

Close working adds value throughout supply chain

Steel Australia recently spoke with specialists from the engineering and design sector on the value of integrated project delivery for their practices and the steel supply chain.

Value for structural engineers

Michael McVeigh and Vince Williams, McVeigh Consulting

Engineers receive huge benefits to their programs as they no longer need to convert 3D BIM models into 2D drawings to communicate their design intent to the detailers as this all happens electronically and in 3D.



Michael McVeigh Vince Williams

Engineers no longer need to coordinate their steel details with CAD drawings as this all happens electronically now with engineering sketches within a 3D model. Engineers no longer need to spend tens of hours reviewing hundreds of printed-out 2D shop drawings as this now all occurs within 3D models and with automatic clash detections.

On a current 25,000sqm warehouse project we have been able to squeeze the delivery of steelwork shop drawings by four weeks by using this workflow. This has saved the engineering team around 40 hours of unnecessary detailing and shop drawing review time in the 825 man hour program or around five percent.

The verbal face-to-face communication happens a lot more frequently now as a matter of course. The technology has brought this positive change into action due to forced coordination within 3D and in real time. IPD also enhances our working relationship with the architects by enforcing earlier engagement of ideas between both parties. This really allows the engineering value to be added early in the design development process and expels late coordination changes between the two disciplines.

For example the communication of steel surface treatments now happens visually and is embedded as an attribute within the 3D model. Galvanized steel may be in one on-screen visual colour and painted steel in another. This prevents design intentions being misinterpreted.

The key is still verbally communicating any potential design changes to the entire IPD team as early as possible, just as you would to your fellow engineers in your own company who are involved in a project.

There are no longer requirements for multiple revision clouds and long winded explanations in revision boxes, although even electronic model transfers require document control with revision numbers in order to keep track of current issues.

Engagement with additional minds assists in managing safety in design concerns. For example on a recent 30,000sqm warehouse project, we were able to work with the fabricator, detailer and rigger to explore and nominate the requirement for temporary bracing for a safe erection procedure.

The 3D models can also contain attributes for approved compliance and visually steel members that have been approved may come up in a different on-screen visual colour to those that aren't, which can then be approved for fabrication.

Value for steel detailers

Clayton Roxborough and Phil Shanks, Jackson Roxborough

One of the advantages of the IPD process is its flexibility. Whether its face-to-face meetings, high-end 5D model translation or something in between, there is a freedom to collaborate that progressive construction professionals are now beginning to recognise and value.



Clayton Roxborough Phil Shanks

The IPD process allows direct liaison between detail modellers and designer disciplines while the design is still able to be adapted as or when issues are exposed. Altering the 3D model is far easier than making the changes after detailing is complete.

The request for information (RFI) process is the bane of project managers in construction, particularly when the pressure is on critical path items like hold down bolts or other early works items. With IPD there may still be questions but the answers are practically immediate. We've found that IPD fosters a more team-like approach to resolutions rather than the often toxic atmosphere of contractual cut and thrust.

It has long been the belief of the construction industry that one of the most significant risks faced by the structural steel supply chain is the workshop detailing drawing office. That's because it's during the detailing process that many design issues are first exposed.

Whether it's coordination of architectural intent with structural integrity or just a silly design drafting error, it's the delay in resolving these problems that can have serious impact on the rest of the steel supply chain and the construction schedule.

IPD is most powerful in the Design & Construct sector. The model that steel detailers develop is referred to as the 'Integrated Construction Model' (ICM). Being able to create the ICM in conjunction with the final stages of design development allows for a very fluid and immediate information flow to our modellers. Having this communication with the design consultants minimises the doubt and delay that detailers have had to endure with the traditional process. As a result, IPD practically eliminates the biggest risk in the steel supply chain.

With a tolerance of one millimetre, the integrated steel detailer's model provides a level of accuracy unsurpassed in building and construction.

The IPD approach has opened up a whole new field of value-add potential for steel construction. We have developed processes that handle this data in a way that is flexible and user-friendly to third parties, making the information available when and how they want it.

It's an advantage to the project that is simply not available if the detailer has not been engaged in the IPD method by either the builder or the project principal.

Value for supply chain managers

Karle Vogt and Mark O'Loughlin, STEELiNK

The IPD way provides value in project controls as an enormous amount of engineered data can easily be applied to an established set of unit rates that can be used for all progress reporting of engineering, shop detailing, tendering, procurement, expediting, accounts payable, client monthly claims and construction status.



Karle Vogt Mark O'Loughlin

Project team collaboration via virtual 3D models can include the client, engineers, procurement people, vendors and construction stakeholders.

Standard reports can be generated using one main database for all types of documentation, including scopes of work for tendering, procurement and delivery advice, quality control, RFIs, scheduling updates, work packages for fabrication, installation, commissioning and maintenance activities.

Everything is stored, managed and reported in a single cohesive system that provides disciplined platforms for accurate reporting whilst slashing data entry by 90 percent.

All materials are tracked from drawings right through to use onsite. Every nut, bolt and washer is tracked and accounted for. Commissioning, maintenance and asset management activities can be effectively managed and controlled from the 3D model and central database.

This collaborative approach significantly improves 'realistic' communication and efficiencies between the project team and the many interfaces of the supply chain that mitigates risk. Improved construction staging, sequencing and erection functions are significantly improved.

IPD also significantly increases triple bottom line values in terms of quality, schedule and budget outcomes. Whilst it does introduce some marginal indirect overhead costs for the project management structure, it is significantly offset by reduced project risks and lifting supply chain efficiencies.

Vendors' claims and tax invoices can be accurately verified and approved via progress reports and central database to expediting payment. Project production activities can commence either on time or ahead of schedule to improve shareholder commercial returns.

Early engagement of IPD is critical so the methodology should be included in the head contract between the client and EPC and/or the subcontract agreements between the EPC and all vendors.

Value for architects

Stephan Langella, Strategic BIM Manager, Rice Daubney



Stephan Langella

Traditionally an architect is required to coordinate a set of information from a design consultant (with a commercial outcome in mind). This is then refined and in some cases, largely modified by the subcontractor (who has a hard dollar commercial outcome in mind).

This in turn must be re-coordinated by the architect. It's time intensive, financially risky and inefficient.

IPD and BIM by nature consolidate a lot of information and decision making involved in such a process into earlier and more singular events.

In our practice we are beginning to see more initial options being explored and shorter distances between the agreed idea and the result delivered and installed onsite as a result of BIM.

Through IPD the architect can have a lot more exposure to the manufacturer or installer and their processes and software. Design BIM software is mostly about modelling and documenting a finished product whereas for example, a sheet metal or steelwork manufacturer's software is also about the process accounting for manufacturing efficiency and reductions in waste.

"We see one of the greatest challenges to our practice (and the profession) as not to be relegated to 'a scribble on a napkin' but rather remaining valuable through active and relevant participation in the information supply chain that ultimately delivers a building."

With BIM we investigate more design alternatives better leveraging our models by engaging with the person who knows best about the manufacture of the end product. We then see better validation and results feeding back into the design earlier. This is why we can see better designed buildings with less financial risk and reduced waste which ultimately benefits the client, the building's inhabitants, the community and the environment.

The value of IPD and BIM is fairly clear and the 'green shoots' of this are visible on projects now. However, our role is changing.

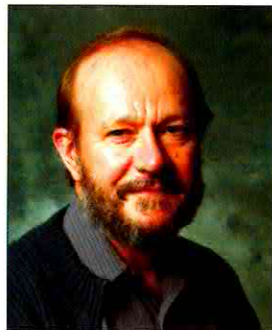
The consolidation and streamlining of the overall process has meant the architect's emphasis is shifting more to focusing on the design intent and managing the overall process, and less on documenting detail. Accordingly our fee structures and ultimately the business model are evolving to remain viable and be sustainable.

We see one of the greatest challenges to our practice (and the profession) as not to be relegated to 'a scribble on a napkin' but rather remaining valuable through active and relevant participation in the information supply chain that ultimately delivers a building.

Linking relationships, technology and process

By **ROBIN DROGEMULLER**

Professor of Digital Design, Queensland University of Technology



The construction industry is knowledge intensive. Most participants – architects, engineers, quantity surveyors, construction/project managers, facility managers – are all knowledge workers so it stands to reason that exchanging information more efficiently can benefit development works.

An integrated building model concept shared by all of project participants was first applied to the construction industry in the 1990s from applied research starting in the 1980s from which grew Building Information Modelling/Management (BIM). There were large scale efforts to define what needed to be in a building model and how this information would be shared. The introduction of the Industry Foundation Classes (IFCs) in 1995 gave this concept the recognition that was needed to push uptake for building work by industry.

IFCs can now bring together information about a building and its components and services, the spaces within, the people and companies involved in the building process, the activities needed to build it and the costs of design and construction. The development of the IFC concept over the past 18 years has necessitated working through collaboration issues:

- How can a single unified model of a building project meet the wide range of needs of the various users?
- Can information that is irrelevant for other users be hidden?
- What level of detail is it possible to provide and what is necessary?

This approach uses software and data stores from a range of vendors to provide the 'open' collaborative project environment being developed under the OpenBIM label. Uptake of the BIM concept within building construction has led to its extension to infrastructure projects.

The improvements in computer performance have also led to the concept of the single vendor platform to ease the issue of sharing information between various members of a project team. The challenge is that all members of the team have to use products from the same vendor for it to work as intended. The decision of a project team to use either OpenBIM or a single vendor platform needs to be taken for a particular project and the needs of the team. There has been considerable Australian influence on the development of the BIM concept. The Australasian Chapter of buildingSMART (previously the International Alliance for Interoperability) was formed in 1997 and has been contributing internationally since then. In 1998 the CSIRO started investigating the use of IFCs to support the exchange of technical information about buildings.

The formation of the Collaborative Research Centre for Construction Innovation (CRC CI) in 2001 added impetus to work around information flows within the construction industry. The CRC CI also sponsored a number of projects to improve the uptake and use of BIM by industry including Australian BIM Guidelines and case studies.

Various software tools were developed by CRC CI and CSIRO teams to understand the OpenBIM process. These supported activities such as lifecycle environmental analysis, quantity take-off and estimating,

building code checking, parametric building design systems, automating construction scheduling and facilities management. The development of CostX BIM-based quantity take-off and estimating software as an Australian software product in this space should also be recognised.

The impact of these technical developments laid the groundwork for design and construction decision making to be more integrated and considered earlier in the building procurement process.

The 'traditional' approach to building construction involves the architect working with the client to establish the client's needs and designing a building to meet those needs. Problems are identified with the contract documents during construction or the client's needs change, and the as-built structure is seldom identical to the building as-designed. The advantage of this traditional approach is that there is a high degree of certainty in what the client will receive on completion of the building. The disadvantages are that final cost is not known and the process is very linear taking significantly longer to achieve results than alternative methods. There is also a high reliance on the knowledge of construction methods and onsite processes by the architect and design engineers to avoid designing buildings that are difficult to construct.

The use of information technology can speed up the activities within the traditional design process but it cannot remove the linear nature of the process or the lack of 'feed forward' of information from construction teams to building designers.

New integrated engineering design software is also changing the way the design and construction process works. For example, Queensland Project Services identified inefficiencies in the design and manufacture of mechanical services in their buildings. A mechanical engineer would design the heating, ventilation and air conditioning (HVAC) plant for a new project to size the plant room and provide coordination data to the other design disciplines on duct sizing and location. Some mechanical services sub-contractors would use specialist software to redesign the duct sizing and layouts and resize plant to offer a cheaper price. The ability to send data directly from HVAC design software to numerically controlled machines that could then automatically cut, fold and assemble ducts was a significant competitive advantage. While this process is more efficient due to the availability of enabling software, the traditional procurement process means that in this case the HVAC system is designed twice.

Clearly clever software alone is not enough to anticipate and deal with issues pre-emptively to avoid rework. Integrated Project Delivery (IPD) is one method of improving efficiencies in the building procurement process.

As the industry moves towards IPD methods of procurement there will be increased opportunities for the use of steel in prefabricated components due to its light weight and strength. A challenge will be to adapt our supply chains and off-site manufacturing processes to ensure that this work is done in Australia.

Designers have a clear stake in safety of structures

By **DEBORAH HAMMOND***

Occupational Health and Safety Solutions



Under recent changes to work health and safety legislation, designers (architects, engineers and builders) have greater responsibility for safety throughout the lifecycle of a structure.

Substantial improvements in safety can only be achieved when designers address hazards at the design stage of the project.

There are five key principles of safety in design:

- Systematic risk management
- Lifecycle assessment
- Knowledge and capability of designers
- Consultation and cooperation
- Information transfer

Systematic risk management

Safety is not just common sense, although undoubtedly this has a role to play. It is important for designers to understand how other people downstream do their job, the challenges they face and how their designs can impact on their working lives.

They need to identify risks in how a building will be used from construction through to demolition and assess the likelihood and potential impact of those risks. Obviously a structure is only as strong as the materials that form it. Are the right materials being chosen? If imported from overseas, who is checking the materials meet Australian Standards?

Just because a product is on the market does not make it the right choice for a design. The history of asbestos use and its ramifications should be a stark warning to all designers about the importance of product choice.

A risk review workshop will allow the design team to review plans, discuss options for managing workplace hazards and identify strategies to improve the work environment. Clearly risk assessments need to be completed before plans are finalised and there is little opportunity for change.

Lifecycle assessment

Designers are required to consider the structure throughout its lifecycle. Consider how the structure will be built. How will it be maintained? How would it be cleaned? How will workers use the spaces created? What types of people will access it? And at the end of the cycle, how will it be demolished and materials recycled?

Sustainable and robust products and materials reduce the need for repairs and maintenance. Inferior products lead to more maintenance, earlier replacement and higher running costs for clients.

Knowledge and capability

It is no longer sufficient to know how to design a building. Designers must also understand work health and safety requirements, the risk management process, the structure lifecycle and even human nature. Yes, they even have to consider how a structure may be misused.

Consultation

The new legislation stresses the importance of consultation. The best way of increasing knowledge and capability is through consultation with all key stakeholders.

Ask the builder what construction methods they recommend and identify any hazards with them. Ask the client how they plan to use the structure – what activities will be conducted, space requirements, special ventilation needs, numbers of workers using the building, access to the public. Ask the facilities manager what they need – where will maintenance occur (at heights, confined spaces, under water?), how often will workers need special qualifications, what are the manual handling requirements? If a structure is hard to maintain, maintenance may not happen, leading to early deterioration in the building fabric and reduced amenity for occupants.

Armed with this information, designs can be modified to eliminate or minimise hazards in the use of a building.

Information transfer

When all that is worked out, designers need to make sure everyone involved understands the design intent and that the right people have access to the right information at the right time. This may be constructors ensuring the correct building products are used through to the facilities manager understanding how a falls arrest system works when maintaining high areas.

Safety in design offers a great opportunity for designers to demonstrate how good design can improve the working environment of all workers and for the community at large.

Reference: Code of Practice – Safe design of Structures, www.safeworkaustralia.gov.au

**Deborah Hammond has been a leader in training on Safety in Design for many years having developed the course for Consult Australia and facilitated it across the country for the past five years. She also facilitates design risk workshops for a number of clients in the building and engineering industry. Visit www.ohssolutions.com.au*

For more information on new workplace health and safety legislation visit: <http://steel.org.au/keyissues/compliance/whs-2011/>