

artibus INNOVATION

Developing industry skills

Building Information Modelling (BIM) Awareness Project
CONSTRUCTION PLUMBING SERVICES TRAINING PACKAGE

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BIM Awareness Project

CPC Industry Overview



The Project

This project will develop a skill set in Building Information Modelling (BIM) awareness for the Construction, Plumbing and Services (CPC) Training Package. BIM is an emerging technology within the built environment and will be a requirement across many occupations in the construction and property industries. A skill set in BIM awareness is an essential component of the CPC training package. Other training packages that cover occupations across the built environment will be able to import this skill set to use as upskilling or continuous professional development.

Summary of Project Components

One new skill set will be developed:

- Introduction to Building Information Modelling comprising the development of up to 3 new units of competency.

Timeline and Key Dates

Details	Date
Expected approval by AISC of proposed work	March 2019
Project kick-off	July 2019
Establish Technical Advisory Group (TAG)	August 2019
Initial project consultation	August – September 2019
Review feedback and update Draft Pack 1 accordingly, as per TAG advice	October 2019
Training package components put forward for consultation (Draft pack 2)	November 2019
Review feedback and update Draft Pack 2 accordingly, as per TAG advice	December 2019
Training package components put forward for validation	January 2020
Finalisation and Quality Assurance	March 2020
Training package components sent to STAs for sign-off	April 2020
Training package components submitted for endorsement	May 2020

Industry Description

The construction industry is a multi-sector industry.

The primary activities in the industry are:

- Building contracts
- Building construction
- Building surveying and compliance
- Building project management
- Site management
- Contract trades
- Contract labour
- Building completion

What is BIM?

Building Information Modelling (BIM) is the digital representation of a building, which includes all information on the building throughout its whole lifecycle, including:

- design
- building/construction
- facilities management
- repair and maintenance, and
- demolition.

BIM allows professionals across the built environment – from construction to property management and maintenance – to access and share construction and operational information about a building.¹

BIM has been shown to have major demonstrable benefits for the built environment and construction industry, chiefly at the operational and design stages. Benefits include:

- better control and predictability over costs and capacity to deliver lifecycle values in the built environment
- reliable predictions of the building's sustainability rating
- early assessment of potential issues and design errors
- tracking of construction activities and site safety planning
- better communication between project owners, designers, subcontractors and workers on site,² and
- improved building record creation, collection, storage and sharing.³



Occupations

BIM is predicted to impact all occupations across the built environment, including technical, managerial and strategic roles in the construction industry. BIM awareness is expected to become an integral competency required of existing construction industry occupations, as well as creating BIM-specific occupations. An example of the latter is the new occupation of BIM Manager. This managerial role, still relatively uncommon in Australia, attracts 20,000 students per year in Singapore, where BIM has been common for over a decade.

Artibus Innovation's own snapshot analysis of Australian job advertisements identified occupational demand for BIM knowledge,

¹ Construction and Property Services Industry Skills Council, (2014), *Environmental Scan 2014-15*

² Azhar, S., Khalfan, M. and Maqsood, T. (2012) 'Building Information Modeling (BIM): Now and Beyond', *Australasian Journal of Construction Economics and Building*, 12 (4) 15-28.

³ BIM is expected to deliver cost-savings in the property services industry, including improved facilities management, maintenance and service delivery, improved asset awareness and access to asset profiles shared in real-time.

skills and experience, particularly within the Australian building and regulatory environment.⁴



Regulation and Licencing

At the current time, no BIM-specific regulation and licensing requirements have

been identified. However, these may emerge as a component of licensing and regulation as BIM technology is more widely adopted, is mandated by governments, or is utilised to meet new regulatory and compliance record keeping and reporting requirements.

⁴ On a single day, 267 jobs featuring the term 'BIM' advertised. JORA advertisements featuring the search term 'BIM' at

5/04/2019. The tabulated results of this analysis are included in Appendix A, Table 1.

Industry Trends

This section describes current and future trends expected to impact on the construction industry's BIM awareness requirements. It also provides discussion of BIM's non-technology competency requirements, as identified in recent case studies and reports.



Social Trends

The Australian government's 2016 *Smart Cities Plan* recognises that most Australians currently live and work in cities and regional centres.⁵ The population density of Australian cities is projected to increase, with demand for housing, employment and infrastructure within cities.

A key tenet of the Smart Cities plan is investment in smart technologies, with a 'technology first' approach, including using data and analytics to improve efficiency, sustainability and services. These social and policy drivers are expected to increase demand for BIM-enabled buildings.



Technological Trends

BIM is projected to completely replace current computer-aided design (CAD) systems in the future.⁶ BIM will expand from its early use as an advanced modelling tool to become an integrated technology used by applied, managerial and strategic workers within the construction industry.

BIM processes and technology are expected to impinge on job roles throughout the construction industry, especially at the technical (applied), managerial and strategic levels, as outlined in Appendix A. However, the Australian construction industry is one of the least 'digitally engaged' industry sectors⁷ and its adoption of BIM to date has been varied and gradual (depending on the complexity of the project).⁸

Tier One companies are well advanced in BIM usage and are starting to require sub-contractors to be able to connect with this technology. However, as the 2014 Perth Children's Hospital Case study identifies, BIM is 'not a technology' but a process which can enable communication and collaboration through technology.⁹ It requires a good governance structure for effective engagement at all occupational levels.

⁵ Australian Government (2016), *Smart Cities Plan*, accessed 2/7/19 at https://www.infrastructure.gov.au/cities/smart-cities/plan/index.aspx#_Toc450057390

⁶ Azhar, S., Khalfan, M. and Maqsood, T. (2012) 'Building Information Modeling (BIM): Now and Beyond', *Australasian Journal of Construction Economics and Building*, 12 (4) 15-28.

⁷ Vision Critical, Telstra Loop; *Self Employed Tradies Summary Report*, June 2016

⁸ StartupAUS, (2017), *Digital Foundations: How technology is transforming Australia's construction sector*, accessed online 01/02/2018 at

<https://startupaus.org/document/constructiontech/>

⁹ PwC (2014), *PCH BIM Case Study*, accessed 2/7/19 at https://bim.natspec.org/images/Article_files/Resources/Case_studies/PWC_2014_Perth_Childrens_Hospital_BIM_case-study.pdf

Converging technologies, such as smartphone and tablet technologies, will enable project workers and stakeholders to quickly access building information, but key competencies in BIM awareness need to be further developed. Effective interaction with BIM systems by chains of subcontractors require awareness, familiarity and experience interacting with BIM processes and technology. Those without BIM awareness are likely to be locked out of supply chains.



Economic and Environmental Trends

BIM has potential economic and environmental benefits over traditional project management, such as construction cost-savings and improved sustainability and operational projections. Recent PwC modelling of BIM benefits for the UK government identified four types of economic savings:

- project asset maintenance savings
- time savings as a result of design efficiencies
- time savings in building and commissioning
- cost savings as a result of clash detections.¹⁰

The estimated benefits of BIM at the design, build and commission phases combined is 0.7% of capital expenditure, with the majority of savings (60%) are projected to occur at the asset maintenance stage. In the UK, BIM level 2 is expected to yield project savings up to 400 million pounds per year on public sector infrastructure and capital assets, such as new buildings, renovations and refurbishments.

The pursuit of construction and operational efficiencies is expected to increase demand for BIM use across the built environment, as governments adopt and mandate BIM.¹¹ For example, BIM was mandated under the UK's 2016 Government Construction Strategy for government procurement.¹² In late 2018, the QLD government mandated that all major government construction projects with an estimated capital cost of \$50 million or more will be required to use BIM.¹³

However, realising the economic, environmental and efficiency benefits of BIM as a planning and project management tool depend on each project participant (managers, contractors, builders and labourers) being able to:

- rely on the model and the accuracy of its information, and
- provide inputs to 'the agreed level of definition by the agreed deadlines, at

¹⁰ Chevin, D. (2018), 'BIM benefits quantified for the first time', accessed 2/7/2019 at <http://www.bimplus.co.uk/news/bim-benefits-report-government-could-save-400m-yea/>

¹¹ For evidence of Australian Government as a driver of BIM through Standing Committee on Infrastructure, Transport and Cities released in March 2016 (Report), see <https://www.ipwea.org/blogs/intouch/2016/08/01/what-you-need-to-know-about-bim-in-australia>


¹² Institute of Workplace and Facilities Managers (UK) (n.d.), 'FM Awareness of Building Information Modelling (BIM)', accessed 2/7/19 at <https://www.iwfm.org.uk/insight/research/bim-awareness>

¹³ Queensland Government (2018), *Building Information Modelling (BIM)*, accessed online 21/02/2019 at: <https://www.statedevelopment.qld.gov.au/infrastructure/building-information-modelling-bim.html>

each stage of the design and construction process.¹⁴

As in traditional process management, BIM clashes and inaccuracies are also likely to have flow-on effects and cascades and contractors will require contractual protections and resolutions.

PwC's report 'Collaborative Contracting' contends that effective BIM usage will require technical skills to engage with technology and additional shifts in process management and the assumptions of traditional contracting.



How will the pursuit of economic efficiencies drive BIM use?

What are the technical and non-technical core competencies industry requires of BIM users?



Educational Trends

BIM awareness requirements are likely to differ from existing industry practices. Workers in the construction industry will need to be upskilled, not only so they have the knowledge and skills to use BIM in their

fields¹⁵, but also because BIM will bring about new ways of working,¹⁶ which is likely to result in new processes, tasks, policies and regulations.

Is there a skills gap?

A skills gap is likely to emerge if industry demand for BIM skills and knowledge is not met. BIM usage will span across many occupations in the construction industry, so it is important that competencies are incorporated into the training package progressively as adoption increases and application becomes better understood.¹⁷

Artibus Innovation's analysis of BIM job advertisements identified Australian demand for workers with familiarity and experience of BIM software in the context of the local regulatory and building code environment.¹⁸ The Strategic Forum for the Australasian Building and Construction Industry's BIM Knowledge and Skills Framework has also argued that the industry's BIM requirements will include 'some ideas [which] will be consistent with some of your practices and knowledge, and some [which] will be challenging, new and very particular to BIM.'¹⁹

¹⁴ PwC (March 2018), *Collaborative Contracting*, accessed 2/7/19 at <https://www.pwc.com.au/legal/assets/collaborative-contracting-mar18.pdf>

¹⁵ Queensland Government, 29 Nov 2018, *Building Information Modelling (BIM)*, accessed online 21/02/2019 at: <https://www.statedevelopment.qld.gov.au/infrastructure/building-information-modelling-bim.html>

¹⁶ Byrne, C., 2015, *Building Information Modelling in Australia: Lesson from the UK*, ISS Institute Inc, accessed online

01/02/2018 at: <http://www.issinstitute.org.au/wp-content/media/2015/05/Report-Byrne-FINAL-LowRes.pdf>

¹⁷ Ibid

¹⁸ A sample of 30 advertisements using the search term 'BIM' on 5/4/19.

¹⁹ Strategic Forum for the Australasian Building and Construction Industry (2017), *BIM Knowledge and Skills Framework: An Introduction*, Australian Construction Industry Forum and Australasian Procurement and Construction Council, Canberra, p.27.



Political Trends

BIM has the potential to address known weaknesses of existing building and construction compliance systems, such as loss and inaccessibility of building records, which were issues noted in the recent *Building Confidence*²⁰ report by Professor Peter Shergold AC and Ms Bronwyn Weir. Shergold and Weir recommend the creation of a central database by each jurisdiction for record keeping and collaboration to develop a platform that has information sharing capabilities.²¹ This is a function that can be performed by BIM. Accordingly, governments are expected to mandate BIM useage to address these weaknesses, although there are no existing units that develop this competency area.



Can a BIM awareness skill set address risk, compliance and regulatory requirements?

Consultation Undertaken

The Artibus Innovation consultation strategy for the development of the skills forecast included targeted consultation with IRC members. BIM was identified by six IRC members as an issue facing industry, and technology issues were mentioned by a

further five members. (A table of relevant stakeholder concerns is included in Appendix B.)

Consultation with industry stakeholders will continue to be a major priority throughout the proposed project, using survey and targeted consultation approaches.

²⁰ Shergold, P., & Weir, B. (2018). *Building Confidence: Improving the Effectiveness of Compliance and Enforcement Systems for the Building and Compliance Industry Across*

Australia, accessed <https://aibs.com.au/Public/News/2018/ShergoldWeir.aspx>

²¹ Ibid.

Training Information



Relevant VET Qualifications

This project involves the development of one new skill set (or micro credential):

- Introduction to Building Information Modelling
- Up to 3 new units will be developed.

Consultations with members of the Australian BIM Advisory Board and the Construction, Plumbing and Services IRC, noted that there are no existing BIM units in the CPC training package. However, there are existing units in the Property Services Training Package and two newly endorsed courses in Victoria. Charts of enrolments from 2015-2017, where available, are provided below.

The Australian Procurement and Construction Council (APCC) and the Australian Construction Industry Forum (ACIF) have developed a relevant BIM knowledge and skills framework. This framework provides policy guidance around the required skills and knowledge relevant to BIM for a broad range of construction industry workers and stakeholders.²² This framework may potentially be used as part of this project to identify core competencies and develop the units to align with current industry thinking.



How will BIM awareness requirements differ from existing construction industry practices and knowledge?

What competency requirements will be challenging, new and very particular to BIM?



Related Enrolment Numbers

There are no existing BIM units within the CPC Training Package. However, several relevant units exist within the CPP package:

- CPPBDN5013A – Develop and collaborate on building information models for small-scale building design projects

²² Australian Procurement and Construction Council (APCC), 2017, *BIM skills and knowledge framework*, accessed online 24/02/2019 at: <http://www.apcc.gov.au/SitePages/BIM%20Knowledge%20and%20Skills%20Framework.aspx>

- CPPBDN4004 – Set up BIM-capable software and files for building design drafting projects
- CPPBDN5101 – Produce digital 3-D models of building designs

CPPBDN5013A and CPPBDN4004 units have both demonstrated increased enrolments, as illustrated in Charts 1 and 2 (over page).

In Victoria, two BIM-focused courses were approved in March 2019:

- 22507VIC – Advanced Diploma of Building Information Modelling (BIM)
- 22508VIC – Course in Building Information Modelling (BIM)

These courses are yet to be offered by any RTO and further information has sought from the Victorian Department of Education and Training.

What competencies are needed?

A functional analysis of available BIM units within the VET sector (Appendix C), based on unit titles, identified three central BIM competency areas:

1. Modelling – what is BIM? Why use it? Usually demonstrated by using BIM technology to 3D design and model a building and to apply and provide design and sustainability solutions
2. Information content – how do you interact with BIM? What competencies are required to interact with and use BIM information content in a technical (applied) or managerial setting?
3. Process management – how do you generate a report and handover on site using BIM? This refers to using BIM as a process tool for strategic decisions and management of a building project.

The two CPP units in the National Training Package (CPPBDN4004 and CPPBCN5013A) primarily focus on the second level of working with BIM information content. These units are appropriate for Technical or Managerial occupations who will have to interact with BIM systems.

The units included in the Victorian course in BIM (22508 VIC) chiefly develop the first and second levels: design-focused, modelling and applied management competencies.

Victoria's Advanced Diploma in BIM (22507 VIC) develops competencies across all three BIM competency areas, with units on using BIM strategically as a process management tool.



What are the core competencies that industry requires of a CPC BIM Awareness skill set?

Do the three units need to address the three types of BIM competency?

Are existing CPP units with an information content focus suitable for importing in to the CPC BIM Awareness skill set?

Are new Victorian units suitable for importing in to the CPC skill set?

Chart 1: Enrolments in *CPPBCN5013A Develop and collaborate on building information models for small-scale building design*, by state/territory, 2015-2017

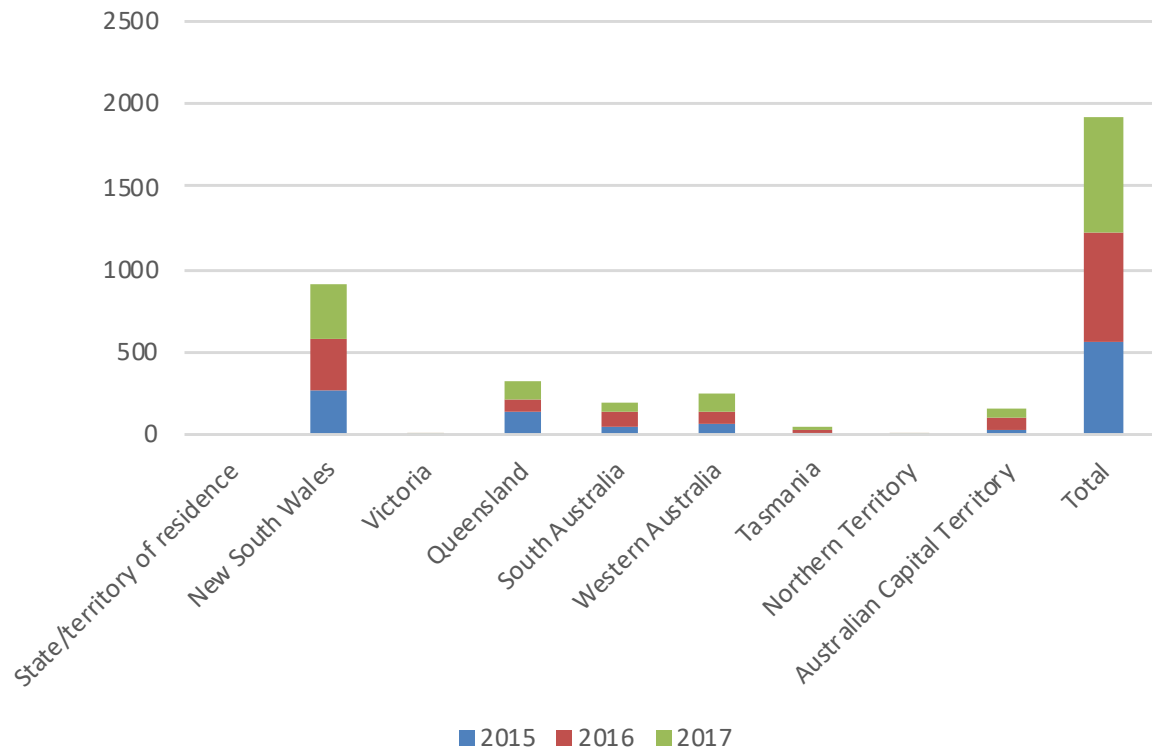
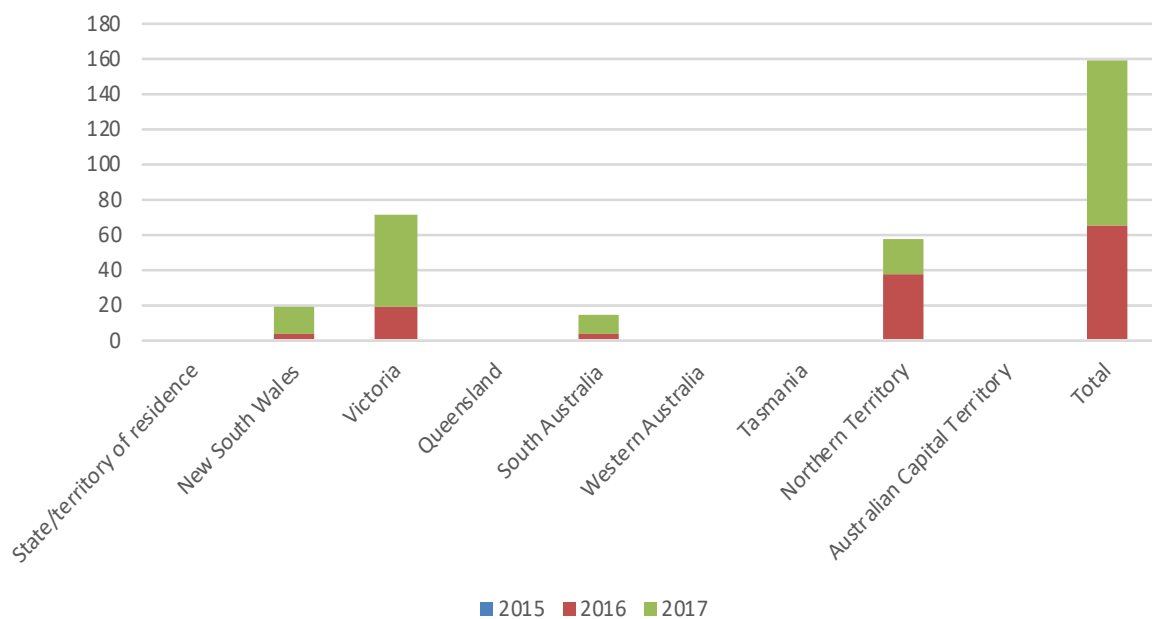


Chart 2: Enrolments in *CPPBDN4004 - Set up BIM-capable software and files for building design drafting projects*, by state/territory, 2015-2017



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Vision Critical, Telstra Loop; *Self Employed Tradies Summary Report*, June 2016

Appendix A – BIM Occupations and Knowledge and Skills Framework requirements

Table 2: Industry demand for BIM Occupations in Recent Job Advertisements

These are the emerging BIM occupations currently being recruited for in Australia

Occupation Title	Likely Built Environment Stage	Occupational Level	AQF equivalent	Number of Jobs identified²³
BIM Manager	<i>Pre-build and Construct</i>	<i>Managerial</i>	5	8
BIM Coordinator	<i>Construct</i>	<i>Managerial/Technical</i>	4, 5	8
Draftsperson	<i>Pre-build</i>	<i>Technical</i>	4	3
BIM Designer	<i>Pre-build</i>	<i>Strategic/Technical</i>	4	3
BIM Modeller	<i>Pre-build</i>	<i>Technical</i>	4	2
BIM Consultant	<i>Pre-build and Construct</i>	<i>Strategic/Technical</i>	4, 6	2
Documenter	<i>Pre-build</i>	<i>Technical</i>	4	1

²³ As advertised on 5/4/19.

Revit operator	<i>Pre-build</i>	<i>Technical</i>	4	1
BIM construction Visualiser (junior)	<i>Pre- and post- build</i>	<i>Technical</i>	4	1
BIM leader	<i>Pre-build and Construct</i>	<i>Strategic/Managerial</i>	4, 6	1
Total				30

Table 2: Alignment of AQF levels with Strategic Forum for the Australasian Building and Construction Industry (ABCI) BIM Knowledge Skills Framework Pyramid and Occupational Training Outcomes

Strategic Forum ABCI Occupational level	AQF level²⁴	AQF Summary	BIM System Role	Occupational training outcomes
Technical/applied	4	Graduates at this level will have theoretical and practical knowledge and skills for specialised and/or skilled work and/or further learning.	Technical BIM workers use their knowledge and skills to develop, utilise and update relevant building	<ul style="list-style-type: none"> • Builder • Construction labourer • Designer • Modeller • Documenter

²⁴ Australian Qualifications Framework, accessed 15/04/2019 at <https://www.aqf.edu.au/aqf-levels>

			information service data.	<ul style="list-style-type: none"> • Service Technician (e.g. Fire Protection Technician) • Compliance and Audit Manager • BIM Consultant • BIM Coordinator
Managerial	5	Graduates at this level will have specialised knowledge and skills for skilled/paraprofessional work and/or further learning.	Managerial BIM workers use their BIM skills and knowledge to manage building performance, including scheduling and producing compliance, maintenance and routine service reports.	<ul style="list-style-type: none"> • BIM Manager • Design Manager • Project Manager • Facilities/Asset Manager • Manager of property services business • BIM Consultant • BIM Coordinator

Strategic	6	Graduates at this level will have broad knowledge and skills for paraprofessional/highly skilled work and/or further learning.	Strategic BIM workers use BIM to improve the efficiency of existing buildings, including financial, maintenance and compliance cycles and compliance, in response to real time data.	<ul style="list-style-type: none"> • Strategic BIM Manager • Procurement Advisor • Contract Specialist • Project Director • Estimator • BIM Consultant • BIM Leader
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Appendix B – Consultation Undertaken

Name	Organisation	Consultation Type	Topics covered during consultation
Adam Cox	Fernbrooke Homes	Interview with CPC IRC member	<ul style="list-style-type: none"> • Tech changes in the industry • Tech changes good for WHS • BIM • Mental health
Alan Davis	Western Australian Construction Training Council	Interview with CPC IRC member	<ul style="list-style-type: none"> • Skills shortages • Downturn in construction • Aging population effects on industry • New technology • Industry will demand specific training based on skill sets in future (micro-credentialing)
Lynda Douglas	Department of Defence	Interview with CPC IRC member	<ul style="list-style-type: none"> • Technology • Artificial Intelligence • Safety in the workplace • Mental health • Micro-credentialing • Big data
Ken Gardner	Master Plumbers	Interview with CPC IRC member	<ul style="list-style-type: none"> • Downturn in construction industry • Ageing workforce • Technology • Skill specialisation • Keeping training package up to date
Lindsay Le Compte	Australian Industry Group	Interview with CPC IRC member	<ul style="list-style-type: none"> • Skill specialisation • Higher education-based careers • BIM • Drones

Name	Organisation	Consultation Type	Topics covered during consultation
Andrew Marshall	Marshall & Brougham Construction Pty Ltd	Interview with CPC IRC member	<ul style="list-style-type: none"> • BIM • Mental health • Continuous professional development • Shergold and Weir report and Opal tower • Skills shortage
Jocelyn Martin	Housing Industry Association Ltd	Interview with CPC IRC member	<ul style="list-style-type: none"> • Technology • Hiring an apprentice v someone already skilled • BIM • Mental health
Stuart Maxwell	Construction, Forestry, Maritime, Mining and Energy Union	Interview with CPC IRC member	<ul style="list-style-type: none"> • Mental health • Pre-fabrication • Technology • Skill impacts from regulations
Marie Paterson	SA Building & Construction Industry Training Board	Interview with CPC IRC member	<ul style="list-style-type: none"> • Commercial waterproofing • BIM • Continuous learning and micro-credentialing • Steel framing • Technology
Greg Smith	National Fire Industry Association	Interview with CPC IRC member	<ul style="list-style-type: none"> • Mental health • BIM • Shergold and Weir report
Yvonne Webb	Industry Skills Advisory Council, NT	Interview with CPC IRC member	<ul style="list-style-type: none"> • Compliance and regulatory issues • Migration • Apprentices • Technology

Appendix C – Functional Analysis of Existing BIM Units of Competency

Table 3: Analysis of Existing BIM units of competency by functional BIM focus/competency

These are the existing BIM units available on the National Training Package and in Victoria, grouped by BIM competency developed

BIM Competency	Strategic Forum ABCI Occupational level	Unit of Competency	Existing CPP BIM Units	22508 VIC - Course in Building Information Modelling	22507 VIC - Advanced Diploma of Building Information Modelling (BIM)
Modelling	Technical	VU22460- Design sustainable buildings		Yes	Yes
Modelling	Technical	VU22710- Apply sustainable design principles and practices for BIM projects		Yes	Yes
Modelling	Technical	VU22456- Apply structural and construction technology to the design of commercial buildings		Yes	Yes
Modelling	Technical	VU22465- Provide design solutions for residential and commercial buildings			Yes
Modelling/Information content	Technical	VU22711- Utilise digital fabrication technology for BIM		Yes	Yes

Information Content/Process Management	Technical/Managerial	VU22678- Use building information modelling (BIM) technologies for a project		Yes	Yes
Information content	Technical/Managerial	CPPBDN4004- Set up BIM-capable software and files for building design drafting projects	Yes	Yes	Yes
Information content	Technical/Managerial	CPPBDN5013A- Develop and collaborate on building information models for small-scale building design projects	Yes	Yes	Yes
Information content	Technical	VU22679- Use mixed or blended reality technologies		Yes	Yes
Process Management	Managerial/Strategic	VU22709- Apply benefits of building information modelling (BIM) for a project		Yes	Yes
Process Management	Managerial/Strategic	VU22708- Manage projects using building information modelling (BIM) technology		Yes	Yes
Process Management	Managerial/Strategic	VU22715- Apply Building Information Modelling (BIM) technology to validate project performance			Yes
Process Management	Managerial/Strategic	VU22714- Manage cost control, planning, analysis and control processes			Yes
Process Management	Managerial/Strategic	BSBPMG415- Apply project risk management techniques			Yes

Process Management	Managerial/Strategic	VU22713- Manage building information modelling (BIM) contracts			Yes
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