required competencies through past study or a significant time spent in practice. This ideally would be a temporary / stop gap measure to enable existing practitioners who need to, to upskill in order to maintain currency in the professional environment. Also, micro-credentials could address near term shortages in graduates entering the market. As such, this could be up and running possibly within 6 months but ideally continuing for no more than 4 to 5 years.

The development of these programs would require a gap analysis of capacity / competence in industry to identify courses required for development. This should be done by education providers in collaboration with industry.



L-R Warren Centre Chair Richard Kell, NSW Building Commissioner David Chandler, and TWC Executive Director Ashley Brinson at the 2020 FSE Seminar.

Accreditation of these micro-credentials would require specific discussions with Engineers Australia and could possibly be fast tracked if they relied on content from otherwise accredited programs; otherwise the courses would need to run two or three times over a course of 12 to 24 months before accreditation could be considered.

In terms of cost to implement, this is difficult to estimate but most likely it will be higher than a traditional higher education program. Higher education programs are accompanied by research and outreach activities that defray the cost of those delivering the programs. This is not possible if micro-credentialing is developed as an independent offering. The only means to reduce costs is by developing these micro-credentials on the basis of current course offerings. Costing to students would depend on the structure under which this was delivered.

Master’s program development

Master’s programs could be developed based on consultation with industry to identify the required content of an industry focussed program.

These programs would be directed at existing practitioners, possibly with a first degree in Engineering and who have significant experience and a solid grasp of the fundamentals in Fire Safety Engineering; or at students wishing to graduate with an ME instead of a BE, and possibly wishing to move into PhD research.

These could be accredited as satisfying some of the competency requirements related to Fire Safety Engineering that cannot be obtained from other engineering degrees, e.g. skill in application of the body of knowledge that underpins Fire Safety Engineering; skill in research methods and application of those to

develop new and novel solutions to complex problems in the built environment. For this to work it would need to comprise a number of optional modules.

One possibility to ensure that appropriate amount of credit is gained would be to partner with companies to recognise, through reflection, time spent in practice in lieu of general level 6 or 7 engineering electives.

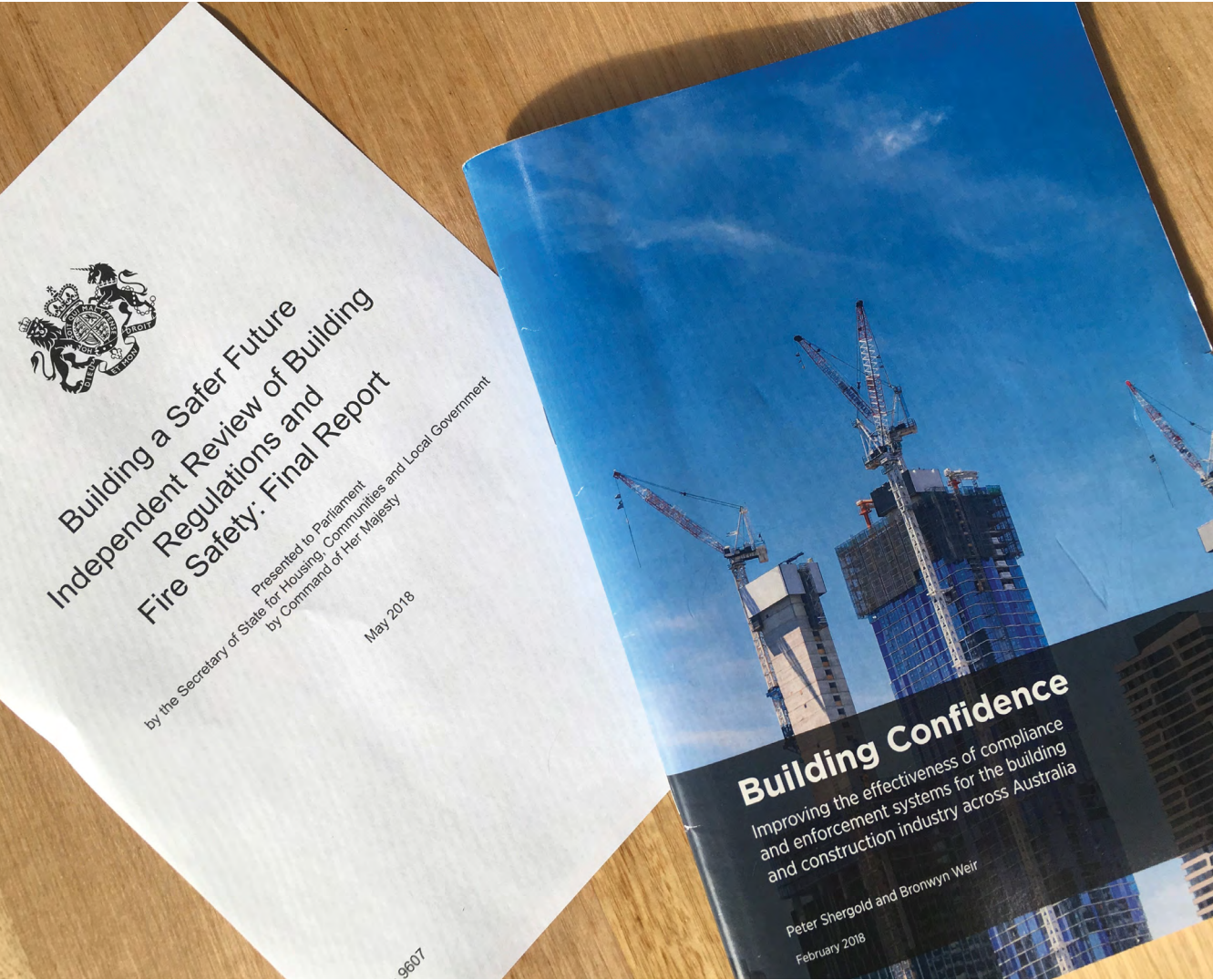
The program should comprise short courses with focussed learning, ideally delivered in a manner that suited industry – either through online learning or through intensive multiple day sessions and with a significant amount of home study, or some combination of the two.

The program could take advantage of some of the courses / modules developed as part of the micro-credentialing option described above.

This could be an evolving program with modules developed that address specialist knowledge in greater depth than is possible for undergraduate programs, e.g. numerical methods in Fire Safety Engineering, laboratory classes and the application of laboratory techniques to advanced problems, evacuation and human behaviour. Alternatively, it could include modules developed based on current research that address specific issues such as combustible cladding or timber buildings.

This program should be a one year master’s with options to study part time.

This initiative is likely to require 12 to 18 months to gain approvals from university administrations, develop course content and begin to admit students. A minimum of 36 months after first intake for a one-year program would be expected before any program could gain partial accreditation. The timeline will require discussions with Engineers Australia.



In terms of costing, this would be clearly the most expensive option because it requires a long-term commitment from universities while having limited access to the leverage associated to research and outreach activities. It is not appropriate to define the cost on the basis of existing master's programs in Australia, which today are all structured around a framework of a minimum number of students making the program viable. Furthermore, most master's programs in Australia are spin-off of more comprehensive activities that include research and outreach. The cost to students would be the same as any other master's program and will always be based on well-established university fee structures.

5.1.2 MEDIUM-TERM ACTIONS

Medium- and long-term actions need to be seen in the context of generating an activity that leverages educational needs with research and outreach. It is by leveraging all three aspects that universities are inclined to initiate such programs. Thus, when discussing these types of initiatives, it is important to think not only of the educational activity but also of those who are delivering the program.

The expectation of a university is that their members of academic staff will be active in externally funded research, that they will contribute in a positive manner to educational activities and that they will engage with their stakeholders in outreach activities.

Educational aspects are thus seen as a component of an academic's activity. When this component is associated to traditional disciplines, the contributions are associated to the specific components of the delivery. For example, if an academic is appointed to the Civil Engineering program, this individual might be expected to teach statics or structural design. The degree program, i.e. Civil Engineering, is financially viable given the number of students enrolled and the partial coverage of the academic's salary via research and outreach activities. For traditional disciplines this assessment is not explicit because of the reputational damage that eliminating such a program might bring to the institution. Nevertheless, department's finances are regularly reviewed by universities.

For a new activity the financial assessment is much more explicit because a business plan has to demonstrate the financial viability of the activity. If the financial viability is predicated on student numbers, then demand needs to be demonstrated, attained and maintained. Unless the demand is extremely high, this financial viability model leads inevitably to a drop-in standards to attract more students. If the financial viability is supported by research and outreach, then it is much easier to give sustainability to a program and to maintain standards.

A co-operative teaching model, drawing on specific expertise from universities in different states serves to minimise the cost of delivery, to capitalise on expertise and existing activities, and thus deliver the necessary educational programs at a smaller expense. Nevertheless, it still needs to be framed under the premise of an overall teaching, research and outreach proposition.

This model could also rely on input from accredited programs, with possible restrictions on the degree awarding institution, certainly in the short term, if accreditation is a requirement.

Possible routes to implementation include:

1. Course completion including assessment at various universities, building credits towards a degree
2. Teaching being delivered by various partner institutions, with assessment being made carried out by the degree granting institution.

Possible barriers to this include recognition of credit from different universities as well as potential funding issues. Funding issues could be resolved if courses are delivered in their entirety by a single institution. However, this may put undue burden on students to travel between states if learning activities cannot be completed remotely or in bulk delivery mode.

This process will be addressing the core problem in Fire Safety Engineering, ultimately delivering a robust and effective professional practice.

Therefore, remote learning should be explored as far as is possible, without sacrificing the quality or extent of the graduate attributes.

Recognition of credit requires review of course content, delivery and assessment practices and agreement between universities. It is likely that this will be easier where the universities delivering a co-operative teaching program are similarly ranked nationally and internationally.

This initiative is likely to take a minimum of 6 to 12 months to implement and to start to advertise to potential undergraduates. This is the case only if there can be minimal impact on existing programs and courses throughout the institutions involved. Ideally, accreditation would be maintained based on current accreditation of a single degree granting institution, but this must be explored with Engineers Australia. However, if this was not possible then it is likely that accreditation could not be sought for a minimum of six years after the first-year student intake, assuming a four year BE degree.

In terms of cost, this will require a significant initial investment in set-up and will be most likely higher than existing programs because the research and outreach leverage would have to be put in place in advance to make these programs attractive to universities. However, if it took advantage of existing teaching activities then the set-up costs could be reduced and running costs would not be any more than for the existing courses / programs. An indicative cost to students is approximately AU\$45k per annum for a four-year degree, depending on study support, etc.

5.1.3-LONG TERM ACTIONS

The co-operative teaching model discussed above is a means to take advantage of the teaching capacities, capabilities and infrastructure of the various universities

with an interest in Fire Safety Engineering throughout Australia. It would enable, in the medium-term sustainable growth in the numbers of Fire Safety Engineers throughout the country as well as those capable of taking academic positions in other universities to deliver such programs. This will address the need to accommodate students in Australia who tend to not study interstate.

Once financial support, stakeholder engagement and demand are evidenced, then it will be attractive for universities in Australia to develop and offer Fire Safety Engineering programs based on a timetable of sustainable investment. These may include for example additional BE / ME degree level programs in Fire Safety Engineering.

The demand for this is likely to be evidenced by graduate recruitment from the co-operative teaching program within 6 to 10 years of its initiation. There would then be a period of up to 6 years from first student enrolment in a new program before accreditation could be sought for any new program.

It is entirely possible that any new program would complement a co-operative teaching model in Fire Safety Engineering, allowing individual universities to deliver and grant degrees in Fire Safety Engineering, taking advantage of this co-operative teaching model proposed above.

It is not for this research or report to set out in detail course structures or curricula for Fire Safety Engineering as the basis for professional accreditation. That should be left to the professional university educators.

However, there are some essential elements of professional practice by Fire Safety Engineers which can help inform this education process. Australia needs a steady stream of FSE graduates who can help design buildings and infrastructure as a priority. That is not to forget

that FSEs may also be needed for industrial plant, oil and gas facilities, mining, insurance and other fields. In the case of buildings, FSEs have often simply played the role of analysts and not contributed creatively or substantially to building design and the fire safety strategy and fire safety design in particular.

Another issue recognised in the earlier Warren Centre 'Education Report' is that Australia has FSEs who are "generalists", as well as some "specialists". This latter group might specialise in human behaviour of fire and evacuation modelling, fire performance of structures, material fire behaviour, or fire and smoke modelling. However, most FSEs practicing in Australia are generalists, and if they are to contribute truly to creative design of buildings and infrastructure and develop comprehensive fire safety strategies as full and proper engineering professionals, they

need to have the requisite competencies built around knowledge, skills and attributes in a range of subjects that comprise the various curricula in Fire Safety Engineering that have been proposed elsewhere.^{31,32,33}

However, given the needs of practicing FSEs, the degree programs need to consider how best to teach this material with a pedagogy and a structure which emphasises problem solving and creative design as opposed to simple transfer of knowledge, helping to generate competencies of a true professional engineer. All of this suggests that development of any FSE courses needs very special attention to be given to the ultimate competencies required of FSEs, the practice needs of design professionals, and the pedagogy needed to ensure that graduates can make a full and proper contribution to creative building and infrastructure design.



Fire & Rescue NSW.

³¹ Magnusson, S.E.; Drysdale, D.D.; Fitzgerald, R.W.; Mowrer, F.; Qunitiere, J.; Williamson, R.B.; Zalosh, R.G.; A proposal for a model curriculum in fire safety engineering; Fire Safety Journal Volume 25, Issue 1, July 1995, Pages 1-88
³² Society of Fire Protection Engineers (2010) Recommendations for a Model Curriculum for a BS Degree in Fire Protection Engineering (FPE)
Society of Fire Protection Engineers (2013) Recommended Curriculum Content for an MS/ME in Fire Protection Engineering
³³ M. Woodrow, L. Bisby, J.L. Torero; A nascent educational framework for fire safety engineering; <https://doi.org/10.1016/j.firesaf.2013.02.004>

5.2 ACCREDITATION AND LICENSING

In addition to this, specific considerations need to be put in place for the accreditation process. These, although highlighted in this report, are discussed in more detail and recommendations made in the Accreditation Report.³⁴ In summary, these processes must consider the following:

- Complete agreement from industry and governments that Fire Safety Engineering design should only be undertaken by accredited (registered) professional Fire Safety Engineers and that accreditation/registration should be based on completion of educational programs which themselves are accredited by professional assessment bodies such as EA.
- Professional review should be undertaken by somebody with knowledge of the competencies required for Fire Safety Engineering and the field of Fire Safety Engineering.
- For review of professional practice, the objectives and structure for the period of supervised professional practice must be set, the required or expected duration must be agreed and there must be a critical mass of the profession to support this second stage of accreditation. This demands a strong growth in education of Fire Safety Engineers.
- There needs to be agreed assessment methods and criteria for
 - Evidence based assessment of existing practitioners; and
 - Alternative assessment of existing practitioners, e.g. exam.

5.3 OUTREACH

Finally, EA through the Society for Fire Safety and the Institution of Fire Engineers (IFE) as well as the Fire Protection Association (FPA), Australia and the National Council for Fire and Emergency Services (AFAC), should create an outreach program working on behalf of the profession, with representatives in the different states and territories. The objective would be to promote Fire Safety Engineering within schools and communities as a career. Information, including salary ranges and career opportunities, as well as project showcases to inspire career development, could be collected and used to create material for presentation to potential students about to embark on their engineering education, including testimonies from graduate, intermediate and experienced Fire Safety Engineers highlighting their career journeys and the benefits as they see them.

State representatives would manage visits to local schools and universities. Ultimately, this should come from the SFS, IFE, FPA Australia and AFAC to avoid over representation by any one company.

5.4 AN INDUSTRY LED RESPONSE

What is clear from all of these recommendations is that significant investment is required in the development of the profession from its current state to respond to the current situation in which it finds itself and to adequately support the new legislation in VIC and NSW in particular. Fire Safety has a history of responding to external drivers through the evolution of codes and standards without addressing the skills and competences of those individuals who are charged with implementing these codes and standards. The balance of achieving fire safety is therefore tilted in favour of technical regulation. The current situation in Australia, as well as the other recommendations in the Warren Centre project, result in the need to reassert the importance of the professional exercising the responsibility of providing a fire safe environment in which the public should live and work.

The benefit of this re-balancing process to both practitioners and to the public is clear. Currently Australia is faced with a huge bill to both the public and private sectors as a result of inadequate fire safety consideration being given to facades. More competent professionals will reduce the cost of this remediation, as evidenced by the approach of Queensland. Looking forward, more competent professionals with an ability to identify the issues posed by changes to the materials and techniques used in the built environment will limit the potential future

risk as developments in construction and materials move further away from the limits of applicability and suitability of existing codes and standards. The risk posed by fire to the building stock of tomorrow will be limited. Competent, ethical and responsible practise leads to optimised, creative and effective solutions; thus, the long-term benefit of professionalising Fire Safety Engineering will be an increase in quality with a substantial reduction in the cost of fire safety.

This can only, however, be achieved by creating a framework that makes Fire Safety Engineering education provision attractive to universities. This needs broad financial support and leadership from the profession as well as from the states and territories who are implementing their new legislation. Implementation of these recommendations without this support will lead Fire Safety Engineering along the same path that it has been on for the past two and a half decades, and the benefits extolled elsewhere in this report and project will not be realised. The impact of this on the profession will be devastating.

Industry and governments must therefore grasp the very real opportunity presented for change here and provide financial support to universities to develop the capacity to deliver professionals to market and to grow this engineering discipline sustainably.

³⁴ Kip S., Wyn-Jones M., Johnson P. (2019) The State of FSE Regulation, Control and Accreditation in Australia; The Warren Centre for advanced engineering, Sydney

6. Conclusions



Civil engineering fluids laboratory test at University of Sydney.

THIS REPORT HAS OUTLINED RESOURCES AND ADDITIONAL PROVISIONS THAT MUST BE PUT IN PLACE TO ADDRESS THE SHORT, MEDIUM- AND LONG-TERM SKILLS AND GRADUATE SHORTAGES IN THE OCCUPATION OF FIRE SAFETY ENGINEERING IN AUSTRALIA AS IT TRANSITIONS TO A FULL AND PROPER PROFESSION. THE REPORT RESPONDS TO THE UNIQUE SET OF CIRCUMSTANCES THAT FIRE SAFETY ENGINEERING FINDS ITSELF IN TODAY, AND IT BUILDS ON EARLIER WORK CARRIED OUT AS PART OF THIS WARREN CENTRE PROJECT.

In summary, the recommendations can be split into three broad categories: firstly, those targeted at tertiary education providers with an aim to develop capacity to both upskill current practitioners and to deliver degree exit level graduates with the required competencies for first stage accreditation; secondly, those targeted towards accreditation and licensing which must be developed in collaboration with

those tertiary education providers; and finally those targeted towards outreach activities in support of growing the profession.

RECOMMENDATIONS TARGETED TOWARDS TERTIARY EDUCATION PROVIDERS MAY BE BROADLY SUMMARISED AS FOLLOWS, ACCORDING TO THE ACTIVITY, TIME TO IMPLEMENTATION, TENTATIVE TIME TO ACCREDITATION, ETC.:

ACTIVITY	TIME TO IMPLEMENTATION	TIME TO FIRST GRADUATES	TENTATIVE TIME TO ACCREDITATION	COMMENT
MICRO-CREDENTIALING	6 months	12 months	12 to 24 months	Short term solution to address current shortfalls in the profession.
MASTER'S PROGRAM	12 months	24 months	48 months	Targeted towards the profession. Timelines are based on an assumption of a 1-year degree.
CO-OPERATIVE TEACHING PROGRAM	12 months	56 months	0 months to 70 months	Time to accreditation depends on program and degree granting institution. Timelines based on a 4-year BE.
ADDITIONAL PROGRAMS IN FIRE SAFETY ENGINEERING	> 12 months	> 56 months	> 70 months	These could be implemented at the same speed as any co-operative teaching program, however sustainable development could be undertaken over a period of time. Timelines based on a 4-year BE.

Recommendations targeted towards accreditation and licensing procedures essentially comprise the development of standards with regards to expectations from the period of supervised professional practice before second stage accreditation. These recommendations should be actioned in the short term since they have a direct influence on the effective transition of current practitioners towards the profession as defined in this project. They also have an impact on the career journey of future degree exit level graduates.

Recommendations concerning outreach activities which should be undertaken by the profession should be actioned in the short term, since this will result in an increased interest in Fire Safety Engineering by students embarking on their studies now, the full effects of which will only be felt by the profession in five or six years.

Finally, support of these required changes is discussed. It is advocated that financial support must be given by industry and government to the universities to develop the resources



Cross Laminated Timber (CLT) fire test at UQ.

6. Conclusions

to develop the capacity to deliver graduate Fire Safety Engineers to market in Australia, addressing the current and future resourcing needs of the profession. This initiative must be industry led and must be implemented in such a way that the importance of the professional over technical regulation, codes and standards is reinforced.

While five or six years appears as a long period of time, this is a process that will set Australia in a path of improvement immediately. Furthermore, this process will be addressing the core problem in Fire Safety Engineering, ultimately delivering a robust and effective professional practice. Australia should not wait another thirty years to complete the process that started with the first Warren Centre report in 1989.

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