BIM Education

E3 BIM Learning Spectrum

BIM IN PRACTICE

CONSULT AUSTRALIA

Australian Institute of Architects

BIM Education

E3 BIM Learning Spectrum

Contributors:

Bilal Succar (Chair) // Change Agents

Carl Agar, Menco Electrical

Scott Beazley, Project Services

Paul Berkemeier, Australian Institute of Architects

Richard Choy, NATSPEC//Construction Information

Rosetta Di Giangregorio, RMIT / TAFE

Steven Donaghey, Suters Architects

Chris Linning, Sydney Opera House

Jennifer Macdonald, UTS

Rodd Perey, Architectus

Jim Plume, UNSW

E3 BIM Learning Spectrum [Version 1 – August 2012]

CONSULT AUSTRALIA

Australian Institute of Architects

INTRODUCTION

The BIM Learning Spectrum is composed of all BIM topics (technical, operational and managerial), across project lifecycle phases, and specialities. Depending on the perspective adopted, these topics can be identified as learning topics, teaching subjects or individual competencies. This paper adopts the perspective of the learner and will use the term individual **BIM Competencies**[1] to represent the granular elements within the broad BIM Learning Spectrum.

1 BIM Education focuses on individual attainment of BIM skill and knowledge. Every BIM subject matter – if used within the context of educating/training individuals – will be referred to as a BIM competency.

UNDERSTANDING INDIVIDUAL COMPETENCIES

The BIM Learning Spectrum includes all that should be learned about BIM technologies, workflows and protocols. It is the combined list of all learnable BIM subject matter within construction disciplines and roles; the ever-changing sum of individual BIM competencies which industry practitioners and students need to learn.

According to the US Department of Education, a competency is a 'combination of skills, abilities, and knowledge needed to perform a specific task'[2]. Using this definition as a base, a BIM Competency is the combination of conceptual knowledge, BIM skills (practical knowledge) and experience necessary to perform a BIM-related task.

2 Refer to Defining and Assessing Learning: Exploring Competency-Based Initiatives (2001), the US Department of Education; National Center for Education Statistics, page 1. Note that the Australian Qualification Framework (AQF) indirectly defines the term competency as follows 'Training Packages use competency standards to describe the skills and knowledge needed to perform effectively in the workplace' – refer to AQF Certificate I Guidelines.

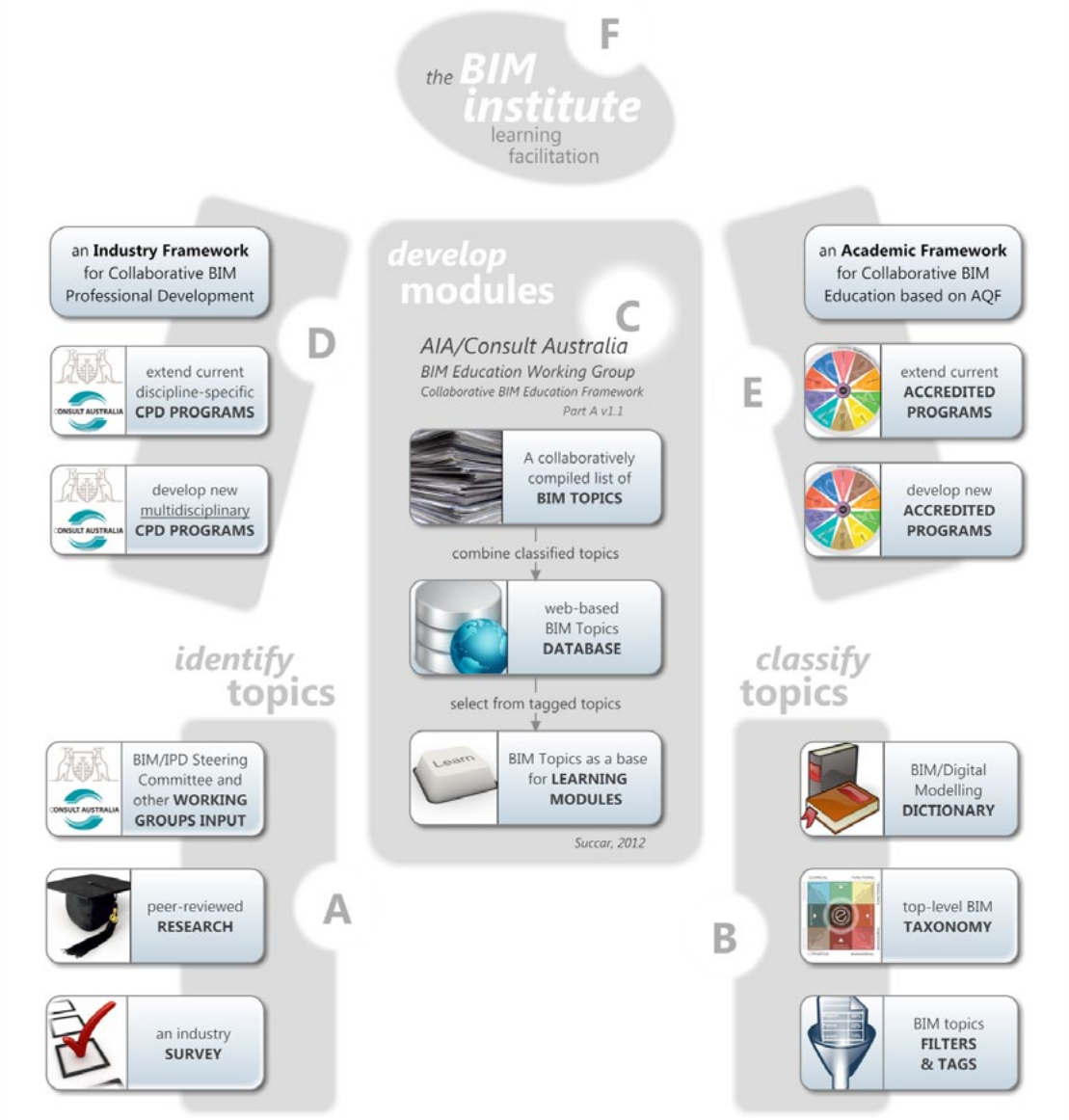

Figure 1. Collaborative BIM Education Framework Part A v1.1

There are hundreds or even thousands of BIM Competencies which can be learned by individuals involved in the design, construction and operation of the built environment. These individuals range in their position of responsibility and role within the construction supply chain. For example, an architect implementing a spatial program within a hospital model will require a different set of competencies from an engineer performing thermal analysis on those spaces. Also, the competencies needed by a junior modeller during their day-to-day activities are quite different from those required by a team manager responsible for coordinating the efforts of many individuals.

For BIM competencies to be defined in a useful manner, they need to be organised against overlapping criteria: disciplines, specialties, roles and levels of practical experience. Some classifications which can be used to organise BIM Competencies already exist (eg, OmniClass Table 33 – Disciplines) while others need to be specifically developed. In organising competencies, the EWG acknowledges that:

1. Some BIM Competencies will be applicable across several disciplines and roles while other competencies will be specific to a single discipline or role.
2. The same BIM Competency may be delivered and measured differently by each BIM Learning Provider. A university may, for example, use Bloom's taxonomy as a basis to deliver and measure student learning, while an AEC organisation may use a simpler three or five-scale model. To account for this variation between different BIM Learning Providers – and particularly between academia and industry – the process of identifying BIM topics or competencies should be kept separate from the process of measuring them.

DEFINING THE BIM LEARNING SPECTRUM

The Collaborative BIM Education Framework intends to generate discussion within and between industry and academia. As a first step towards generating a comprehensive approach, this paper introduces a partial framework (refer to Figure 1) subdivided into six main components:

Component A. Identifying BIM Competencies

The framework highlights three main ways to identify BIM Competencies:

- A seed set of BIM Competencies has already been identified by this Working Group[3].
- BIM Topics and Competencies will be identified through reviewing peer-reviewed literature, benefiting from relevant educational frameworks (refer back to Document E2 – 2.1 & 2.2), and surveying the educational requirements of participating institutions.
- BIM Topics are identified through a survey, a set of workshops and discussions with industry and by harvesting the knowledge of different groups through their representative associations.

Component B. Classifying BIM Competencies

For BIM Competencies as a basis for BIM Education, they should be clearly and consistently defined:

- A BIM dictionary to clarify BIM terms and acronyms across all topics. It will structure the syntax governing BIM Competencies (how a competency is named, defined, abbreviated, etc).
- A top-level taxonomy (a classification) to organise all BIM Competencies under a single hierarchy. This is important to collect all current and future learning topics in one structured list.
- A number of BIM labels (eg, role groups, disciplines, difficulty levels, delivery modes, etc) to organise BIM Competencies against several criteria (a faceted classification).

This may be better understood by referring to the sample table following:

3 A list of seed individual BIM Competencies may be published online at a later stage. Please visit the BIM Education page on the AIA/Consult Australia website - http://bim.architecture.com.au/.

BIM TOPICS (competency)	TAXONOMY (competency class)	TAGS or LABELS					
		Discipline	Sector	Speciality	Role Group	Difficulty	Delivery
Understanding Typical BIM Collaboration Workflows	F (Functional)	33 (all disciplines)			2 (Team Managers and Project Leaders)	3	Online Video
Legal Implications of Using Models as a Primary Source of Design Information	A (Administration)	33-21 (Design)	All		1 & 5 (Operational Management and External Service Providers – Legal)	4	Online Video, Workshop, Pamphlet
Developing and Managing Object Libraries	I (Implementation)	33-21	All		4 (BIM Managers)	2	Workshop

TAXONOMY: the sample used here includes nine mutually exclusive classes. Each BIM Topic can exist under one class only.

TAGS: each BIM Topic can be tagged indefinitely. Tags are flexible, non-exclusive labels which are used to organise and then filter competencies. **Discipline, Sector and Speciality** are tags based on OmniClass Table 33 (listed as Title Level 1, 2 and 3 respectively – Title Level 4 is not used here). OmniClass is an open standard developed by the Construction Specifications Institute (CSI). **Role Group** is a sample taxonomy to identify target audience based on their organisational roles. **Difficulty Level** is a sample scale applied to each BIM topic to indicate prerequisite levels of knowledge, skill, and experience (e.g. Difficulty Level 1 topics focus on 'BIM awareness' and have no prerequisites). **Delivery Mode** identifies the recommended format(s) for delivering a BIM topic to a target audience.

Tabel 1.

BIM Learning Modules (Target Audience)	**BIM Topics Included** (Competency Class)	**Delivery Level** (Delivery Method)	**Prerequisites**	**Optional Tags**
BIM Project Facilitation (Project Managers, Clients, Facility Managers)	**Developing a BIM Management Plan** (Implementation)	**Level 1** (workshop)	Understanding BIM Workflows	Workflow Management, Team Management, Conflict Resolution, etc...
	Understanding Data Exchange Protocols (Functional)	**Level 1** (presentation)		
	Understanding Model Progression Specifications (Technical)	**Level 2** (workshop)		
	...Other			
Model Management for Collaborative Projects (BIM Managers, Senior Technical Staff)	**Understanding Data Exchange Protocols** (Functional)	**Level 3** (online presentation)	BIM Managers, Technical	Data Management, Technical Roles, Auditing Protocols
	Model Auditing for Model Managers (Technical)	**Level 2** (lab)		
	...Other			

Tabel 2.

Component C. Collating Competencies & developing BIM Learning modules

The number of BIM Topics required by BIM Learners (refer back to Document E1) is quite large in number. To enable BIM Learning providers and other industry stakeholders to collate and classify BIM Competencies, a dedicated information system is needed. The EWG believes that an online **BIM Learning Hub** – a web-hosted database – is the most efficient way forward. With an adequate database structure and intuitive interface, the Learning Hub will be able to streamline the process of collecting and classifying BIM Competencies.

The online system will also be instrumental in developing **BIM Learning modules** – a collection of BIM Competencies, intended for delivery to a specific audience at a selected level of difficulty. The content and **delivery format** (course, lab, workshop, video) of each learning module depends on which group of BIM Learners are being targeted (an undergraduate student, a tradesperson, a construction manager).

BIM Learning modules can either be standardised (for the purpose of course accreditation) or customised by each BIM Learning Provider to match their constituent members. While all modules use the same BIM dictionary definitions and taxonomy classifications (as discussed in Component B), they can vary significantly in how modules are packaged and delivered to learners:

Component D. An industry framework for professional development

As discussed in Document E2, many organisations and their representative bodies already deliver **BIM Learning and accreditation opportunities** to their staff and constituent members. However, to deliver the needed **Collaborative BIM Training and Development** to current professionals across disciplines and specialities, there is a need to develop a **BIM Education Cooperation Framework** between industry associations. Such a cooperation framework – even if partially subscribed to – will allow the generation and joint delivery of much needed, collaborative BIM Learning modules (in the form of Continuing Professional Development courses or similar). A well-structured and accessible BIM Learning Hub will facilitate such cooperation and allow practitioners to contribute towards and make good use of discipline-specific and multi-disciplinary BIM Learning modules.

Component E. An academic framework for BIM Education

Tertiary institutions are facing specific challenges as they adopt ever-changing BIM technologies and multidisciplinary workflows (refer back to Document E2). Specialised academic frameworks for BIM Education will be needed to enable academic institutions to contribute to and benefit from the BIM Learning Hub. Such frameworks exist today (eg, the OLT project identified in Document E2) and can play an important role in aligning the deliverables of this collaborative framework with the specific requirements of tertiary education. Jointly identified and developed BIM Learning modules – customised for university lecturers or graduate/undergraduate students – can play an important role in facilitating the introduction of BIM topics into schools and faculties.

Component F. The BIM Institute

The Collaborative BIM Education Framework requires a substantial effort to implement. It also requires a well-coordinated, long-term commitment by industry stakeholders. In alignment with buildingSMART-Australasia's National BIM Initiative, the Education Working Group acknowledges the need for an organised effort – a National BIM Institute, BIM Academy or similar – to facilitate the development and delivery of BIM Education across industry[4]. The education-focused tasks assigned to such an institute should be collaboratively defined by all BIM Learning Providers – but may well include:

- Develop and maintain classification systems for organising BIM Education
- Develop and maintain the BIM Learning Hub
- Develop a coordination framework between professional associations for the purpose of multi-disciplinary BIM training and development
- Initiate BIM collaboration labs for sharing knowledge and testing new workflows
- Conduct BIM-usage surveys and publish relevant papers and reports
- Act as a central social space for all BIM Learners and BIM Learning Providers

To reiterate the importance of the Collaborative BIM Education Framework introduced above, the three BIM facets (the BIM Leaner, the BIM Learning Provider and BIM Learning Spectrum) are combined into a simplified yet typical scenario:

> Each BIM Learning Provider (a university, TAFE, professional association) has (a) a unique interest, ability and approach in delivering (b) a selected part of the whole BIM Learning Spectrum to (c) a targeted subset of BIM Learners.

> For example, a professional association (a Learning Provider) representing cost planners may be interested in delivering a CPD Program to their members (cost planners – a type of Learner) titled 'IPD from a Cost Planning Perspective' (a BIM Topic within the overall Learning Spectrum). However, the same professional association may not be well placed or interested in delivering other topics needed by the same learners. For example, 'Cost Estimation for Algorithmic Structures' and 'Cost-Estimation using [Software Name]' are better delivered through a tertiary course and a registered, online training video respectively.

Using the example above, it is in all stakeholders' interest to participate in a Collaborative BIM Education program which allows them to focus on developing their unique abilities and rely on other Learning Providers to deliver the complementary BIM topics needed by their constituents.

CONCLUSION

The BIM Learning Spectrum includes all topics that need to be learned by various BIM Learners – irrespective of their discipline, role or formal qualification. At the core of the BIM Learning Spectrum are thousands of individual BIM competencies – the granular learning topics underlying the many discipline, sectors and trades. Using a specialised taxonomy, these individual competencies can be collated into BIM Learning Modules, each customised to match the requirements of their target audience. The BIM Education Framework, introduced in this paper, proposes how to identify, organise and collate these competencies and modules. It also identifies two additional and complementary frameworks intended to encourage the proliferation of collaborative BIM education across professional associations and academic institutions. The framework finally proposes the formation of a BIM institute, an entity which can play an important role in promoting and facilitating BIM learning throughout industry and academia.

4 Such an institute will have many other objectives beyond BIM Education (eg, lobbying, communication, etc)

Summary

EP15. There are many BIM competencies which need to be learned by individuals involved in the design, construction and operation of facilities

EP16. A collaborative CPD program is an integral part of the Collaborative BIM Education Framework.

EP17. A web-hosted, socially connected BIM Learning Hub at the core of the Collaborative BIM Education Framework is needed.

EP18. A BIM Learning Module is a collection of BIM topics, customised for a target audience, and delivered at a defined level of difficulty.

EP19. An academic framework informed by research, discipline professionals and other industry stakeholders is a pre-requisite for delivering Collaborative BIM Education within tertiary institutions.

EP20. The establishment of a well-structured and well-funded BIM institution is essential to facilitate the development and delivery of Collaborative BIM Education across the construction industry