

# Exploring Risks and Rewards Associated with High Performance Manufactured Buildings

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## ABSTRACT

The transition to the offsite construction and manufacture of buildings stands to create a lucrative opportunity for the global building sector. The shift to the manufacture of buildings stands to generate numerous benefits including economic benefits (such as construction times for major commercial construction projects substantially), social benefits (significantly improving workplace occupational health and safety by bringing the majority of building construction indoors), and environmental benefits (through reduced materials wastage, reduced materials transportation, greater inclusion of energy and water efficient elements, and the potential for greater use of recycled materials). This paper explores a range of factors that affect the attractiveness of such benefits along with the perception of the associated risks related to the fact that for instance in order to provide the access to capital needed to significantly upscale building manufacture long standing financing structures need to be redesigned in the building sector related to providing progress payments and dealing with completion risk.

The paper is informed by an industry workshop held by Sustainable Built Environment National Research Centre (SBEnc) in Australia, in collaboration with the EU Centre for Global Affairs at the University of Adelaide and prefabAUS, on the topic of "Capturing Opportunities from Financing Offset Building Manufacture". The workshop was held as an official partner event as part of the European Union's Green Week 2016. The workshop was well attended with 25 representatives from banks, builders, government agencies and researchers. In-line with the Green Week theme of "Investing in the Future" the workshop focused on how the banking community perceived risks and rewards from investing in the manufacture of buildings in Australia.

**Keywords:** *building manufacture, construction risk, innovation*

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## 1. INTRODUCTION

The transition to the offsite construction and manufacture of buildings stands to create a lucrative opportunity for the global building sector. The shift to the manufacture of buildings stands to reduce a number of impacts including economic (reducing the time homebuyers rent while their home is constructed), social (significantly improving workplace occupational health and safety by bringing the majority of building construction indoors), and environmentally (through reduced materials wastage, reduced materials transportation, greater inclusion of energy and water efficient elements, and the potential for greater use of recycled materials).

In 2012 the economic output from the manufacture of buildings globally was estimated at just over US\$90 billion, up from \$60 billion in 2011. Asia-Pacific was the largest regional market in 2012, worth just under \$60 billion, outperforming all other regional markets, and set to rise to some \$100 billion by 2020. In 2014 the largest regional market was Asia-Pacific valued at US\$44.4 billion, followed by Europe at US\$31.5 billion, and North America at US\$10.2 billion. China constituted the largest share of the Asia-Pacific market with just over 60% in 2012, followed by Japan at 22%, Australia at 7%, and Indonesia at 5%. The growing number of case studies and examples of manufacturing buildings provides quantifiable data that can inform efforts to capture the opportunities by providing strong evidence to developers, investors, and homebuyers.

There is great potential for the manufacture of buildings to be harnessed to significantly strengthen both the building and manufacturing sectors. Domestic building industries around the world will face strong international competition in the near future, especially as the quality of imported prefabricated and manufactured building offerings is increasing and the price is decreasing. If not considered as part of a strategic transition such competition can have significant impacts on domestic construction industries with an Australian study suggesting that Australian imports

of buildings are anticipated to reach a value of \$30 billion by 2025, which could displace as many as 75,000 jobs nationally. Hence the transition to manufactured buildings needs be undertaken in such a way as to harness a nations existing pool of skills and trades so as to allow workforce transitioning in a manner that strengthens industry.

A leading example is the 'Little Hero Apartments in Melbourne Australia that demonstrated the savings possible, from time to safety improvements. Built by Hickory for Delphine Holdings, Little Hero Apartments is an eight storey building, comprised of 75 prefabricated modules which were able to be assembled on site in just 10 days – significantly reducing the interruption to traffic in the CBD of Melbourne associated with onsite construction methods. The total project time was 9 months, which reduced the construction time by at least 6 months when compared to an onsite build, fast tracking the return on investment.

## 2. BENEFITS OF OFFSITE CONSTRUCTION

Research by the Australian Sustainable Built Environment National Research Centre has shown that building manufacture allows for cost savings, faster delivery times, and the reduction of a number of impacts associated with on-site building construction methods, such as:

- Cost savings

The shift to prefabrication of buildings stands to deliver a range of cost savings to developers, builders, and owners. The greatest cost benefits are achievable in projects where replicable structures are used, such as apartments, housing developments, hotels, student accommodation, classrooms, prisons, and mining accommodations. Direct costs savings are achieved from the faster delivery of buildings using prefabrication methods, along with reductions in construction waste both from design and higher reuse of materials, weather damage of materials, damage caused from onsite handling in often restricted sites with multiple trades, and the elimination of vandalism and site theft during construction. The potential for such savings opens up the opportunity for the greater provision of affordable and social housing along with the provision of a higher level of quality and non-standard inclusions in residential and commercial buildings. In particular it would make 'sustainability' related inclusions that can deliver lower operating costs to occupants and owners more economically feasible at the construction stage (especially energy related inclusions).

- Faster delivery

The shift to the manufacture of buildings stands to significantly reduce construction times, along with reducing onsite delays often caused by waiting for materials delivery, coordinating service providers and subcontractors, and from inclement weather. Reducing construction times can lead to a range of benefits such as reducing the cost of fees on land taxes, equipment hire, fuel bills, and staff on-costs. The shift will also allow a greater volume of buildings to be delivered as not only is the construction time shorter it can be carried out at the same time as site preparation (i.e. footings, retaining walls, and landscaping). This is important as the shift is likely to reduce the labour requirement of individual buildings so it will be important to compensate with a growth in building output.

- Improved work place conditions

The shift to the manufacture of buildings in dedicated facilities will provide a number of improvements to workplace conditions, including:

- Protection from weather and other hazards for both workers and materials, along with the provision of appropriate lighting levels 24 hours a day,
- Provision for use of central power tool facilities rather than the reliance on hand tools or portable power tools onsite, and
- Greater ability to provide elevated platforms, mini cranes, roped harnesses, and other safety equipment due to construction undertaken in a fixed facility with flat floors and overhead beams.

Furthermore, the shift to a centralised facility leads to a number of benefits such as greater flexibility in supplier choice as materials can be stockpiled rather than being needed on demand at multiple sites across a city or region,

a regular delivery location with dedicated loading bay facilities reducing transportation costs of supplies, and the assurance that there will be someone to sign for materials at the facility.

On the 24th of July the Sustainable Built Environment National Research Centre (SBEnc), in collaboration with the EU Centre for Global Affairs at the University of Adelaide and prefabAUS, held an Industry Stakeholder workshop in Perth, WA, at the WA Club on the topic of "Capturing Opportunities from Financing Offset Building Manufacture". The workshop was held as an official partner event as part of the European Union's Green Week 2016. The workshop was well attended with 25 representatives from banks, builders, government agencies and researchers. In-line with the Green Week theme of "Investing in the Future" the workshop focused on how the banking community perceived risks and rewards from investing in the manufacture of buildings in Australia.

- **Reduced risk of delays**

Faster construction times and a focus on greater quality construction will reduce the risk that the project will be delayed, especially from supply issues or weather related delays. This reduces a number of risks, such as delayed mortgage payments, delayed rental payments, and delayed occupancy dates for hotels.

- When asked how valuable the reduced risk of delays was to lenders and investors just over 35% responded 'Very High' with a further 35% responding 'High' and 25% responding 'Moderate', suggesting that this provided tangible value.

- **Reduced risk of variations**

A manufacturing approach shifts focus from assuming that variations can be undertaken onsite, to getting it right the first time. This is achieved by eliminating defects and ensuring consistent quality in design, workmanship, and materials, hence avoiding costly variations.

- When asked how valuable the reduced risk of variations was to lenders and investors some 28% responded 'Very High' with a further 34% responding 'High' and 24% responding 'Moderate'.

- **Increased construction safety**

A factory environment for building construction allows improved workplace occupational health and safety that will reduce the number of work place accidents and injuries and the associated impacts.

- When asked how valuable the reduced risk of variations was to lenders and investors just under 32% responded 'Very High' with a further 25% responding 'High' and 44% responding 'Moderate' (with no respondents indicating 'Low' or 'Very Low').

- **Greater return on equity**

The faster construction times mean that return on equity can be increased by completing a project sooner and re-investing the capital in subsequent projects, especially on commercial projects. Given the faster construction time the initial capital could be invested into multiple subsequent projects in the same time that it would take to deliver an onsite construction project.

- When asked how valuable the greater return on equity was to lenders and investors some 20% responded 'Very High' with a further 60% responding 'High' and 20% responding 'Moderate' (with no respondents indicating 'Low' or 'Very Low').

- **More attractive to home buyers**

Given faster construction times, homebuyers are likely to be interested in reducing the time they wait for their home to be built, which not only reduces the amount paid in rent or alternate accommodation but also sees them occupying the property sooner and hence paying the mortgage.

- When asked how valuable the potential for greater appeal to homebuyers was to lenders and investors just over 22% responded 'Very High' with a further 56% responding 'High' and 17% responding 'Moderate'.

- Less theft, vandalism or damage of materials

Given the construction is undertaken in a factory environment materials and tools can be better protected from weather conditions and from theft. Such costs can increase the construction cost and cause delays.

- When asked how valuable the potential for less theft, vandalism or damage of materials was to investors/financiers just under 18% responded 'Very High' with a further 30% responding 'High' and 42% responding 'Moderate'.

- Reduced materials costs

A central facility allows for 24 hour receipt of bulk orders with secure storage which will reduce costs and delays. Further materials can easily be reused which can reduce waste by 30-40%, reducing wasted materials and dumping costs.

- When asked how valuable the potential for reduced materials costs was to lenders and investors just under 12% responded 'Very High' with a further 53% responding 'High' and 35% responding 'Moderate' (with no respondents indicating 'Low' or 'Very Low').

- Land value unaffected until completion

As construction is offsite the land value of the intended site is not affected should the construction be interrupted, postponed, or abandoned. Rather the near complete building is delivered to site, maximising the lands utility and worth throughout the construction phase.

- When asked how valuable it would be to lenders and investors that the land value was unaffected until close to completion just over 6% responded 'Very High' with a further 38% responding 'High' and 44% responding 'Moderate'.

- Greater security on completion risk

Given the construction is undertaken in a centralised facility the majority of the tools and equipment are owned by the manufacturer and can be used as security for loans, rather than these assets being owned by independent trade contractors.

- When asked how valuable it would be to lenders and investors to have greater securing on completion risks no respondents indicated its importance was 'Very High', 23% responded that it would be 'High' and 46% responding 'Moderate'.

### 3. WHAT IS HOLDING UP PROGRESS?

The workshop explored the premise that in order to increase the market penetration of offsite construction and building manufacture a number of key challenges need to be addressed related to finance, insurance, and warranty structures with the following findings:

- Negative perceptions

There is a need to shift perceptions of the industry and consumers around manufactured buildings being simply temporary reloadable structures to recognising them as high quality precision built buildings; this may be through independent quality verification, demonstration buildings, community education programs, and qualifying the specific benefits to consumers.

- When asked how much of a risk the issue around negative perceptions was to lenders and investors nearly 40% responded 'Very High' and a further 40% responded 'High'.

- Quality and lifespan

There is a need for a clear and accountable process for the rectification of defects, especially when sourcing building modules from overseas, along with insurance and warranty structures that support offsite construction and onsite erection. The allocation of responsibility for defects is complicated by the nature of the offsite delivery model in that it can require multiple contractors to undertake offsite construction, module transportation, and onsite preparation and assembly, with each stage able to identify defects and warranty issues.

- When asked how much of a risk the issue around quality and lifespan was to lenders and investors nearly 30% responded 'Low' and just under 45% responded 'Moderate'.

A key element in ensuring the quality of buildings constructed offsite using prefabrication and/or manufacturing based processes is the provision of associated design codes and standards that can be assessed for compliance. In the USA, the U.S. Department of Housing and Urban Development can created a construction and safely standard for offsite construction and building manufacture, the 'Manufactured Home Construction and Safety Standards'. This standard classifies a manufacture home as one that is 'constructed on a permanent chassis' and provides standards for design, construction, and installation of manufactured homes to assure the quality, durability, safety, and affordability. The standards include a dispute resolution component along with the provision for inspections and record keeping.

A second key way to provide assurance of quality is through the provision of a warranty or assurance scheme. For example in Japan building owners are provided with a standard 20 year warranty which entails strong after sales service. In the UK efforts to increase the viability of securing construction financing have focused on providing independent certification of the processes used in offsite construction and building manufacture in collaboration with the Council of Mortgage Lenders. The 'Build Offsite Property Assurance Scheme' (BOPAS) seeks to provide assurance to lending institutions that buildings constructed offsite are sufficiently energy efficient and durable and will be readably saleable for a minimum of 60 years.

- Completion risk

There is also uncertainty around managing completion risk, such that the building is in the possession of the manufacturer up until delivery and may not be able to be easily completed should the manufacture halt operations (this may be affected by issues related to intellectual property of manufacturing methods hindering a shift in manufacturer if required). This also presents a risk to the builder or manufacturer as clients may not provide purchase confirmation until the building is delivered and able to be used for collateral for loans, leaving open the potential to withdraw part-way through the offsite construction or not being able to secure a loan at time of delivery.

- When asked how much of a risk the issue around completion risk was to lenders and investors nearly 65% responded 'High' and just under 12% responded 'Low' or 'Very Low'.

- Progress payments

In order to provide the access to capital needed to significantly upscale building manufacture, and capture the associated benefits, long standing financing structures need to be redesigned in the building sector that are on progress payments at different stages of onsite construction rather than being able to support factory style construction prior to transportation to site of completed product for erection. Issues related to the lack of a standardised quality assessment process for offsite construction along with gaps in current building standards and codes complicate matters.

- When asked how much of a risk the issue around progress payments was to lenders and investors nearly 70% responded 'High' (25%) or 'Very High' (44%) and no respondents indicated the risk was low.

Considering the progress payments related risk, lending institutions are however accustomed to releasing funds for buildings constructed offsite after the building has been placed on site. The stage at which funds are released varies between lenders from when the building is installed on approved footings to when a certificate of occupancy has been issued. Hence the issue of progress payments is currently being overcome by developers, or even the

building manufacturers, providing the funding required for the construction phase to then allow customers to seek purchasing finance based on the completed building. Although this model allows for the client or owner to secure traditional loan products based on a completed building there are two draw backs that are hindering the growth of the industry. Firstly it lends itself to large companies who can afford to provide construction phase financing, with smaller operators having to mortgage their own assets (or requiring customers that have appropriate assets to leverage), and secondly it means that the risk is carried by the builder or manufacturer until payment is made. Since the purchase finance cannot be secured prior to the construction stage this leaves the builder open to risks like the customer not being able to secure funding after the building is complete, or having the client change their mind before the building is completed.

#### **4. CONCLUSION**

At a project level there are numerous economic, social, and environmental benefits associated with building manufacture or offsite construction. According to research by the Australian Sustainable Built Environment National Research Centre (SBEnc, 2014), new approaches to design, materials, and expanding the use of modular techniques can take advantage of faster fabrication times, lower costs, less waste, high quality standards, and shorter onsite construction periods. These enhanced outcomes provide benefits to both the builders and the financiers.

In order to capture the potential of building manufacture the building sector needs to quickly develop the infrastructure for the construction of buildings in centralised facilities and their transport and erection on site. This may involve a transition strategy that includes an initial push for the use of panelised onsite construction to build momentum in the manufacture and erection of prefabricated components and modules. It is particularly important to develop the sector in a manner that takes advantage of the cost effectiveness of sourcing building modules offshore, otherwise such offerings may compete with domestic construction. Hence, if countries slow to invest in this new sector do not seize the opportunity, offshore interests will certainly continue to bring them to market, which if not harnessed as part of the sectors overall development could lead to job losses across the building sector and its supply chain.

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