The Impact of New Building Techniques and Technologies on the Residential Housing Sector of the Construction Industry

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Construction Training Fund
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1 Introduction
The object of this research was to further investigate the impact of new technology in the Construction industry with emphasis on the residential housing sector. The major component of the research examined the modular construction sector and its impact on the trades and occupations within the Construction industry.

Identification of new technologies will enable the Building and Construction Industry Training Board (BCITB) to identify any future changes in demand for subsidies. In addition, it is expected to identify any changes in skills development needs.

2 Background
During 2014, research by the Construction Training Fund identified the impact of new technologies in the wider construction industry. Part of this research considered pre-fabricated or modular housing but did not concentrate specifically on the individual trades and skills requirement for this sector of the industry.

Over the last century, the residential sector in metropolitan Western Australia has become reliant on double brick construction. Homebuyers expect this as the accepted construction method. However, affordability and suitable land availability are of growing concern for homebuyers.

A number of terminologies are used to describe alternative construction methods and these include pre-fabricated, modular and delivered frame housing. These types of construction have for many decades gained acceptance in regional and remote areas where they suit climatic and specific local factors.

Major technological advances over the past twenty years have also impacted on the residential construction industry. These advances include solar hot water systems, passive solar power generation (photovoltaic), the National Broadband Network (NBN), smart wiring and wireless systems for security, internet and mobile rather than fixed line telephones.

Minor changes have occurred in choice of material for internal finishes such as glass splashbacks in kitchen, lined shower cubicles and pre-formed bases.

3 Executive Summary
Alternative construction methods currently account for less than 600 homes per annum, or 2%, of the current residential market. It is predicted by researchers that gradual growth will occur as home buyers accept new practices and also overcome a perceived stigma associated with alternative construction materials and methods. Home affordability of modular homes, with up to an 18% reduction in cost and 50% reduction in build time are predicted to be drivers for the acceptance of change.

It is predicted that over the next ten to twenty years the size of the market could grow to 20% or 6,000 homes per annum. Given this predicted slow growth, the shift in focus for some trades will be gradual. However, current apprenticeship training programs may need to be modified to incorporate the development of skills required to transition to new technology, materials and construction methods as they occur.

There are currently 16 major builders involved with modular construction ranging from small to medium operations.¹

Other advances in technology are closely aligned with acceptance of alternative construction methods. Solar power generation, solar hot water systems, smart wiring, improved framing, insulation and cladding products will contribute to reducing homeowners’ on-going expenditure on utilities.

Companies involved in alternative construction methods are utilising the existing trade workforce without the need for any substantial, additional training. Therefore, the impact on training a future workforce will be manageable.

The modular construction sector does not have a dedicated workforce, rather it utilises subcontractors that are part of the overall industry workforce.

The number of tradespeople within the overall construction industry, currently 45,800, is not predicted to change substantially to accommodate changes in alternative construction. However, cross-skilling may be required for existing construction workers as a broader range of skills may be required in the future. This will be progressive in line with the rate of introduction and acceptance of alternative construction methods and materials.

It is apparent that there is no immediate need for adjustment to the provision of subsidies to cater for changes in construction methods or new technology. It is expected that any impact related to the Fund and its supported programs, could be absorbed within current budget parameters, when modified training requirements are identified.

### 3.1 Key Findings

- Modular construction in the residential sector currently comprises less than 2% of total residential construction.
- Modular construction is predicted to grow to 20% or 6,000 homes per annum over the next 10 to 20 years.
- The modular home sector utilises subcontractors that are already from the traditional sectors of the industry and applying existing trade skills.
- Carpenters and wall and ceiling fixers are the most sought after tradespeople and will continue to be in high demand.
- There is no immediate need for the Construction Training Fund to provide additional support as modular home builders are accessing adequate numbers of skilled workers.
- Research by other bodies and feedback indicates that modular construction offers significant advantages including:
  - 30% better thermal performance.
  - 50% less waste.
  - Up to 50% less construction time.
  - 10% to 20% cost saving on traditional methods.
- The introduction of new communication and electrical/electronic technologies is growing and will be an increasing component of modular as well as traditional housing:
  - Part of this trend includes dramatic growth in solar power panels with installations increasing by 20% per annum.

¹ Queensland University of Technology, Steinhardt, D., Manly K. and Miller, W., (2013) Prefabricated Housing in Australia. Phase 1 Background Industry Paper 3, Brisbane. CTF research of Modular and Prefabrication builders websites.
4 Expected Outcomes

It was expected the research would identify:

- New technologies being utilised in the residential sector
- The need for new training methodologies or content
- The impact on demand for training subsidies in new and developing markets
- New areas of growth that may cause high financial demand on the Training Fund for new trades or associated up-skilling
- Skill sets required within the modular construction sector
- The on-going impact on demand for occupations and training needs
- Requirement for any redesign of training programs in the future

These outcomes will enable the Construction Training Fund to estimate and prepare for the impact on future financial demand for training subsidies in new and developing markets.

5 Research Methodology

Research methods utilised were:

- Desktop research.
- Site visits to major modular construction factories to gain first-hand knowledge of the type of skills and materials utilised in the construction of modular or delivered frame housing.
- Email, phone and face-to-face consultations with builders; including unsolicited comments from informal discussions with industry stakeholders.

6 Evidence from the Research

6.1 Desktop Research

During the desktop research there were limited findings relating to the future skills or trades requirements for alternative residential construction methods. However, it did identify a number of issues in the following research reports and Australian Bureau of Statistics (ABS) data:

- At 2011, ABS identified the main materials used for outside walls in homes in Western Australia. The percentage of all homes is:\(^2\)

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double brick homes</td>
<td>72.2%</td>
</tr>
<tr>
<td>Brick veneer homes</td>
<td>8.9%</td>
</tr>
<tr>
<td>Timber homes</td>
<td>1.9%</td>
</tr>
<tr>
<td>Fibro Cement</td>
<td>7.7%</td>
</tr>
<tr>
<td>Other</td>
<td>9.3%</td>
</tr>
</tbody>
</table>

- Queensland University of Technology (QUT), research into pre-fabricated housing in Queensland and Western Australia identified a number of key issues.

  The issue of a reducing and ageing workforce, along with the pressure on the availability of suitably qualified tradespeople were identified as potential issues for concern. It was also identified that this could lead to centralising of construction tasks

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\(^2\) ABS 4602 Main material of outside walls – households 2011

using prefabrication assembly in factories, particularly when construction occurs outside of the larger urban centres.\(^3\)

QUT viewed greater recognition of prefabricated methods through the awarding of government construction contracts as one way to boost ‘visibility’ of the prefabrication industry.

- As part of the Western Australian Government’s Affordable Housing Strategy for 2010-2020 it was stated that; “The Government will ‘open doors’ to increase the supply and diversity of affordable housing across Western Australia by taking bold, practical measures to generate at least 20,000 additional affordable homes by 2020”.\(^4\)

- The media release ‘Modular housing milestones for Perth projects’,\(^5\) identified that promotion of prefabricated methods through government contracts was already occurring under the above Affordable Housing Strategy. The amount of housing already built under this initiative being approximately 17,000 since 2010. A small percentage of these homes have been of modular or pre-fabricated constructions, including:
  - Twenty single residential homes at Banksia Grove
  - Ten residential homes at Shorehaven Estate, Alkimos
  - One six-storey block of seventy-seven single apartments at Stella Village, Cockburn

An analysis by Curtin University Sustainability Policy Institute of a six-story block of seventy-seven modular apartments found that they had:
  - 30% better thermal performance
  - 50% less waste
  - 40% to 50% less construction time
  - Vastly improved inconvenience impact on site and surrounding area
  - 10% to 12% saving in construction cost
  - 35% to 40% less total funding costs
  - Improved return on equity for investors

- In 2013 the Curtin University Sustainability Policy report identified that reducing the materials and resource intensity of the built form in the Perth and Peel regions could mean a change in work methods. It was identified “…off-site Construction methods might include the use of Basic Raw Material (BRM) substitutes which reduce the total amount of building materials required per construction project. In addition these substitutes are often less carbon intensive. They include materials such as concrete/brick made from fly ash, or steel, besser bricks, floating slabs, roof trusses and metal frames, pre-cast concrete walls and cross laminated timber (CLTs)”.\(^6\)

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- A UK article by ARUP relating to CLTs stated that; “…we are now looking into pre-finished wall systems that have insulation, window openings, and façades already included. This speeds up construction and does away with the need for scaffolding”.

- A 2014 Climate Council report quoted that; “…solar photovoltaic uptake in WA was third highest in the nation with 18.4% of houses having solar panels on their roofs”. The report warned that the use of solar panels on West Australian homes and businesses will increase tenfold over the next decade but the Government is unprepared for the uptake. The uptake of solar has been growing at a rate of almost 20% a year, while the cost of buying panels has been dropping at the same time.

6.2 Predictions for Construction
During this research numerous predictions from the last few years were identified, especially those relating to the modular pre-fabrication industry:

- The Curtin University Sustainability Policy predicted that; “Construction innovation will constitute the use of off-site construction as a model for better construction practices, much of which can already be demonstrated. Construction innovation is not currently being applied consistently to Perth’s urban development”.

- In the Boomtown 2050 report, as quoted in the Curtin University Sustainability Policy, it was predicted that; “Perth’s current population of circa 1.5 million is predicted to more than double by 2050. To accommodate this influx we need to build at least 700,000 homes. More than housing, the city’s entire infrastructure will have to double. What was built in 179 years will need to be reproduced in (the next) 40 years”.

- A recent release by the CEO of prefabAUS stated that; “Pre-fab housing has “significantly developed” this decade and while statistics are unavailable because relevant data is not collected by Building Commissions or the Housing Industry Association (HIA), a “reasonable estimate” is about 3% of all housing (in Australia), up from less than 1% in 2004, is prefabricated in a factory. Feedback suggests demand will rise, conservatively, to between 10% and 20% in the next 10 years”.

The future workforce required for this predicted increase in housing will need to have the skills to be able to cope with traditional and modular/prefabricated construction and the place to start is within apprenticeship training.

7 Impacts on Residential Construction - Findings
The following subsets of the research cover a wide range of responses from site visits and stakeholders and are not limited to construction methods. Stakeholders consulted as part of this research appeared very well informed about new technologies and methodologies.

7.1 Construction Methods - Pre-Fabricated/Modular
The mainstay of residential construction in metropolitan Western Australia has, for many decades, been double brick and tile. Modular construction is well accepted in regional

parts of WA. The following includes stakeholder responses relating to pre-fabrication and modular construction of complete homes.

- Modular home construction is estimated to account for between 300 and 900 (1% to 3%) of all homes built in Western Australia. In 2004, and based on ABS dwelling commencements, it was estimated that less than 200 modular homes were constructed in WA.\(^\text{12}\)

- As the modular construction sector expands, one of the major challenges to growth will be gaining homebuyer acceptance of alternative housing methods. However, the traditional double brick housing market will have its own challenges due to shortages of basic raw materials (BRM); skilled labour; available land and affordable housing.

- Given the stigma attached to pre-fabricated or modular homes, a number of builders are promoting the use of ‘Delivered Frame Housing’ to describe transportable, modular and pre-fabricated housing. This is meant to overcome negative perceptions relating to the poorly designed pre-fab homes of the 1980 and 90s.\(^\text{13}\)

- A major modular home builder estimates that it is possible to reduce construction waste by between 40% and 90% when compared to traditional construction.\(^\text{14}\)

- With a reduced build time of up to 50% for modular housing, earlier completion is a positive factor in affordability for homebuyers changing homes or building for the first time. A comparison of a basic 3 or 4 bedroom home in the Perth metropolitan region shows an average 12 week build time for modular and 24 weeks for traditional double brick construction.

- Overall cost comparisons between a 3 bedroom modular framed and mid-range brick and tile home shows an overall cost saving of up to $38,000 or 18%. This is also confirmed when comparing build costs based on a per square metre estimate of cost.\(^\text{15}\)

- It is predicted by local modular builders, that more residential homes will be assembled on-site, rather than in a factory. This may lead to the future use of brick veneer and continued work for bricklayers, albeit on a reduced scale.

- Builders predict that given the ageing population and downsizing of current homes for this cohort, the Park Home sector is predicted to be the next growth industry.

- Modular residential housing has standard slab sizes between 3.4 and 4.8 metres wide, to ensure that they fit on standard transport carriers; and not require additional costs associated with a police escort. Multiple sections can be assembled on site to overcome this limitation on size and therefore access a wider range of home buyers.\(^\text{16}\)

### 7.2 Trade Skills

Carpenters appear the most significant trade associated with modular home building as their skills are readily transferable when using different types of material. They are adept at a broader range of skills such as wall and ceiling lining, avoiding the need for additional

\(^{12}\) Based on current and historical ABS data for dwelling commencements (2004 to 2014).

\(^{13}\) The Australian – Quote by Rob Colquhoun from Prebuilt (16 April 2013) NSW

\(^{14}\) Media Release, Business News Western Australia, BGC Modular Housing Initiative, (July 2014)

\(^{15}\) Australian Construction Handbook, Estimating building costs per square metre, Rawlinsons (2014)

\(^{16}\) Comments during Modular Construction factory tours (10 March 2014, 10 September, 12 November and 13 November 2014), Western Australia

workers to complete these tasks. However, since 2007 there has been a 33% reduction in the number of carpentry apprentices in training, down from 1,885 to 1,252.17

- A major builder of modular homes stated that:

  “Currently carpenters are being trained in-house to up-skill to wall and ceiling lining, but not necessarily cornices which are handled by professional flushers, in the modular / pre-fabrication construction”.18

It was suggested the skills associated with the increased use of steel frames, roof trusses, steel trusses or installing plasterboard wall and ceiling lining could be introduced during an apprenticeship as the skills can be achieved while undertaking traditional ‘carpentry’ training.

- The bricklaying trade may have a reduced role if modular or alternative construction methods increase. During 2011 to 2013 there was a reduction of 25% (300) in bricklaying apprenticeship numbers which appears to have created a skills shortage in 2014. Stakeholders commented that at present there is an 8 week delay in the construction process due to the shortage of bricklayers.19 This is likely to hasten the consideration of using brick veneer.

- New construction methods do not rely as heavily on both plastering and bricklaying. This applies particularly in the pre-fabricated, modular and framed construction sector. However, Plastering is currently seeing an increase in previously low apprenticeship commencements. Since 2007 there has been a 54% reduction in the number of plastering apprentices in training, down from 185 to 85. This could also hasten the move to alternative wall finishes.

- Due to the small size and sub-contract nature of the market, it is not possible to quantify the number of tradespeople currently employed in modular construction as they periodically work between sectors of the industry.

- As change occurs, apprentices could be exposed to new technologies and methods during their off-the-job training. However, if the ratio of the number of apprentices in training continues to fall when compared to tradespeople in the industry, known as the ‘training rate’, then an opportunity to train apprentices in new technology or methodology will be missed. The training rate in 2006 was 13.1% and by 2014 had dropped to 8.97%. This has been demonstrated in a steady fall since 2006 rather than a dramatic fall in one year.

- Due to the sub-contract nature of the industry it was identified that many builders do not employ their own apprentices and this may be having a detrimental effect on the apprentice numbers. These builders rely on sub-contractors to employ apprentices and this will affect all sectors of the industry when locating skilled tradespeople.20

7.3 Construction Materials

One of the major base raw materials used in housing construction is sand. Builders and researchers have highlighted that construction quality sand is in short supply and this will ultimately affect wet trades such as bricklaying, plastering and concreting and impact on the method of home construction.

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17 All Statistics under Trades Skills (7.2) have been taken from the TRS October 2014 and the ABS November 2014 figures.
18 Comments during Modular Construction factory tours (10 March 2014, 10 September, 12 November and 13 November 2014), Western Australia.
19 Unsolicited quote from builder at Construction Training Fund’s Promotions Committee meeting, (18 November 2014), Perth.
20 Comment by Construction Training Fund’s Training Support Officers (21 October 2014), and stated by modular builders during various interviews (2014), Perth.

Planned increases in waste levy costs for 2015 may have an impact on the type of construction materials that will be used and the amount of waste that requires disposal. The rate for inert waste has risen by 400% from $12 to $60 per cubic metre\textsuperscript{21}. This will increase to $105 by July 2019.

- Modular, manufactured homes have as little as 10% of the waste in traditional home construction, and also have reduced requirements for site preparation. Although the site needs to be levelled and excess ground material removed, this is minimal and equates to a cleaner site. A reduced waste levy will contribute to a lower construction cost and a more affordable home.

7.4 New Technologies

New technology has already impacted on many households in the form of smart wiring, lighting and power control systems, solar panels or structured cabling and this requires a different level of skills to basic electrical installation. These technologies have contributed to a reliance on and demand for electricians in the residential sector. In contrast to all other construction trades, the training rate is very high with a 10 year average of 22.8% and growth from 1,940 apprentices in 2005 to a peak of 4,068 in 2014.\textsuperscript{22}

- The National Broadband Network (NBN) does not appear to be having a major impact on the Construction Industry workforce, particularly with electricians. This is confirmed by one major electrical contractor stating that:

  \begin{quote}
  \textit{“No occupations (electricians) in our company are affected by the roll-out of National Broadband Network and no additional skills are needed. There is only the need to supply information, instruction and in-house training on the NBN procedures”}.\textsuperscript{23}
  \end{quote}

With a high training rate and planned changes to training package content, the electrical sector of the industry appears well placed to manage any further changes in technology.

7.5 Building Information Modelling (BIM)

The impact of Building Information Modelling (BIM) was covered in “The Impact of New technologies on the Construction Industry” (May 2014) with recommendations to support introductory ‘basic awareness’ training programs but to not support higher level training. Software vendors appear to provide the majority of training for students in the use of their own BIM software packages.

8 Conclusions

The research has identified a number of the impacts that new technology and alternative construction methods will have on the residential housing sector.

8.1 Alternative Construction Methods

This sector of industry will grow slowly over the next ten years but with little impact on overall numbers of tradespeople as existing trade skills are readily transferable.

- Homebuyer acceptance of alternative construction methods is a major challenge in growing the sector.

\textsuperscript{21} Dept. of Environment Regulations, (January 2015), Landfill levy rates (www.der.wa.gov.au)
\textsuperscript{22} TRS DTWD data October 2014
\textsuperscript{23} Feedback from a local Electrical Contractor (2014), Perth.

- Approximately 81% of homes built are of brick construction as at 2011\textsuperscript{24}. However, a percentage of this construction could be replaced using a modular or framed home erected on site and finished using brick veneer and pre-fabricated components.
- Build time and affordability are the main positive factors for buyers considering alternative construction methods. This may not affect the total number of homes being built; rather it will change the types being built using the existing workforce.
- One of the drivers for change is the cost, and looming shortage of basic raw materials particularly quality sand for concrete, plastering and bricklaying. This could make traditional homebuilding too expensive, especially for first home-buyers.
- A major advantage of undercover, factory-based modular construction is the safe and stable environment for all workers in extreme weather conditions.
- Programs such as the Government’s Affordable Housing Program could drive an increase in the use of modular homes and multi storey apartment buildings.
- There is reduced wastage when using modular home construction.

8.2 New Technologies
A number of other technology changes were considered during this research as they could impact on the industry.

- Although the NBN is a considerable project it appears to be having minimal impact on the electrical and residential sector. However, it could impact on the cost of new homes where NBN is part of the utilities to each home.
- The growth of solar panel sales may not be sustained due to reduction in “Feed in Tariffs”. In the case of an increase in growth, there may be additional demand for electricians and subsequently apprentices.
- The acceptance of BIM in the residential sector has been slow with only a small number of builders using it for limited residential construction.

8.3 Impacts on the Workforce
Many of the modular housing builders are using sub-contractors who have their own apprentices. Unfortunately, builders only employ a small number of tradespeople on site, in particular, carpenters. This may have a negative effect on apprentice numbers.

Shortages of major basic raw materials; skilled labour; suitable, available and affordable land, may drive change in construction methods and impact on the future workforce.

Trades that may be affected if alternative home construction increases are:
- Wet trades, such as bricklayers and plasterers will have a limited role in the initial construction of modular housing.
- Carpentry is predicted to be in high demand in the modular framed housing sector due to the ease of transfer of trade skills when using alternative construction materials. There is also an identified need for cross skilling of workers between carpentry and wall and ceiling fixing.

\textsuperscript{24} ABS 4602 main materials of outside walls – households 2011

- A number of existing construction trade qualifications contain elective competencies that can be offered to apprentices working in the modular/pre-fabrication sector. For example, in the carpentry qualifications there are electives for truss making, installing walls, panelling and lining.

- One of the largest builders in WA confirmed that "the shortage of tilers will drive builders to seek alternative wet area finishes". However, alternative products such as glass splashbacks in wet areas and pre-formed shower cubicles have been available for many years and have not had a negative effect on demand for tilers.

- In respect to the NBN, there is expected to be growth in demand for telecommunications workers, cable jointers and planners. This does not appear to be having a significant effect on the demand for tradespeople in the construction industry at present.

The current situation for critical trades is:

- Bricklayers and plasterers are in short supply for traditional residential construction however; they are also the trades which will be in lower demand if the uptake of modular framed housing increases.

- Skilled carpenters are in demand in the modular framed housing sector, especially those with experience working with steel and timber framed construction.

9 Recommendations

This research has identified that alternative construction methods have been slow to gain widespread homebuyer acceptance. However, given build time, affordability and raw material shortages, it is predicted that this sector of industry could grow by up to 100% or an additional 900 homes per year during the next 5 years.

This growth will be an integral part of dwelling commencements rather than in addition to the total build in WA.

It is recommended to:

- Place a watching brief on the modular building sector, to monitor growth and any changes in demand for skilled labour.

- Consider strategies to support up-training of unqualified workers in the Industry as carpenters and wall and ceiling fixers, to meet any future growth in demand in modular construction.
**APPENDIX 1 - Trade Predictions – Modular and General Residential Construction**

When substantial growth occurs in modular residential construction or alternative construction methods, the following changes in skills demands will impact on the industry.

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>AFFECTED</th>
<th>CAUSE/OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main trades reducing</strong></td>
<td>Bricklayers and plasterers</td>
<td>Require alternative trades such as carpenters and joiners.</td>
</tr>
<tr>
<td><strong>Other trades changing</strong></td>
<td>Some traditional trades will be</td>
<td>This will depend on changes to wall construction methodology. Could affect</td>
</tr>
<tr>
<td></td>
<td>impacted by new building methods</td>
<td>wall and ceiling lining and wall and floor tiling trades.</td>
</tr>
<tr>
<td></td>
<td>and materials</td>
<td></td>
</tr>
<tr>
<td><strong>Possible reduction</strong></td>
<td>Wall and ceiling liners and fixers</td>
<td>This is ‘debatable’ as carpenters are currently broad skilling to perform this work.</td>
</tr>
<tr>
<td><strong>Trades to increase</strong></td>
<td>Carpenters and joiners</td>
<td>Increase in wall and floor framing or assembly of components.</td>
</tr>
<tr>
<td></td>
<td>Cabinet makers</td>
<td>Cabinets manufactured and delivered to modular home factories in flat packs or ready to assemble by carpenters.</td>
</tr>
<tr>
<td></td>
<td>Wall and floor tilers and</td>
<td>With current low numbers of apprentice commencements in these trades, alternative materials for use in wet areas may need to be sourced.</td>
</tr>
<tr>
<td></td>
<td>concreters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Steel framers</td>
<td>Change in framing materials.</td>
</tr>
<tr>
<td></td>
<td>Roof plumbers</td>
<td>Due to the vast majority of modular homes having steel roof construction there will be increased demand.</td>
</tr>
<tr>
<td><strong>Other occupations</strong></td>
<td>Installation teams (Modular)</td>
<td>Specialised teams on site after modules arrive.</td>
</tr>
<tr>
<td><strong>liable to increase</strong></td>
<td>Electrical (Modular) in-house</td>
<td>Employment of full-time ‘in-house’ contractors.</td>
</tr>
<tr>
<td></td>
<td>contracting</td>
<td>Required to transport either modular homes or modules for traditional home construction.</td>
</tr>
<tr>
<td></td>
<td>Truck drivers (Modular/Residential)</td>
<td>As modular construction increases apprenticeships such as 2 year apprenticeships (Housing) could increase as they are narrower qualifications.</td>
</tr>
<tr>
<td></td>
<td>Building trades (Residential)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frame welders</td>
<td>Could be utilised both in off-site manufacturing and on-site assembly.</td>
</tr>
<tr>
<td></td>
<td>Crane operators</td>
<td>Required for loading and unloading increased number of modules.</td>
</tr>
<tr>
<td><strong>Up-skilling required</strong></td>
<td>Carpenters</td>
<td>The competencies in the current Carpentry and Joinery Cert III qualifications cover the skills required – the only difference is the material being used.</td>
</tr>
<tr>
<td><strong>Readily Available</strong></td>
<td>Electricians and plumbers</td>
<td>As the NBN, solar panel and hot water usage increases in popularity, these trades are able to undertake the work without substantial additional training.</td>
</tr>
</tbody>
</table>

11 APPENDIX 2 - Trades inherent to Modular and Pre-Fabrication Construction

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concreters</td>
<td>Concrete slabs used in traditional and delivered frame housing.</td>
</tr>
<tr>
<td>Electricians</td>
<td>Fit out in factory and / or onsite. Also in demand for Solar Panel installation.</td>
</tr>
<tr>
<td>Plumbers</td>
<td>Fit out in factory and / or onsite.</td>
</tr>
<tr>
<td>Earth workers</td>
<td>To prepare the building site for the placement of the home/building.</td>
</tr>
<tr>
<td>Painters</td>
<td>Required for all types and levels of the residential sector.</td>
</tr>
<tr>
<td>Carpenters / Carpenters and Joiners #</td>
<td>The most essential trade in this sector, also being up-skilled on-the-job.</td>
</tr>
<tr>
<td>Roof Carpenters #</td>
<td>As there is a shortage of truss makers in this sector, carpenters are able to transfer their skills to use the different materials.</td>
</tr>
<tr>
<td>Wall and Ceiling Liners/Fixers #</td>
<td>In short supply, carpenters are being upskilled in this area.</td>
</tr>
<tr>
<td>Wall and Floor Tilers</td>
<td>This occupation is an essential trade in this sector, but currently is reported to be in short supply which may force use of alternative “wet area” lining materials.</td>
</tr>
<tr>
<td>Steel workers (steel trusses)</td>
<td>This occupation is critical but is in short supply. (see Carpenters)</td>
</tr>
<tr>
<td>Welders (steel frame assembly)</td>
<td>Used at the factory set-up stage and on-site as required.</td>
</tr>
<tr>
<td>Estimators</td>
<td>Requirement will remain the same, although were identified as being hard to find. May be impacted by the use of BIM.</td>
</tr>
<tr>
<td>Designers</td>
<td>Requirement will remain the same.</td>
</tr>
<tr>
<td>Schedulers</td>
<td>Requirement will remain the same.</td>
</tr>
<tr>
<td>Crane Operators</td>
<td>Required for lifting at destinations and for multi-story apartments. Could be an in demand occupation.</td>
</tr>
<tr>
<td>Road Train truck drivers</td>
<td>Increase for the modular/pre-fabricated housing transportation local and regional.</td>
</tr>
</tbody>
</table>

# It should be noted however, that in the Carpentry and the Carpentry and Joinery Certificate III qualifications, the components of truss making are undertaken at the Core level. As the material used is normally timber, the skills could be transferred to steel. Other competencies for installing walls, panelling and lining, if not in the core units, are in the electives.
# 12 APPENDIX 3 - Unsolicited Feedback from industry consultations

<table>
<thead>
<tr>
<th>Contact</th>
<th>Organisation</th>
<th>Event</th>
<th>Subject</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIA CMI Political Panel Event 24/10/2014</td>
<td>Basic Raw Materials (BRM) - Sand</td>
<td>Sand may not be in short supply but just hard to get. 30% used in urban sector. Sand could be recycled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIA CMI Political Panel Event 24/10/2014</td>
<td>BRM – Sand Skills in demand</td>
<td>Sand shortage and increased price. Electricians, Carpenters, Plumbers will be in on-going demand.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel Discussion Building Blocks for the Future – NAWIC Forum 11/09/14</td>
<td>Alternatives to double brick</td>
<td>Due to shortage of Bricklayers, there may be a need to look to brick veneer as an alternative.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel Discussion Building Blocks for the Future – NAWIC Forum 11/09/14</td>
<td>Construction waste reduction</td>
<td>Less construction waste on site by the use of modular and the use of recycled products such as crushed concrete (for roads). Architects don’t have the required training to do design for modular building.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Informal meeting 13/10/14</td>
<td>Bricklayers</td>
<td>The transition to brick veneer if a shortage of bricklaying apprentices’ situation continues.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTF Promotions Committee 18/11/14</td>
<td>Wall and Floor Tiling</td>
<td>Low commencements will likely see changes to the finishes of wet areas in the future with alternatives to tiles being sought.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting with CTF Training Support Officers 21/10/14</td>
<td>Apprentices</td>
<td>The builders are not employing apprentices as Subcontractors are expected to. Apprentices should be multi-skilled.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Institute of Technology Forum 01/10/14</td>
<td>Building Information Modelling</td>
<td>The event was titled: “Forum For All Things BIM” and covered a wide range of topics related to BIM.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIA CMI Political Panel Event 24/10/2014</td>
<td>Modular homes</td>
<td>Building timber frame split level homes without the need for fill reduces sand usage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIA CMI Political Panel Event 24/10/2014</td>
<td>Residential Building</td>
<td>As sand is expensive, it could be cleaned and reused. One builder stated they only employ sub-contractors if they have an apprentice. Colorbond is becoming more prevalent than tiles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tilers and 457 Visas</td>
<td>If builders source alternatives to tiling, then training decisions can be made but there is no evidence of a major change in this area. It was also confirmed by a major builder that large numbers of overseas workers (Class 457 Visa) are filling the skills gap in this trade</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX 4 - Site Tours and Consultations

<table>
<thead>
<tr>
<th>Contact</th>
<th>Organisation</th>
<th>Site</th>
<th>Comments</th>
</tr>
</thead>
</table>
| | | Canningvale | - Build 10 homes per month.  
- In regional areas local workforce is utilised including bricklayers for site extras like garages, etc.  
- Use roof sheeters or carpenters to install final roofing.  
| | | Wangara | - Employ 3 indigenous apprentices and 8 carpenters.  
- All other trades people are sub-contractors. Mainly Plumbing, Painting and Electrical.  
- Have 16 sub-contractor teams working for them.  
- Sub-Contractors have apprentices, some through Group Training Organisations.  
- Building 50 homes at Onslow and will be supplying 198 retirement homes at Boyanup.  
- Building Granny Flats in the residential sector.  
- Use all local workers when erecting homes.  
- Won awards for Murchison home (2 yrs)  
- Upskilling is done in house.  
- All workers are Worksafe and High risk licence trained.  
| | | O’Connor | - Pod construction building two storeys at same time, reduces time for client usually lower level built on site and the 2nd storey is transported and placed on top.  
| | | Maddington | - Now building residential houses, schools, etc. in areas such as– Brookton, Shoalwater.  
- Main contracts are for the regional areas.  
| | | Kenwick | - NBN has not affected occupations or the skill requirement.  
| | | Yangebup | - Contracted as a painting contractor for modular homes.  
- Employs 2 apprentices – no up-skilling needed.  
- No change to electricians in NBN only in the IT trades.  
- 94 homes built over 24 months. Length of construction of pre-fab homes is 12 weeks plus 2 weeks on site.  
- BIMx used by local builder  

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25 Emailed information and notes from Factory tour  
26 www.summithomesgroup.com.au – Myaree  
27 Large Modular builder  