

# BIM Outreach

010 *BIM for specialist  
sub-contractors  
and trades*

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**BIM IN PRACTICE**



Australian  
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# BIM Outreach

## *O10 BIM for specialist sub-contractors and trades*

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### O10 BIM for specialist sub-contractors and trades [Version 1 – October 2013]

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## INTRODUCTION

The purpose of this paper is to describe practical applications for the specialist sub-contracting and trade supply chain with adopting BIM tools/workflows and to introduce them to the associated process change. Subcontractors form an essential 'link' in the supply chain of lifecycle BIM, and an increasing number of subcontractors adopt BIM as part of their delivery process. Further, the use of BIM suggests new pathways in the workflow between consultants, the head contractor and subcontractors and the client / owner with new opportunities for physical pre-assembly and off site fabrication to reduce safety risks, plus just-in-time site deliveries.

## LINKING DESIGN TO CONSTRUCTION (AND BEYOND)

Similar to the physical world where subcontractors are responsible for the assembly of custom built products and installation of precisely specified building equipment. they now also do so virtually by pre-assembling and coordinating the installation of 'Construction BIM'. Subcontractors thereby aim at obtaining not just 2D documents, but 'Design Intent' BIM from consultants as a basis to specify the precise equipment to be installed. In doing so, subcontractors interpret the Design Intent BIM to then select components and /or materials for virtual coordination and construction.

*Design Intent BIMs* contain the design/procurement/CAB (commissioned as built) technical schedules and provide a basic range of standard, generic design models covering the majority of the designer's requirements. Design data embedded in the BIM objects that are compiled during the design development stage includes the extraction of specification relevant data for the equipment schedules, as well as system integration information. It is expected that the design model schedules should significantly improve the quality of design technical data scheduling assuring the majority of technical parameters are clearly specified to aid the tendering and letting of contracts workflow processes.

*Construction BIMs* on the other hand are manufacturer specific models which have both the design schedule and procurement schedule data completed. Models are dimensionally accurate sufficient for workshop detail drawings for manufacturing and installation purposes. The technical data schedules will include a range of parameters, some of which are not accessible and others which are defined as shared parameters – i.e. can be scheduled. Construction BIMs consider the non-geometrical data (properties/attributes) that needs to be attached to the BIM for Operation and Maintenance (O&M) further down the track; they also need to consider the installation constraints and safe handling sequencing, as well as the spatial requirements for access and servicing during operation. In some cases (e.g. within the realm of mechanical subcontracting), well configured Construction BIMs allow specialist trades to communicate their workshop detail drawings straight to the fabrication equipment and robotic site positioning layout equipment, thereby strongly reducing the need for 2D documentation. The Construction BIMs can now be accessed via the cloud and viewed on hand held tablet devices that can extract the data on demand.

The closer we can link from design to fabrication and construction, the greater the overall benefits to the industry lifecycle as a whole. One open question related to these new opportunities deals with the effort consultants put into configuring their 'Design Intent' BIM. Most sub-contractors and trades who receive such models lament the inadequate information content within 'Design Intent' BIMs that were not set up with their estimating, fabricateable, installation and maintenance needs in mind. A trend is noticeable among mechanical subcontractors: they increasingly take over modelling tasks that were traditionally performed by engineering drafters who would provide more than just the performance outline, scope of works and design intent of uncoordinated services routes and equipment to be installed.

## SKILLS AND TRAINING

Australian subcontractors in general are undergoing a major transition in their education of object based 3D modelling. Current and novice professionals undergo dedicated BIM training as the entire industry gears up to become BIM enabled. A pivotal part of this education process is BIM advocacy and stronger awareness of the change in work practices by major industry bodies representing subcontractors in Australia. As stated in the BIM Education papers that form part of this series of documents, BIM Education should cut across all major disciplines that are involved in the management of building information during its lifecycle. Implementing BIM is more than picking up software skills, it is about acquiring communication and collaboration skills that enable and encourage us to deliver projects in an integrated way.

The entire workflow for designing, estimating, procuring, manufacturing, delivering, installing, commissioning and maintaining buildings needs to be reconsidered (revamped). For subcontractors this process-change means: preparing for early involvement in the design process and interpreting "Design Intent" BIM for the purpose of creating "Construction BIM" models that contain bespoke equipment/materials/construction systems. Key to this learning process is an understanding of the relation between expected output from BIM and the manufacturing/installation/maintenance process. Some sectors of the construction industry introduce knowledge-based engineering to support informed transitions from "Design Intent" to "Construction" BIM. Such support requires prior definition of standards for information exchange and the generation of BIM content in order to comply with technical schedules. In this context it becomes crucial to associate Construction BIM components with numeric product data (quantities, cost, servicing), to consider interfaces to CAM (computer aided manufacture) for rapid (and less waste) manufacture, and to facilitate the generation of O&M manuals that can be accessed by a facility's operator. The subcontractor can therefore advise the Facility/Asset Manager on how the Commission As-Built (CAB) will influence the operation of the building.

## CHALLENGES

A lack of standardisation within the industry has created numerous barriers to the effective uptake and use of BIM in Australia. Concerns about the viability of BIM remain among a large number of subcontractors irrespective of a particular discipline; specific concerns reported include:

- Significant time and cost burdens involved in customising BIM modelling software to suit Australian design and construction requirements.
- Lack of industry standards supporting BIM.
- Inconsistent interoperability between different BIM software packages.
- Poor consideration of the requirements for integrated project delivery.
- Limited BIM project management and file management expertise within the industry.
- Reluctance to share the models
- Not enough time allowed with subcontractors to engage earlier
- Contracts exchanged (let) too late
- The tender documents fall short
- The construction overtakes the design
- Client expectations not understood
- Consultants not educated to understand the fabricateable, installation and maintenance site constraints

With some notable exceptions, there currently exist only limited advantages for subcontractors to take the 'Design Intent' BIM generated by consultants to then generate 'Construction' BIM for detailed specification, spatial coordination, assembly and beyond. Models generated by consultants serve a different purpose than models used by the subcontractors. Architects and engineering consultants typically apply far less detail when authoring their 'Design Intent' BIM than what is required by contractors for fabrication. In some cases, consultants still only pass on 2D CAD information (at times in PDF format) to the contractor despite working in BIM themselves. The disruption of the BIM workflow is usually based on a lack of contractual obligations by the consultants to share their BIMs and the risk they perceive (IP, liability) in handing over their original models.

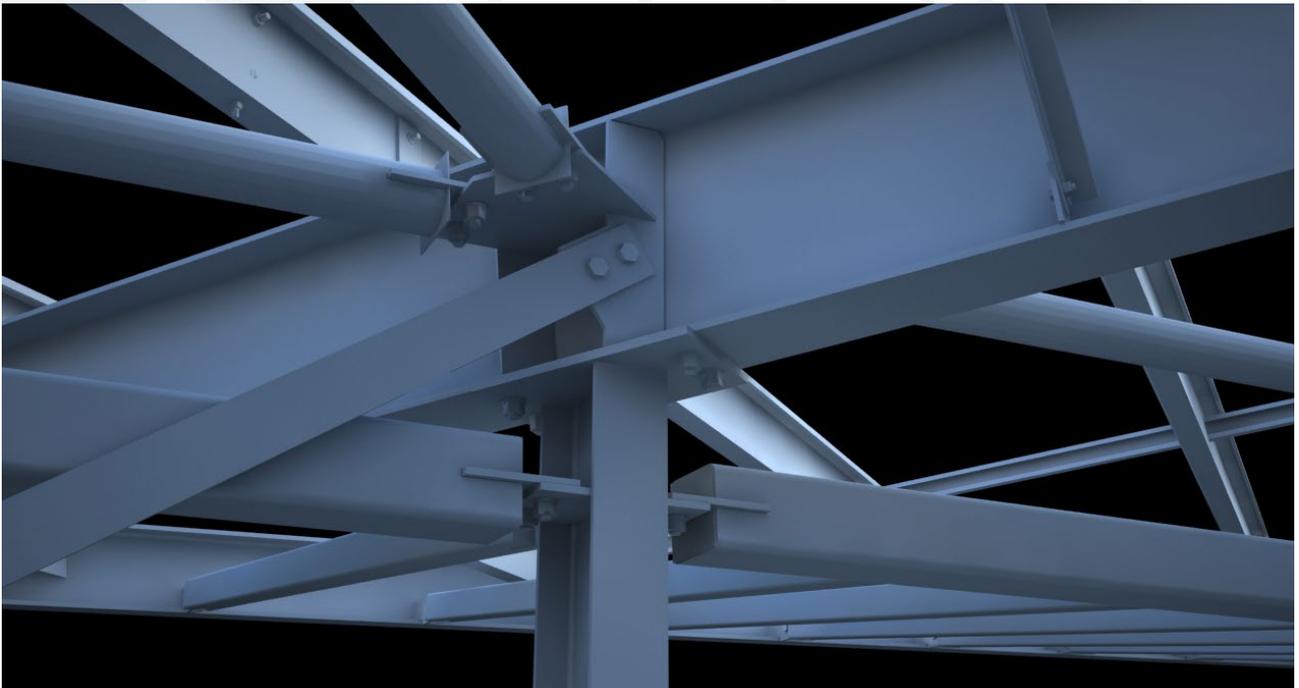


Image: Fraser Coast Detail Model (Source: Jackson Roxborough)

## BRIDGING BETWEEN 'DESIGN INTENT BIM' AND 'CONSTRUCTION BIM'

Several industry bodies representing subcontractors and the trades have started to address the challenges mentioned previously. Standardising data formats and exchange to increase interoperability has been on the agenda of the Australian Institute of Steel Detailers (AISD) for a number of years; the 'Air Conditioning and Mechanical Contractors' Association' (AMCA) supports the development of bespoke standards and BIM content for their members through their initiative 'BIM-MEP<sup>AUS</sup>'.

Other organisations are on their path to consolidate the diverse BIM approaches of their members in order to develop streamlined national policies that are in line with broader industry requirements.

Industry feedback illustrates that one first needs to consider the interoperability of digital formats applied in the exchange of modelling data for linking between 'Design Intent' and 'Construction' BIM. This interface is currently dealt with on two levels among Australian subcontractors.

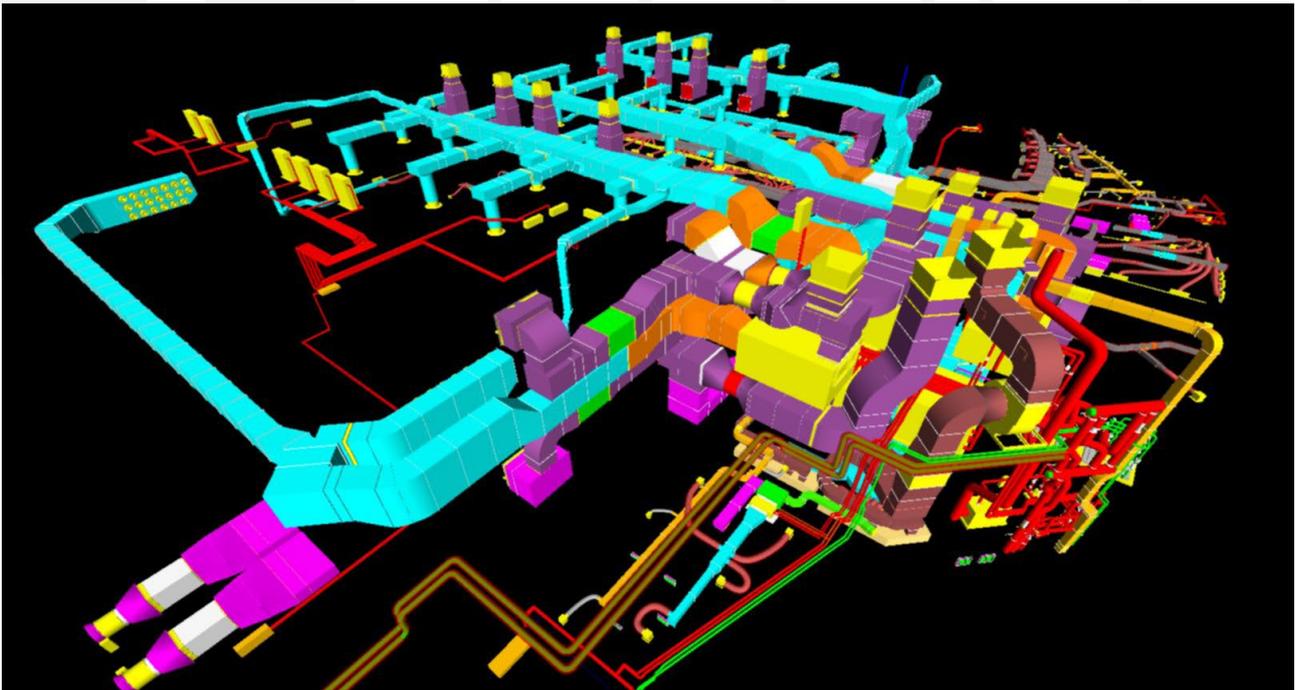
The first level addresses the consistency of BIMs when exchanging data across BIM software from different providers. There is a need in the industry to develop a mentality of linear integration with a focus on process. A process where consultants and contractors collaborate and communicate digitally, using a standard data model that is growing in intelligence as information moves from discipline to discipline. Over the past years, the globally accepted 'Industry Foundation Classes' data model (IFC) has proven to be a stepping stone to allow trade contractors (and others) to communicate digital design information and intent with consultants for the purpose of re-interpreting their intent for shop detailing. As a neutral and open specification, the IFC allows for file exchange between sub-contractors for (spatial) coordination purposes and more.

It should be noted that the IFC is still under development, but it has continuously been improved since its conception in 1994. There remain a number of IFC sceptics in the industry, but inconsistencies, and the level of hand-holding required during data transfer, are diminishing with every new release (currently: IFC4).

The second level considers alternative project delivery strategies that specifically target the use of BIM. The BIM-MEP<sup>AUS</sup> initiative has so far been the most pro-active approach by proposing a 'BIM-all-the-way' design/construction/ (CAB) workflow. The

BIM-all-the-way workflow enables a building to be designed and coordinated in a virtual environment before being built on site whilst also allowing best of breed fabrication software to be used for the manufacture and estimating. The workflow is fundamentally dependent on the use of managed content to deliver standard models which are certified, to assure compliance with the technical schedules and functionality with the BIM-MEP<sup>AUS</sup> add-in for BIM authoring and fabrication software needed for manufacturing purposes and procuring bought in equipment. There is also a range of opportunities for suppliers, particularly interaction among various businesses that link project components from various subcontractors together during off site assembly processes called modularisation for 'just in time' site deliveries. There is also a range of opportunities for suppliers, particularly interaction among various businesses that link project components together during assembly processes.

The BIM-MEP<sup>AUS</sup> approach could be adjusted to suit other trade contractors and their specific workflow. The combination of strong standards in parallel with the development of referring BIM content facilitates a fluid transition from Design Intent BIM to Construction BIM.



1 [http://www.bimmeaus.com.au/home\\_page.html](http://www.bimmeaus.com.au/home_page.html)

Image: MUEF Star Casino (Source: BSA Limited)

## MODEL DEVELOPMENT

Where BIM models for a specific item were not provided by the item's manufacturer, they can either be developed in-house or generated by third party BIM content creators. Where manufacturers have existing content, those third party providers can assess the models and determine whether they are suitable to either modify or augment to generate models that comply to the subcontractors' specification with the shared parameters data fields added for exchange of data between the schedules, during the workflow phases.

There currently exist initiatives to setup a National Object library of BIM components. This development is still in early stages, but should be observed closely as it may one day become the common interface for product manufacturers and specifiers/BIM users.

### Design phase

Manufacturers should be able to promote vendor neutral 'Design Intent' BIMs related to their respective trade (ideally hosted on an online library). Examples of where this is likely to occur are where a new product is introduced into the market.

Where a manufacturer works with a designer/detailer, they would ideally have access to a framework for certification by their respective industry body. This should allow manufacturer models to be inserted in the design model. The design schedules generated will identify the manufacturer as either a nominated supplier, or approved or equal supplier as deemed appropriate by the designer.

### Construction phase

Once the key structural elements are determined and the 'Design Intent' BIM is clearly defined at the end of Design Development, it is envisaged that the trade installers will take custodianship of certified BIM components and will develop them to 'Construction BIM' model status, which will:

- incorporate the manufacturer models for the equipment selected for the project; and
- sufficiently resolve spatial coordination for general construction purposes.
- consider procurement data schedules
- target commissioning data prior to commissioning commences

### Fabrication phase

Once the construction models are approved, it is envisaged that installers will convert them into Fabrication Models in cases where their workflow allows for this mode of delivery (e.g. for ducts and pipework). The level of automation that can possibly be applied to this process depends on pre-defined, knowledge-based semantic interpretation capabilities of the fabrication software in use.

- Fabrication models can be used for a variety of purposes including construction detailing, fabrication and CAM routines for manufacture.

- Construction BIMs can get converted to Fabrication models whilst retaining their geometry
- Conversion back to a BIM Construction model will be possible using the fabrication to provide accurate as-built documentation as required.
- It results in greater opportunities to explore value-adding services.
- Data extracted to exchange onto the robotic site positioning layout equipment,
- The fabrication BIMs can be uploaded to the cloud and viewed on hand-held tablet devices that can extract the data on demand for the installation teams.

## SIGNIFICANT WORKFLOW CHANGES AFFECTING THE SUPPLY CHAIN

In consideration of the changes in the nature of information flow between 'Design Intent' BIM and 'Construction BIM', but in particular when linking BIMs further into fabrication, one can currently observe a new industry trend in Australia (as well as internationally). BIM allows for transparent and well-coordinated supply-chain integration of single or multiple trade models into 'smart assemblies' that can be modulated or unitised. Leading edge subcontractors and trades increasingly opt for offsite fabrication of such assemblies in controlled environments such as a factory or warehouse close to the projects. The resulting modules or units adhere to size and weight constraints required for transport and installation. Offsite prefabrication has significant impact on time, material waste, cost and safety related matters. It reduces risk and offers more certainty about the quality of the assembly and the time required for installation and 'just in time' deliveries. Cost savings are proving to be significant and principals and head contractors are likely to expect from their subcontractors to be able to deliver such assemblies based on well-coordinated BIM.

In addition to the above, the industry is likely to experience a development towards further automation of assembly and construction with the use of robotic equipment that can directly interpret coordinated datasets provided by BIM.

## CONCLUSIONS

The success of the BIM workflow for subcontractors depends on their skill in operating in this virtual context, the availability of (trade) certified BIM libraries of the components they are installing, and the implementation of clear industry standards relating to their trade, but also the trades of other subcontractors they collaborate with. Overall, BIM and IPD signify a major cultural change for subcontractors if it allows them to be more linked into the design process while simultaneously having tighter control over fabrication and installation.