Swinburne University of Technology

# Victoria's Future Industries - Construction Technologies

Swinburne discussion paper

Professor Ajay Kapoor
Dean of Engineering
Swinburne University of Technology
24 Wakefield Street, Hawthorn

25 September 2015

# Table of Contents

**Introduction** _____ **2**

**1. Question 1: How might technology uptake be increased in the Victorian construction sector?** _____ **3**

*Recommendation One* _____ 3

**2. Question 3: How can the uptake of Building Information Modelling (BIM) be encouraged on Victorian construction projects?** _____ **4**

*Recommendation Two* _____ 5

*Recommendation Three* _____ 5

**3. Question 4: What would be the costs and benefits of requiring the use of BIM on all significant public sector projects?** _____ **6**

*Recommendation Four* _____ 7

**4. Question 8: How can construction materials and construction technology firms build on the export success and relationships of Victorian architecture, planning and engineering firms?** _____ **8**

**5. Question 11: How can better industry and research collaboration be facilitated?** _____ **9**

*Recommendation Six* _____ 9

*Recommendation Seven* _____ 9

**6. Question 12: How can firms be encouraged and supported to develop and experiment with new processes to improve the efficiency of the building process?** _____ **10**

*Recommendation Eight* _____ 10

**7. Question 15: Are there opportunities to increase materials innovation by providing information and advice on how to achieve a regulatory approval?** _____ **11**

*Recommendation Nine* _____ 11

# Construction Technologies - Swinburne discussion paper

## Introduction

Swinburne University of Technology ("Swinburne") is pleased to make this submission to the Victorian Government's Future Industries taskforce. We believe it is vital for Victorian business, industry, government and communities to have these discussions about how we grow or transition existing industries into new and emerging markets.

A strong construction industry will provide employment for individuals with diverse skillsets, and will provide an avenue for innovation through investment in research and development. This approach will ensure the sector has access to the most sustainable and optimal materials, and can develop efficient operating systems that facilitate global competiveness for the future.

The Swinburne response focuses on the university's areas of research expertise, expertise in higher education and vocational education in the construction sector, new initiatives, and our understanding of the market. Included are a number of recommendations for the consideration of the Victorian Government. We ask that you review this response in combination with Professor Jay Sanjayan's participation in the Future Industries Fund Construction Technologies Workshop on September 8, 2015.

# 1. Question 1: How might technology uptake be increased in the Victorian construction sector?

The construction industry has demonstrated a history of swift change when there is either a recognised incentive or a legislative imperative. This is reflected in the way the industry responds to new construction technology – if there is an opportunity for efficiency, then adoption is more likely. Examples of this include the development of pre-fabrication, and more broadly the use of mobile phones. In these situations, industry investment has seen the rapid development and adoption of work methods because the correlation between cost and benefit was realised almost immediately.

However, in other instances where the benefit is not as evident, change has come about only with the force of legislation. Examples include the mandating of safety training with the Construction Induction card; the review of accounting methods in the introduction of the GST; and the improvement of environmental sustainability through the compulsory six-star rating for new homes with water tank or solar panel inclusions.

The construction industry will be at the forefront of new technology if the benefit is obvious. The workforce is adept at using mobile technology and ready to take advantage should there be economic, environmental or social benefits. One example would be to use mobile/wearable information technology for monitoring construction workers' health and safety condition on construction sites.

In addition, it is important that technology is relevant, accessible, practical and appealing to the 'early adopters'. The construction workforce has a moderate history of training in new technology – but it's when there is an incentive or a legislative framework that engagement and productivity improvements are realised.

### *Recommendation One*

Where technologies such as Building Information Modelling (BIM) have the potential to positively impact the construction industry, an adoption strategy which includes incentives and a legislative framework should be considered.

## 2. Question 3: How can the uptake of Building Information Modelling (BIM) be encouraged on Victorian construction projects?

Swinburne has supported the construction industry over many years to implement BIM on construction projects. As early as 2008 Swinburne's Advanced Building Studies department implemented 3D modelling for building designers, however more recently we have:

- Conducted research into the United Kingdom BIM mandate to identify key strategies that are helping the industry (and government) successfully implement BIM
- Consulted widely on BIM skill development needs with Federal, State and local government departments and construction industry associations (including the Australian Construction Industry Forum, Australian Procurement and Construction Council, Department of Defence, Consult Australia, Master Builders Association, Australian Institute of Architects)
- Created partnerships with BIM leaders including an MOU with the BIM Academy ANZ, to develop best practice training for Swinburne students and industry
- Investigated the possibility of a joint BIM Centre of Excellence with the University of Canberra.
- Undertaken research on developing and applying digital engineering and BIM for improving construction productivity and safety, in collaboration with China, India and UK.
- Investigated the possibility of international partnerships by leveraging a growth in the digital environment for encouraging jobs growth, foreign investment and productivity confrontation.

As we move forward, we have considered the challenging question of whether or not to mandate BIM on Victorian construction projects. As outlined in the discussion paper, a number of overseas governments require BIM on government-funded projects. However Swinburne's Advanced Building Studies research in the UK and Australia has identified that a mandate alone is not sufficient to drive uptake.

As outlined in our answer to Question 1, the construction industry has at times been required to implement change through the introduction of legislation. An alternative government approach is to support the cultural change that BIM requires, with an incentive. Quite simply, there is a BIM skills shortage, which is the bottleneck to effective BIM implementation. A direct investment in training will encourage BIM uptake and this will assist the industry to see the benefits first-hand. For example, targeted government funding could be provided to integrate BIM training and support to those involved throughout the design, construction and operation of a government project. This will provide a direct correlation between the government's investment in skills with the outcomes required of the BIM project.

The skill level of people in the construction industry varies widely – from individuals who are expert in their field and able to implement BIM management plans, to those whose knowledge is rudimentary. Even examples of best practice with BIM are generally pockets within the organisation, rather than the whole supply chain.

Industry engagement and ownership of the process is vital and partnerships such as that between Swinburne and the BIM Academy ANZ, our links with the UK, and professional associations are examples of innovation in up-skilling our industry. BIM by its very nature is collaborative and Swinburne has adopted this basic principle to foster skills development to

encourage effective uptake. In conjunction with industry, Swinburne has developed innovative learning methods (e.g.: blended and online approaches) that provide customised just-in-time training for people working on BIM projects. These can easily be transformed to an up-skilling training program for industry personnel on BIM projects. Current facilities in the Factory of Future visualisation labs provides advanced virtual reality based 4D modelling and 5D modelling facilities for industries.

Unfortunately the uptake of BIM will not be a simple process. While the industry has access to the necessary technology, as the software and the hardware are readily available, the key will be integrating this with cultural change, which can be a slower process.

### *Recommendation Two*

Swinburne believes that culture change cannot occur without the development and adoption of new skills. We recommend that industry participants undertake BIM training to upskill and to see first-hand the benefits of this technology. This would be enhanced by providing training on a Victorian Government BIM project for immediate application in the workplace.

Suggested actions to achieve success include:

- Identify BIM champions, structure collaboration and foster networks by promoting existing BIM groups.
- Use existing BIM standards, guides and contracts (ie BIM MEP AUS and NATSPEC)
- Develop a learning framework to provide quality and consistency in the provision of training (e.g.: Swinburne developed innovative learning methods offered as up-skilling training programs for industry personnel with government incentives). This will facilitate a flexible learning environment for industries without affecting their existing work load models.
- Create a BIM Centre of Excellence that will act as a source for industry, policy makers and educators to collaborate and deliver practical training options.
- Continue to undertake research in digital engineering and BIM for improving construction productivity and safety. To this end, financial and in-kind support will be needed from the government.

### *Recommendation Three*

Because of its collaborative nature, Swinburne recommends the Victorian Government facilitate relationships between organisations, such as through workshops and networking groups, as to encourage successful BIM uptake.

NB: Further information is available from the Department of Education and Training funded report (ISS Institute, Higher Education and Skills Group Overseas Fellowship) by Christopher Byrne, Lessons from the UK at www.issinstitute.org.au/wp-content/media/2015/05/Report-Byrne-FINAL-LowRes.pdf

# 3. Question 4: What would be the costs and benefits of requiring the use of BIM on all significant public sector projects?

As outlined in the discussion paper, a number of overseas governments are mandating the use of BIM on government projects. Swinburne's Advanced Building Studies and Construction Engineering and Management recent consultation in the United Kingdom and Australia with government and industry has identified that a mandate alone is not sufficient to drive uptake.

There is a common misconception that BIM is a technology, however BIM should be considered a process that uses technology to collaborate when required. Hence, effective BIM implementation requires the adoption of a new process (i.e. culture change), with limited technical change.

BIM implementation will require regional collaboration networks that pave the way for a new style of working. While BIM standards and BIM tools must be created, the real work is in a cultural change that impacts work practices.

Based on Swinburne's Construction Engineering and Management and Advanced Building Studies research with governments and industry, the Victorian government's costs to effectively implement BIM would be to:

- Establish a BIM Task Force to structure collaboration and determine BIM guides, protocols and tools
- Educate the supply chain with cross discipline behaviour change training that moves to occupation-specific BIM proficiency
- Partner with industry and education to promote BIM workforce skills development.

Industry would be required to respond to the government's lead by also investing in training and identifying BIM 'champions' within their business who are able to promote collaboration and culture change. New hardware and software may also be required.

This is not to say that the benefits from a government mandate may not be realised. Swinburne's research has identified that including BIM in the contractual arrangement with a principle contractor or client has a flow on effect throughout the supply chain. Whilst at this stage it's not always implemented well, it is at least exposing the workforce to BIM tools and standards.

Swinburne, together with the BIM Academy ANZ has designed an innovative training program to step in when organisations find themselves in a new predicament of a 'BIM contract'.

The benefits of BIM, once the barriers to effective implementation are overcome, are many. Consultation with BIM users and research has identified benefits (after initial investment) such as:

- Cost savings in the early detection of errors and omissions
- Reduced construction times, less rework, reduced request for information
- Fast and accurate space measurements
- Increased pre-fabrication
- Better transparency and reliability of energy performance measures.
- Enhanced decision making through improved access to data (i.e. building in the virtual world first)
- Increased use of technology that creates efficiencies in workflow and business operations (i.e. financial data to immediately see the return on investment impact of design decisions).
- Real time visualisation of information with the use of Web 2.0 technologies (e.g.: on site by a mobile phone and wearables), which will confront productivity in the construction industry

The benefits for facility managers (asset owners) are only recently becoming more widely publicised, and as expected, improved access to data to accurately plan and manage a building or infrastructure asset is providing considerable savings – with a New Zealand educational institute reporting a ROI of 23%[1].

### *Recommendation Four*

While there are some costs with implementing a BIM system, the benefits are much greater. Victoria has the ability to harness this opportunity and be a BIM leader. Swinburne recommends the Victorian Government takes a leadership role by developing a strategy to incorporate BIM into public sector projects, and combine it with a training plan and support systems to ensure widespread adoption and collaboration.

[1] http://www.building.govt.nz/UserFiles/File/Publications/Building/Technical-reports/nz-bim-case-study-5-unitec.pdf (accessed 22 September 2015)

# 4. Question 8: How can construction materials and construction technology firms build on the export success and relationships of Victorian architecture, planning and engineering firms?

To be successful in export to East Asia, it is important to transfer new technologies to the region where technical infrastructure support is lacking. For example, a light-gauge steel framing industry can be developed in East Asia if there is a light-gauge steel framing standard for the region and some supporting training program for the local designers.

Life-saving developments such as those by the Australian Engineered Fasteners and Anchors Council (AEFAC) would create a positive impact on both developed and developing nations. AEFAC is a collaborative initiative between industry and Swinburne which is transforming the safety, specification, selection, design and installation of structural anchors and fasteners for the Australian construction industry. The outcomes of AEFAC's work include new and unique testing and assessment procedures for various markets; and AEFAC Installer Certification Program; nationwide education for engineers and contractors on design and installation and the development of and AEFAC standard to cover the design of fastenings which is to be referenced in the 2016 National Construction Code.

### *Recommendation Five*

The Victorian Government would play a valuable role in bringing together construction industry stakeholders to identify local capabilities that may lead to export opportunities. Swinburne recommends that the Victorian Government convene workshops to explore such opportunities, from which an export strategy can be derived.

# 5. Question 11: How can better industry and research collaboration be facilitated?

The recent Innovation and Technology Voucher scheme for small to medium sized Victorian businesses (SMEs) provided an excellent platform for the development of industry research collaborations.

The voucher provided funding for a specific project, thus meeting an immediate research and development need, often with an industry partner who was unaccustomed to working with a research organisation. In many instances this was the start of a long-term relationship which generated bigger, more complex collaborations, thus developing innovative goods and services for the Victorian and Australian economies.

### *Recommendation Six*

Swinburne recommends the Victorian Government invest in a program that encourages SMEs to engage with research partners for long-term collaborations. While some federal programs also seek to address this (eg: Research Connections), the Innovation and Technology voucher scheme provided a very accessible and effective model of collaboration.

### *Recommendation Seven*

Another key recommendation is to develop international partnerships in digital learning environments that will attract foreign investment as to facilitate training and implementation of industry research particularly targeting BIM. Such a training and research centre will foster sustained job growth in Victoria and provide meaningful, productive industry partnerships.

# 6. Question 12: How can firms be encouraged and supported to develop and experiment with new processes to improve the efficiency of the building process?

Swinburne believes that organisations should be encouraged to participate in precompetitive collaboration, allowing industry to understand and share fundamental knowledge, such as optimal materials and best practice for safety and design efficiency.

The Australian Engineered Fasteners and Anchor Council (AEFAC) is an example of this. It is collaboration between industry and academia to improve the safety and reliability of structural fasteners in the Australian construction industry. Fastener failures can lead to loss of life, economic loss, and can stifle innovation by severely limiting the specification of products. Prior to AEFAC's formation, the anchor industry was self-regulated and without guidance from an industry body.

A fundamental means of achieving AEFAC's objectives is through the development and delivery of the Installer Certification Program. Combining theory and practical training with an assessment protocol, 40 installers have achieved certification to date, with many more expected to be qualified by the end of 2015. Through an online database, industry can identify a qualified AEFAC installer, ensuring that optimal fastener safety is achieved on a project.

Complimenting this training is the design of the AEFAC Standard for the selection, specification and application of anchors and fasteners in the construction industry. This is on schedule to be referenced in the 2016 National Construction Code and will provide deemed-to-comply solutions for the engineering industry.

Swinburne's involvement in AEFAC has resulted in the formation of a research team, the acquisition of an Australian Research Council Linkage Project Grant and recognition of this group as a leading Australian research facility in this area. Ongoing research and development is imperative to foster innovative technologies that improve efficiency and consolidate construction cycles, while striving to improve standards in an industry where safety is paramount.

AEFAC's achievements are a first for the Australian construction sector. The collaboration highlights the ability of industry, even competitive businesses, to work together for the common good of its communities and ultimately, the future of its industry. All of the members are brought together by the desire for improvement in the safety, confidence and efficiency in the construction industry.

### *Recommendation Eight*

Swinburne recommends that the Victorian Government convenes special interest groups (similar to AEFAC) at the precompetitive stage, to solve important problems in a safe environment.

# 7. Question 15: Are there opportunities to increase materials innovation by providing information and advice on how to achieve a regulatory approval?

Swinburne believes there are opportunities in this area. The regulatory performance-based approach is not well understood by most practitioners and the National Construction Codes are very complex. This leads to the following problems:

It is too easy to obtain approval for an inferior product substitution for those who know (but not necessarily understand) the system.

Fear of not obtaining approval for innovative products because of the complexity of the process and therefore increase cost of construction for those who don't know the system.

### *Recommendation Nine*

Swinburne recommends the development of an educational campaign to help all stakeholders better understand the performance-based regulatory system and a product registration system, so that there may be more control on non-conforming products. We also recommend the Government invest in research in this area for the system's further development and implementation.

*Swinburne thanks the following for their contribution to this paper:*

Paul Sesta, Team Leader, Department of Trades and Engineering Technology

Professor Emad Gad, Chair of Department, Civil and Construction Engineering

Professor Jay Sanjayan, Director of Centre for sustainable Infrastructure

Professor Patrick Zou, Department of Civil and Construction Engineering

Dr Jessey Lee, Centre for Sustainable Infrastructure

Dr Ambarish Kulkarni, Department of Mechanical Engineering and Product Design Engineering

Jane Ward, Director Collaborations and Partnerships

Belinda Anson, Senior Manager, Collaborations and Partnerships

Janine Shearer, Senior Manager, Collaborations and Partnerships

Robyn Watson, Manager, Collaborations and Partnerships

Sincerely,

Professor Ajay Kapoor
Dean of Engineering
Swinburne University of Technology