

DEDICATED TO PREFABRICATION

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INDUSTRY TRANSFORMATION | HISTORIC PERSPECTIVE | CAMP-H: UNLOCKING POTENTIAL

A CENTRE AT THE LEADING EDGE

THE ARC TRAINING CENTRE FOR
ADVANCED MANUFACTURING OF
PREFABRICATED HOUSING HAS A MISSION
TO DRIVE INDUSTRY TRANSFORMATION
THROUGH A RANGE OF INITIATIVES,
UNDERPINNED BY ITS COMPREHENSIVE
TRAINING PROGRAM. HERE, CENTRE
DIRECTOR **PROFESSOR PRIYAN MENDIS**,
RESEARCH DIRECTOR **ASSOCIATE
PROFESSOR TUAN NGO** AND NATIONAL
TECHNICAL MANAGER **DAVID HEATH**
OUTLINE THE SCOPE OF THE CENTRE'S
WORK AND THE CHALLENGES AHEAD.

INTRODUCTION

The ARC Training Centre for Advanced Manufacturing of Prefabricated Housing is the centrepiece for collaborative, eco-friendly, prefabricated housing research in Australia, striving to deliver breakthrough product and process innovations that will enable the Australian housing industry to compete on a global stage. Led by Centre Director Professor Priyan Mendis and Research Director Associate Professor Tuan Ngo from the Department of Infrastructure Engineering at The University of Melbourne, the new centre is partnering with industry to promote prefabricated technologies in the Australian construction industry. The Centre is funded for four years including \$4 million from the Australian Research Council plus a total of \$6 million (cash plus in-kind) support from industry creating opportunities for six post-doctoral fellows and

14 PhD students. Additionally, throughout the life of the Centre there will be more than 100 Master students trained in prefabricated construction. The funding from the Federal Government and industry partners will provide the opportunity to disseminate new knowledge for the benefit of the whole construction industry. The Centre is founded on strong collaboration with three other universities including Curtin University, Monash University and The University of Sydney. The peak industry body for prefabricated construction in Australia, prefabAUS is a Collaborating Partner to the Centre and acts not only as a voice for its members, but also as a conduit for the dissemination of knowledge generated by the Centre to prefabAUS members and the broader prefabricated construction industry.

Strong industry support for the Centre has been achieved with a total of 12 Collaborating Partners from industry including: Amoveo, Australian Reinforcing Company, CIMC Modular Building Systems, Envirosip, Habitech, Kirk Architect, Modulium Homes, Forest & Wood Products Australia, Prebuilt, prefabAUS, Tektum, and Timber Building Systems. Collectively, these companies represent builders, building materials and manufacturing companies, as well as designers. Australia's construction sector is traditionally slow to embrace new technologies and prefabricated construction is no exception. Our construction industry lags behind many OECD countries around the world, particularly countries in Asia, Europe and North America where the benefits of prefabricated technologies have been recognised for decades. As an example, prefabrication accounts for around 70% of Sweden's construction industry, whereas it accounts for only 3% or \$4.5 billion of Australia's \$150 billion construction industry. There is a clear opportunity for Australia to benefit from international experience to unlock the growth potential. This will require some adaptation of international prefabricated building models to accommodate different materials, construction techniques and regulatory frameworks in Australia. Contrary to popular opinion there is a growing demand for housing in Australia, particularly for affordable housing. Over the next decade the forecast for public housing is for an additional 60,000 units in Melbourne and an additional 80,000 units in Sydney. A large portion of the demand for prefabricated housing will be driven by low- to mid-rise public housing projects.

AIM AND OBJECTIVES OF THE CENTRE

The aim of the Training Centre is to unlock the potential growth of Australia's prefabricated building industry. In order to achieve this, a training pipeline is being developed to enable rapid growth of the emerging prefab manufacturing industry to deliver affordable and high-quality housing through innovation and streamlining of the supply chain. This requires a very different mindset to conventional construction but it offers huge advantages to the Australian construction industry. Through the creation of a co-operative training system between industry and universities, the Centre will enable the next generation of engineers and architects to apply the principles of advanced manufacturing to prefabricated buildings. The Training Centre is targeting a tripling of the prefabricated housing market share to 10% or \$15 billion over the next 10 years. This increased representation is also forecast to deliver an additional 20,000 new jobs by 2025. In addition to servicing domestic demand, this transformation will also provide a major boost to Australia's export potential by enabling the prefabricated housing industry to be competitive in the global market.



Two storey office assembled on-site in 2.5 days' time (image supplied by Timber Building Systems).

Through the adoption of modular construction technologies, the construction industry will be transformed through the following outcomes:

- o Novel materials, systems, techniques, and processes
- o New business models and supply chain
- o Step change in productivity
- o Significant cost reductions
- o Up-skilling of the existing workforce
- o Increased export potential
- o Establishing a high value advanced manufacturing environment

APPROACH TO TRANSFORMING INDUSTRY

The Training Centre is focusing on the new thinking that is required to map the successful workflow from design through to supply, manufacturing and delivery. This multi-disciplinary project will comprise four integrated research training programs as follows:

1. Innovation in design for manufacturing and assembly
2. Advanced building systems and assembly techniques
3. Sustainable and high performance materials
4. Supply chain and financing innovation

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There are many learnings for the transformation towards an advanced manufacturing environment that may be drawn from the automotive and aerospace industries. Although Australia's manufacturing industry is suffering due to the downturn in the automotive sector, there is an opportunity for a skills migration towards the prefabricated construction industry, creating a much needed boost for Australia's manufacturing industry.



Example of a building fabricated in a factory environment (image supplied by Habitech).

High productivity and high quality output are among many principles of the automotive industry that can benefit prefab construction. The automotive industry utilises technologies far more advanced than those adopted in the construction industry. The challenge is identifying how the skills and capabilities of engineers and workers in the automotive industry may be transferred to the construction industry, especially through prefabricated housing.

A key challenge for offsite manufacturing is how to achieve mass customisation, including variety and individuality in prefabricated housing. Standardised

connections and panelised systems are some of the strategies employed to achieve this outcome. Sophisticated Building Information Modelling (BIM) platforms may be used to optimise workflow for a manufacturing environment through standardisation, modularisation and mass customisation. Rapid on-site assembly may be facilitated through the integration of mechanical, electrical and plumbing (MEP) systems in panelised and modular systems.

One barrier to entry for builders seeking to enter the prefabricated construction industry are the conventional finance models which are based on progress payments according to on-site progress. The typical workflow for prefabricated construction is for 90 - 95% of fabrication to occur in the factory with on-site assembly occurring in a matter of days or weeks for larger projects. This represents a substantial deviation from the traditional model that domestic lenders are currently unfamiliar with and results in an increased risk needing to be borne by the builder. One of the key deliverables of the Centre is to develop new risk profiling tools and procurement frameworks for prefab housing to assist industry to develop more efficient supply chain and new financing models.

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ADVANTAGES OF PREFABRICATED CONSTRUCTION

Prefabricated construction offers numerous advantages relative to conventional construction for many applications. Various national and international case studies have quantified the benefits of prefab technologies to the construction industry including:

- Building up to 60% faster
- Reduce life-cycle costs by up to 50%
- Up to 100% of components can be reused
- 80% of site wastage is recycled
- Up to 50% reduction in greenhouse gas emissions
- Up to 70% reduction in transport, labour, and site preliminaries
- Risk of inclement weather hampering progress on-site is restricted to a matter of days rather than spread over a period of months for traditional construction. This has been one of the key drivers for Sweden's prefab industry where around 70% of construction is performed off-site.

Many of the above advantages stem from fabrication occurring in a centralised manufacturing facility. An additional advantage for modular buildings is that the individual modules are designed for transport and assembly, meaning they may also be disassembled at the end of their service life and repurposed for assembly at an alternate site.

CONCLUSION

The traditional high cost - low productivity model of our construction industry has created an appetite to learn from the success of countries such as Sweden. Prefabricated construction allows the delivery of high quality, cost-effective solutions for

affordable housing. Embracing the technologies and process of prefabricated construction will help to secure the Australian industry's competitive advantage, leading to economic benefits through increased employment and exports of prefabricated products and services. The ARC Training Centre for Advanced Manufacturing of Prefabricated Housing is undertaking extensive research and training with a view to growing Australia's

prefabricated construction industry. For further information refer to the ARC Training Centre's website: camp.eng.unimelb.edu.au. ■



Dr David Heath



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Two storey office assembled on-site in 2.5 days' time (image supplied by Timber Building Systems).



OSC: UNKNOWN QUANTITY OR TANGIBLE GAIN?

AUSTRALIAN INSTITUTE OF QUANTITY SURVEYORS (AIQS) CEO GRANT WARNER ASSESSES THE OPPORTUNITIES AND CHALLENGES OF PREFAB OR OFF-SITE CONSTRUCTION (OSC) IN THE AUSTRALIAN MARKET.

There are opportunities for increased utilisation of Off-Site Construction (OSC) across the residential and commercial construction sectors, which have adopted OSC at different rates; while significant improvements have been made in the use of Off-site / Modular / Containerised construction products in residential construction, adoption by the commercial construction sector has been more limited.

Increased utilisation of OSC will occur once architects/designers understand the structural and design limitations associated with OSC. This understanding, together with careful cost planning and good control of the design, could make OSC for both the high-rise residential and the commercial sectors more viable. However, many of these cost savings are lost because of Building Code of Australia requirements, which stipulate that buildings of three floors or more, must have concrete or masonry fire escapes.

That said, the cost-benefit of utilising OSC does not always support the use of Off-site / Modular / Containerised construction. While there are benefits associated with installation time, cost, regional location, quality of workmanship, and reduction in waste and unnecessary labour, restrictions associated with transport (size, weight, shipping delays, cost), and design limitations often counter the benefits.

To offset this, better and more innovative designs, which suit modular type construction, utilising Building Information Modelling (BIM), and innovative building products which may provide greater flexibility could lead to increased use of OSC. With the right sort of advancements, opportunities may exist in the industrial and health care sectors, for utilisation of OSC techniques.

Significant improvements in the utilisation of OSC will ultimately be driven by economic factors. Improved communication and collaboration between designers, builders, cost planners, manufacturers of off-site products, and suppliers of innovative building products, could lead to a significant increase in the level of OSC across the construction sector. ■