



Financial Models for Prefabricated Housing

PrefabAUS - Interim Report

9/20/21

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Executive summary

The interim report presents a brief overview of the work done till now by PrefabAUS in partnership with the Australian manufacturing growth centre (AMGC) towards a year-long project on prefab finance models. The report has identified the financial products available for manufacturers and consumers in the prefabricated construction industry in Australia and other parts of the world. Emerging technological trends in FinTech and its proposed use in construction finance and contracts are highlighted in the report.

Manufacturers in the prefabricated construction sector are likely to be classified under small and medium enterprises (SMEs). Amongst multiple financing options available for SMEs, traditional long term debt finance, asset/equipment finance, and working capital financing options are presented in this report. Green loans backed by worldwide consortiums of industry partners and financial institutions offer a significant opportunity in the years to come for SMEs in the off-site manufacturing sector. Peculiar business models for on-shore and off-shore supply chains have been reviewed for off-site manufacturing (OSM). The importance of choosing an appropriate value proposition for an OSM business is highlighted here, where the volume of production can significantly alter the product in terms of cost, quality, time, and design flexibility.

Various accreditation schemes around the world have been explored and their role in instilling confidence in lenders in respective countries is presented. In the end, different consumer financing mechanisms in the US, UK, Sweden, Japan and Australia/NZ are reviewed. While Japan, Sweden, US and UK offer mortgage loan products to consumers Australian banking institutions are yet to offer this service as a standard to its customer. The consumer housing finance in Australia seems to be handling it subjectively on a case-to-case basis that requires substantial involvement of the manufacturer and the consumer. Green housing finance is also being made available to consumers to incentivise the reduction of their carbon footprint. Consumers and manufacturers could leverage the green loan products and experience the benefits of OSM.

Project overview

The project being undertaken in partnership with the Australian Manufacturing Growth Centre (AMGC) is aimed at developing prefabricated building financial models for modern construction methods. The outcome of this year-long project would influence a reluctant banking sector to tailor and improve financial product offerings for the prefabricated building sector.

Context

The advanced manufacturing sector is characterised by optimised supply chains supported by sophisticated decision support tools to maximise efficiency and competitiveness. Financing models for successful advanced manufacturing sectors are also well developed with significant engagement from investment banks. By comparison, the prefabricated housing industry has inherited a traditional construction industry supply chain that is fragmented and inefficient. Similarly, as it is producing a housing product, the industry has been pigeon-holed into a retail banking financing structure that is misaligned with the rapid construction times of prefabricated housing. This project will focus on mapping new supply chains and creating new financing models for prefabricated housing.

Aim

The project aims to accelerate the adoption of new funding and financing models for the Australian prefab building industry. PrefabAUS has identified that inefficient supply chains and stifled financial models are a significant cause of lost productivity and inefficiency. The team has identified the current financing models as a major hurdle to the development of the Industry in Australia. Having engaged directly with the banking community we will bring together key stakeholders to discuss and develop new funding and financing models. We see the key outcome of this project as the transfer of knowledge to influence a reluctant banking sector and dissemination of information to industry through PrefabAUS' network.



Roundtable with PrefabAUS

Discussion Summary

A roundtable meeting held in the first quarter of 2021 included PrefabAUS representatives and partner companies. The outlooks offered by experienced industry partners helped in identifying challenges in prefab finance, supply chain and standardization.

John McDougall from Parkwood Modular identified that the current state of lending and progress payments is grossly insufficient to sustain a manufacturing business. According to him, there were only a limited number of clients (such as governments) that were willing to alter the progress payment plan in favour of the manufacturer. The prevailing status quo only prescribes 5-10% of the project amount as a down payment before the construction begins. The rest of the payments are only released upon the delivery of the modules. Understandably, the manufacturers must bear the cost of the supply chain and manufacturing of the prefab modules until the second disbursement is made available to them. Most companies are unable to sustain this type of model for long.

David Haller from the Mirvac group presented a case study to demonstrate the time, cost and quality improvements upon subscribing to off-site manufacturing of bathroom pods. David believes that a robust performance evaluation scheme should be put in place to objectively evaluate the net performance gain in prefabricated construction. It is understood that the current consumer market in Australia is not mature enough towards prefabricated off-site manufactured buildings. The ambiguity with quality standards, life span, and consumer finance make it a difficult choice for consumers.

Laina Chan, from the Society of construction law Australia, highlighted the intricacies in risk transfer during prefabricated building manufacturing. In a conventional construction model, the builder claims the progress payments against the part of the structure that is completed on-site. The building surveyors, quality assurers and auditors can certify the progress to the lenders upon which the progress payments are disbursed. As the payments are disbursed to the builder, the lender is secured against the partial physical structure that is completed on-site. The risk, at this point, is shared among the builder and the lender proportional to the constructed building. This model, which has evolved over a few decades, is disturbed when one moves from on-site to off-site construction practices. In off-site construction, the manufacturer needs access to capital before the structure could be delivered to the site. The risk is transferred to the lenders without any guarantee tied to a physical asset on site. In an event of the manufacturer's default, the lenders stand to lose since the assets being financed are partially unfinished and in the possession of the manufacturers. There is hardly any scope to redirect the unfinished prefabricated modular project to any other manufacturer since the designs and manufacturing technologies are bespoke at the moment.

PrefabAUS executives Damien Crough and Warren McGregor stressed the legislative treatment given to off-site constructed buildings. The off-site buildings modules are categorized as products in many jurisdictions in Australia. The National Construction Code (NCC) does not adequately acknowledge the off-site buildings. Queensland home warranty insurance, New South Wales home warranty insurance, Victoria builders warranty insurance are mostly ambiguous in defining, categorizing and acknowledging the off-site buildings and products. The productised perspective towards buildings makes it difficult for financiers to remodel lending solutions. The lack of standardization and proliferation of proprietary off-site construction methods are creating additional intellectual property barriers for the adoption of off-site manufacturing in Australia. Similar to supply-side barriers, there exists a significant reluctance in the consumers hindering the demand curve. As mentioned earlier, insufficient confidence in the quality of prefab buildings, perception of boxy and non-flexible architectural layouts, and difficulty in getting financial support are pre-existing barriers from the consumers' side adding to the mix.

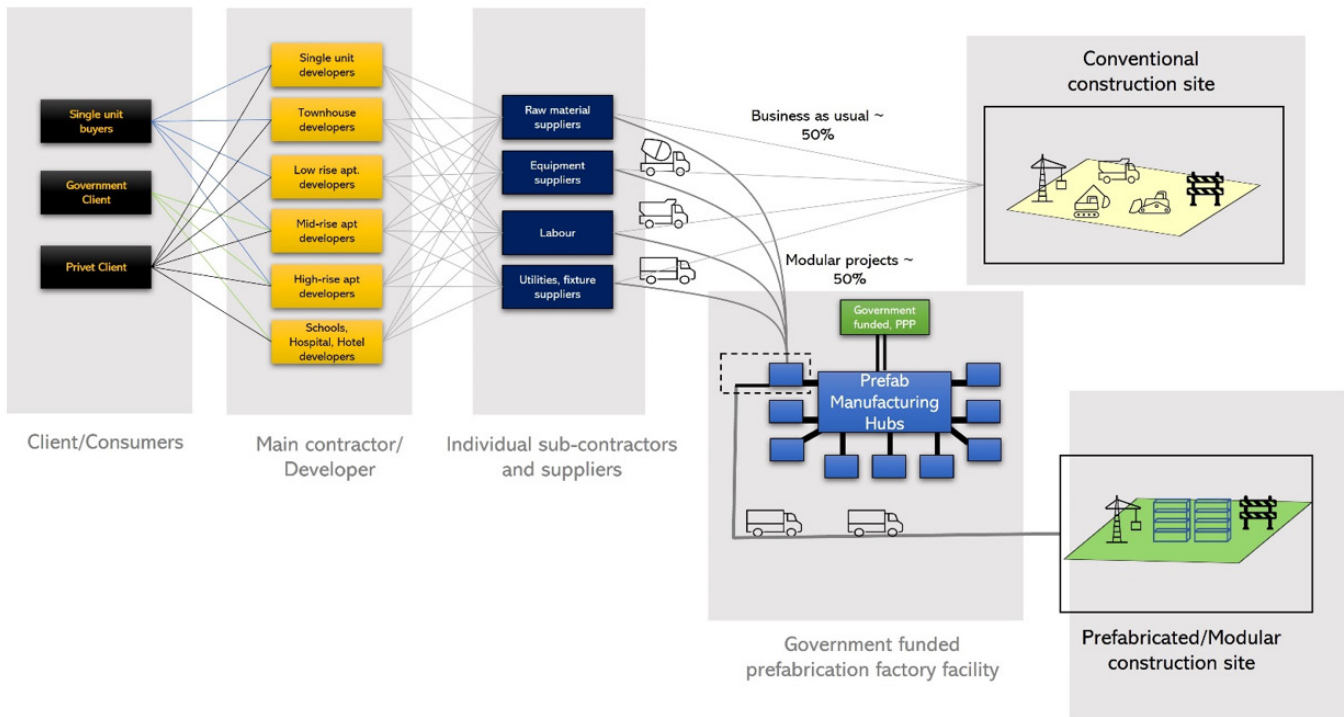


Figure 1 Concept structure of shared manufacturing hub for off-site construction

Summary

In nutshell, the hurdles posed by lack of standardization, unaccommodating current legislative and compliance standards, and unsuitable lending models are found to impede the growth of prefabricated construction in Australia. A consensus amongst manufacturing standards, performance standards, council requirements and financial auditors would go a long way in establishing off-site manufacturing as the preferred choice. Newer models for funding off-site manufacturing projects as well as catalysing consumer demand need to be formulated. Financial technology companies are facilitating newer methods of public, private and personal finance. Open public ledger-based blockchain technologies are at the cusp of revolutionizing payments, contracts and peer to peer lending in the modern world. Smart contracts based on such blockchain technology are being researched for their implementation in construction and supply chain management. Digital wallets, cryptocurrencies, IoT sensors enabled progress tracking and smart contracts are a few of the many technologies that can significantly alter the way conventional capital and consumer finance is practised today. Advances in manufacturing technologies in construction, and appropriate levels of standardization could enable shared spaces for off-site manufacturing (as shown in Figure 1). The cost barriers to entry for small to medium entrants of prefab manufacturers could be significantly alleviated by the adoption of prefab manufacturing facilities. The idea of government incentivisation through land acquisition, tax subsidies, tendering amendments and allocation of special economic zones are also being explored in this direction.

A brief overview of off-site supply chains, capital and consumer finance models prevalent today are explored in the next section followed by an overview of emerging technologies and the way forward.

Chapter 1 - Conventional capital and consumer finance models

Capital Finance for Manufacturers

Overview

Offsite methods could potentially be a cost-effective alternative to the conventional site build methods amongst other benefits. A study conducted with rounds of industry interviews in Australia presented a set of business models that are in practice in the offsite manufacturing industry.¹ Although the study was in the Australian context, the business models were analysed to give an overall picture of the common business practices around the world. According to the study, there are two main types of manufacturing, procurement, and distribution network scheme at work viz. on-shore manufacturing-distribution and off-shore manufacturing- import and distribution. Both these schemes have multiple value chains with multiple points of entry for businesses. Figure 2. captures the essence of onshore manufacturing and distribution value chains.

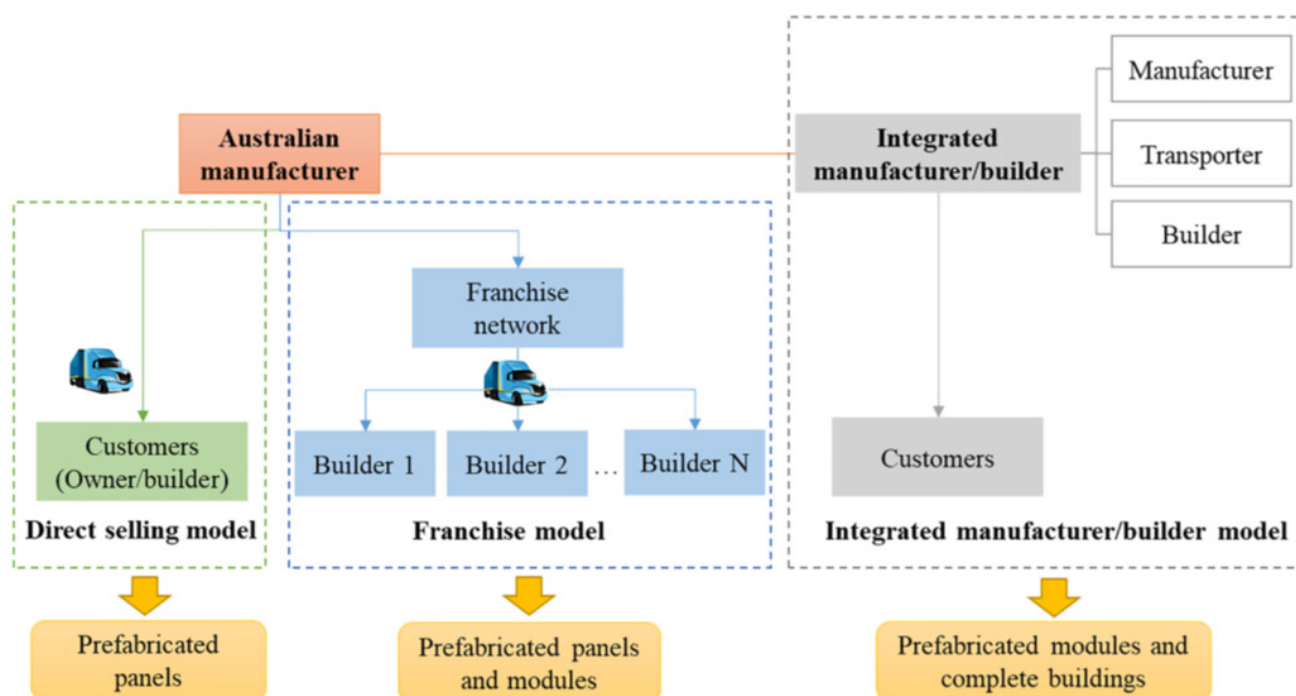


Figure 2 Business models for procuring and distributing prefab components from onshore manufacturers

From such value chains, different business opportunities open for new entrants from manufacturing to distribution. The manufacturing itself comprises different levels of prefabrication. Component level manufacturing, panel manufacturing (walls, floors, ceilings), and volumetric manufacturing (building modules, bathroom pods) require different complexities with respect to manufacturing and capital structure. As shown in Figure 2, the direct selling model connects the manufacturer with the customer, which is the builder in this case. This value chain has much higher profit margins as there are no intermediaries. The subsequent value chains involve multiple intermediaries that make the value chain robust, ensure quality checks, compliances and incorporate design flexibilities. The businesses operating in these areas of value chains may not necessarily face the same barriers for entry as the manufacturers. More so, the franchise networks may help develop resilient demand pipelines for the manufacturer and render financial sustainability.

¹ Lin, T., Lyu, S., Yang, R.J. and Tivendale, L., 2021. Offsite construction in the Australian low-rise residential buildings application levels and procurement options. *Engineering, Construction and Architectural Management*.

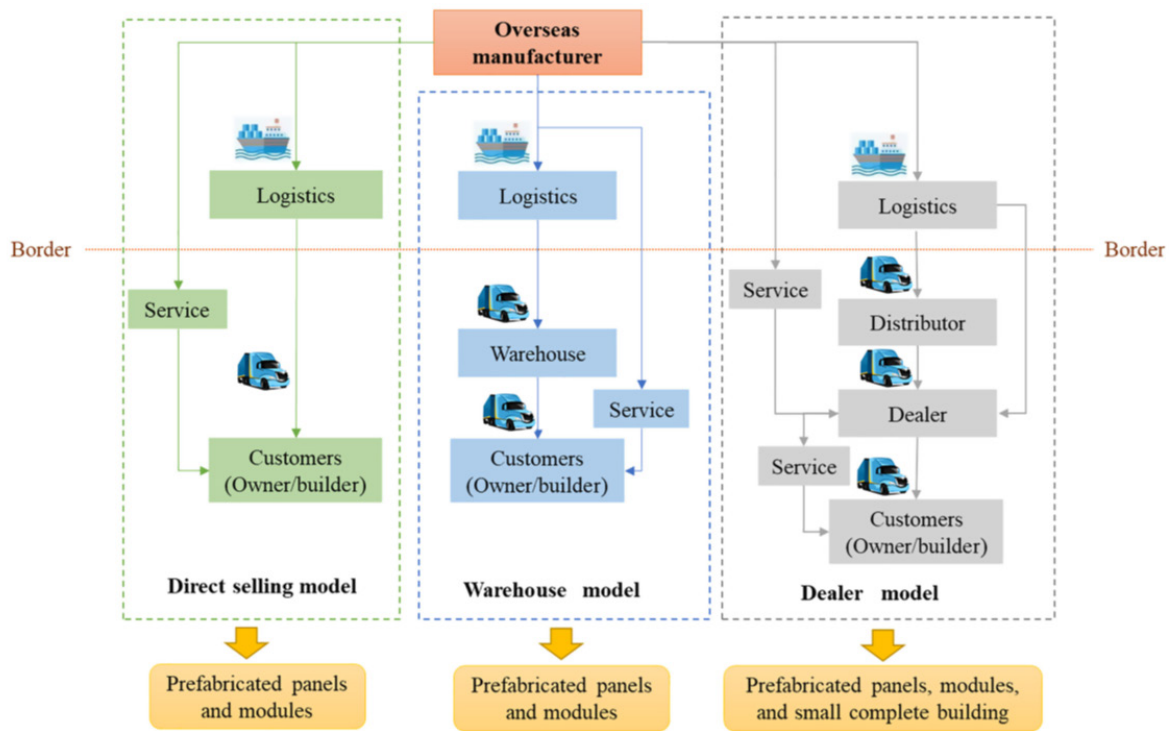


Figure 3 Off-shore imports and distribution of prefabricated buildings/components

The second scheme of value chain comes from offshore imports followed by similar distribution channels (see Figure 3). Different participants are involved in connecting the offshore manufacturers to the end-user that open multiple business opportunities. The businesses operating in this value chain may need to have an additional focus on national import administrative compliances, structural and quality compliances of the manufactured products, effectively communicating the client requirements to the manufacturer, inspections, storage, and distribution. The capital requirements for such business start-ups could still be much lower than the actual manufacturing of the products.

A study compared Australian prefabricated building manufacturers with that of Swedish prefabricated building manufacturers from the manufacturing standpoint. The study highlighted that Sweden has twice as many prefab building manufacturers per capita than in Australia and most of the prefabricated manufacturing in Sweden was developed around panelised construction.² The higher penetration of prefab manufacturing in the Swedish industry was attributed to the ease of adoption of prefab panels as opposed to a volumetric unit. Prefab panels can be incorporated into bespoke designs giving much higher design flexibility over volumetric units.

Manufacturing plant

Moving on from supply chain and distribution business models as seen before, setting up a manufacturing plant for prefabricated components poses substantial challenges. A causality diagram studied by Lou and Gao in China (as shown in Figure 4) emphasizes the complexity of the production strategy of the factories producing modular buildings or components.³

² Steinhardt, D., Manley, K., Bildsten, L. and Widen, K., 2020. The structure of emergent prefabricated housing industries: a comparative case study of Australia and Sweden. *Construction management and economics*, 38(6), pp.483-501.

³ Lou, N. and Guo, J., 2020. Study on Key Cost Drivers of Prefabricated Buildings Based on System Dynamics. *Advances in Civil Engineering*, 2020.

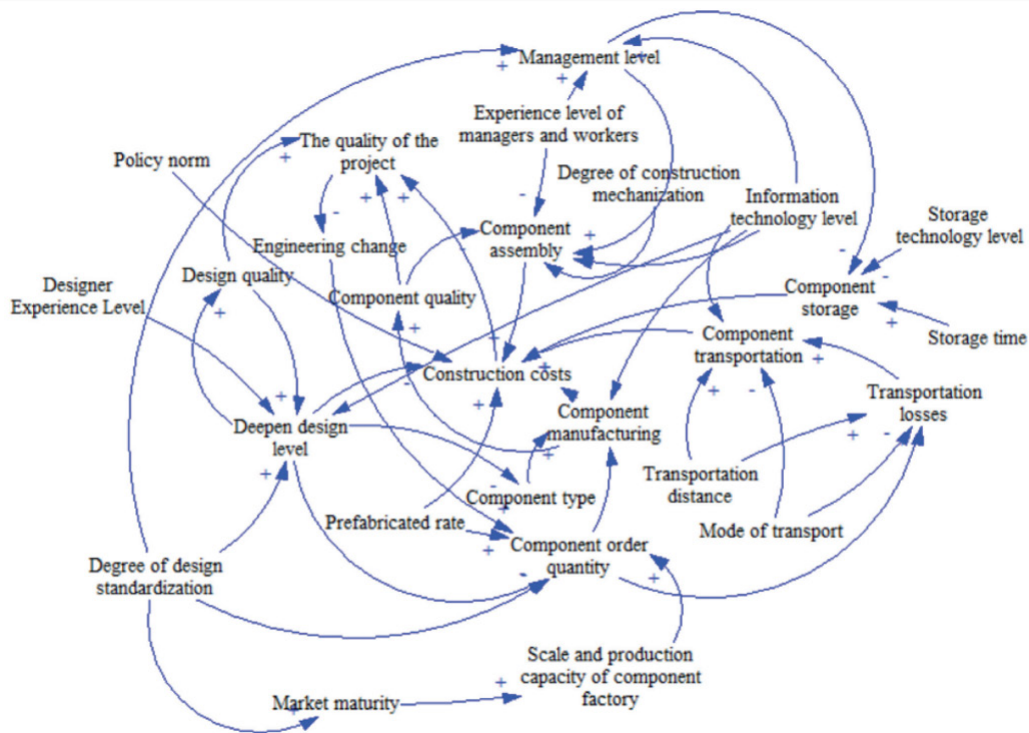


Figure 4 Cause and effect diagram of construction assembly sequence

A statistical study conducted with 191 participants from offsite construction building practitioners in China emphasized the importance of the capital cost barrier in the uptake of prefabricated manufacturing.⁴ Amongst many parameters that were analysed,

- Specification and standards for building design
- Related relevant experience of the manufacturer
- Rationality of prefab/onsite split
- Capacity of the production line in the factory
- Skill level of the labour
- Communication between designers and manufacturers

were the most important and influential parameters for the overall operational cost of prefabricated manufacturing. Modular factory layout optimisation and the use of linear production method was demonstrated by Sunghoon et al.⁵ Authors identify prefab building manufacturing as 'multi-product mass manufacturing' meaning that building manufacturers must design a factory layout that allows design flexibility and offers a satisfactory level of standardization. Bottlenecks in factory layout, labour hour cycles, requisite automation, continuous flow of material and adequate inventory storage facility are crucial factors while planning for a prefabrication factory. Manufacturers need to carefully craft their value proposition as some inherent limitations arising out of 'cost-time-quality' (known as an iron triangle) may adversely affect the financial health of the business. For example, Figure 5 marks two regimes that show compatible and incompatible outcomes from a business point of view for a manufacturing plant.⁶ It highlights that a low volume production facility can offer a great degree of design flexibility and quality at the expense of time and cost. On the other hand, a high-volume production facility can offer greater returns with shorter production times and higher quality control at the expense of design flexibility. Incompatible outcomes (highlighted by red off-diagonal) can result in substantial financial burdens for the manufacturers, which has been seen as the reason for bankruptcies among modular manufacturers.

4 Xue, H., Zhang, S., Su, Y. and Wu, Z., 2017. Factors affecting the capital cost of prefabrication—A case study of China. *Sustainability*, 9(9), p.1512.

5 Nam, S., Yoon, J., Kim, K. and Choi, B., 2020. Optimization of Prefabricated Components in Housing Modular Construction. *Sustainability*, 12(24), p.10269.

6 Jonsson, H. and Rudberg, M., 2014. Classification of production systems for industrialized building: a production strategy perspective. *Construction Management and Economics*, 32(1-2), pp.53-69

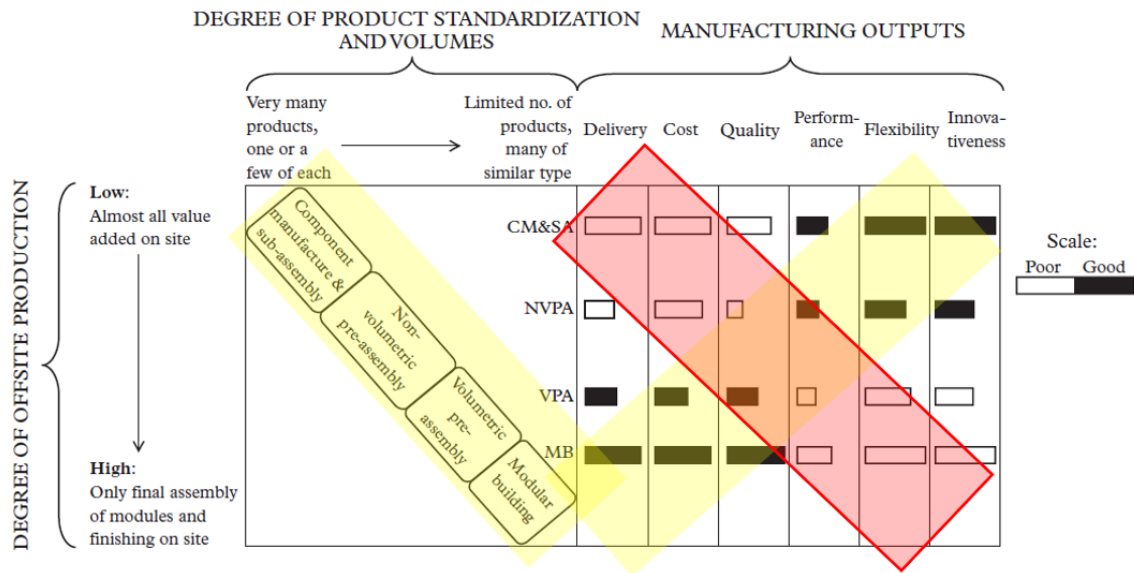


Figure 5 Quantity and nature of manufacturing with its qualitative attributes

A plethora of industrial reports and research articles point to 'lack of capital' as the single most significant barrier to entry and barrier to automate for prefabricated building manufacturing business.⁷ A short review of traditional financing products available for setting up a manufacturing business is presented below.

Traditional financing options

Most manufacturers or new entrants to prefabricated building industries can be classified as small and medium enterprises (SMEs). SMEs are shown to be capable of leading the OSM supply chains provided that their collaborations are strengthened.⁸ Traditionally there are several ways of financing an SME as shown in Table 1. Debt financing, capital structure financing, trade credits and bank loan financing are some of the relevant ways of obtaining finance for setting up a manufacturing facility, adding to existing capacity or accessing operational capital for SMEs.⁹ Bank loans and debt financing are more practised ways of financing for manufacturers.

Low Risk/ Return	Low Risk/ Return	Medium Risk/ Return	High Risk/ Return
Asset-Based Finance	Alternative Debt	"Hybrid" Instruments	Equity Instruments
<ul style="list-style-type: none"> • Asset-based lending • Factoring • Purchase Order Finance • Warehouse Receipts • Leasing 	<ul style="list-style-type: none"> • Corporate Bonds • Securitised Debt • Covered Bonds • Private Placements • Crowdfunding (debt) 	<ul style="list-style-type: none"> • Subordinated Loans/Bonds • Silent Participations • Participating Loans • Profit Participation Rights • Convertible Bonds • Bonds with Warrants • Mezzanine Finance 	<ul style="list-style-type: none"> • Private Equity • Venture Capital • Business Angels • Specialised Platforms for Public Listing of SMEs • Crowdfunding (equity)

Table 1 Traditional options of financing for SMEs based on lenders perception of risk profile¹⁰

7 Darlow, G., Rotimi, J.O. and Shahzad, W.M., 2021. Automation in New Zealand's offsite construction (OSC): a status update. Built Environment Project and Asset Management.

8 Pablo, Z. and London, K.A., 2020. Stable relationality and dynamic innovation: two models of collaboration in SME-driven offsite manufacturing supply chains in housing construction. Engineering, Construction and Architectural Management.

9 Rao, P., Kumar, S., Chavan, M. and Lim, W.M., 2021. A systematic literature review on SME financing: Trends and future directions. Journal of Small Business Management, pp.1-31.

10 New approaches to SME and entrepreneurship financing: broadening the range of instruments. Available at: <https://www.oecd.org/cfe/smes/New-Ap-proaches-SME-full-report.pdf>

Industry	0 to 4	5 to 19	20-199	200+	Total
Banks	56.6	67.1	83.4	83.5	64.0
Finance companies	42.4	33.4	31.7 [^]	21.0	37.4
Existing owner(s)	13.7	13.8	11.7	18.7	13.6
Friends or family existing owner(s)	12.3	8.5	2.1	0.0 [^]	9.5
Other individual(s)	2.8	2.1	0.0 [^]	0.9	2.3
Other businesses	3.2	2.0	4.3	3.4	2.8
Other	0.7	1.8	2.2	4.3	1.4

Table 2 Lenders approached by companies with employment size 2017-19, Australia¹¹

Obtaining banking finance for SMEs in manufacturing is a trusted and traditional way of debt financing as seen from Australian business data in Table 2. Out of SMEs approaching for finance in Australia in 2017-18, 40% of the companies approached for maintaining short term cash or liquidity, 32% obtained finance for the survival of the business, and 24% of the companies obtained finance to replace or upgrade the equipment or machinery.¹² Some of the types of debt financing with banks are shown below:¹³

Long term debt financing

This is a traditional loan granted by a lender based on the company's financial strength and ability to generate sufficient cash flows, in short, the creditworthiness. The decision on the creditworthiness of a borrower is dependent on the company's audited financial statements highlighting debt to equity, current ratio, gross profit, and other financial ratios. For the SMEs that are informationally opaque such as many new entrants in the prefabricated manufacturing business, the creditworthiness is directly tied to the history of the owner of the company.

Equipment/Asset finance

Equipment finance enables SMEs to obtain external financing and acquire cashflow generating assets while retaining the company's capital structure and available funds. There are three types of asset finance products available in Australia viz. lease finance, chattel finance and hire purchase.¹⁴

Finance lease

Finance leasing works when lenders purchase the assets and lease them back to the company. The company then rents these assets from the lenders. Such models have been used in the airline industry where new airliners don't buy the aircraft that they need but instead rent it from a company that buys the aircraft. The ownership of the asset is with the lender who primarily buys the asset. At the end of the lease, the buyer can extend the contract, return the asset, or make an offer to buy the asset with fair market value after appropriate depreciation. In this financial lending, no or very low upfront deposit is necessary reducing the capital investment burden of the manufacturing SME.

Commercial loan/Chattel mortgage

This is where the lenders secure their money against the asset that they are paying for. This requires buyers (consumers or manufacturers in this case) to apply for financing against private property and not real estate. The buyers own the asset and lenders are secured against the value of the asset.

Hire purchase

This is slightly different from a traditional loan in the sense that the ownership of the asset is with the financier/lender until the instalments are fully paid off. The lenders are secured against the titleship/ownership of the asset that they are paying for.

¹¹ ABS, Characteristics of Australian Business 2017-18, Cat. No. 8167.0

¹² SME lending in Australia, Australian Banking Association Economic Report 2019

¹³ <https://www.capitalfinance.com.au/loans-and-finance/compare-business-loans-and-finance>

¹⁴ Emerging trends in business finance: AFIA perspective available https://www.monash.edu/_data/assets/pdf_file/0010/2326492/D2P3-Helen-Gordon.pdf

Working capital

Debtor/receivable finance

With this option, the SME can secure advance cash flow on the outstanding invoices (up to 70-80%) through debtor finance by keeping the receivables as collateral.¹⁵ This provides SMEs with additional borrowing capabilities that they can use to acquire raw materials or goods. The offsite manufacturer can obtain the required working capital for its project, before receiving the agreed progress payment draw to sustain its operations.

Online small business loans

To bridge the gap left by traditional banks in Australia, members of the Australian Finance Industry Association's (AFIA) capital division¹⁶ offer flexible loan solutions. These loans are sanctioned generally within a single business day and are offered at a median of AUD 100,000. The system uses a proprietary credit decisioning system based on data collected by the government and credit bureau. No asset security is required for this type of loan injection.

Corporate credit cards/ revolving credit

In Australia, corporate credit cards are issued by major banks and non-banks (AFIA members: American Express Australia, Latitude Financial Services) to SMEs to acquire assets and grow their business. The products are designed as per SME's previous credit history. The capital provisions are usually smaller in comparison with other products and can be used by SMEs for routine purchases as well as large insurances.

Trade finance

These products are offered to fund the purchase from domestic or international markets. A financier can also provide credit insurance against the risks involved in international trade such as political risk, currency fluctuations, etc. Such loans can alleviate the financial burdens of franchise developers and importers of offshore prefabricated building components. The product can be offered in the form of a letter of credit and bank guarantee between the buyer and the seller.¹⁷

Green loans

Loans are powerful ways of influencing change in the construction market sector. Green loans are means by which cleaner manufacturing and construction can be promoted. The climate bonds initiative is an investor-focused not-for-profit certification scheme that is aimed at promoting a low carbon economy. Its certification criteria are consistent with rigorous scientific data and analysis ensuring the 20 C warming limit set by Paris Agreement. Report prepared by the climate bonds initiative in 2020 surveyed financial institutions in Australia and New Zealand.¹⁸ Four major banking corporations in the region ANZ, New Zealand Green Investment Finance, Macquarie Group and Westpac are leading the way to finance green and sustainable projects. The report stated that direct home loan investment contributed to 13% of Australia's total carbon footprint. There are about 9 million homes in Australia and 1.8 million in New Zealand, and many of them are built below current building code regulations. The green loan initiative is multiplying its creditor base rapidly as more and more firms and corporates find themselves in need to commit to fighting climate change by 2050.

Internationally many financial approaches have been developed to support energy-efficient housing construction and new technology induction towards sustainability. In the US, the Federal Housing Administration (FHA) insures mortgages of approved lenders meeting specific green requirements set out in the Energy Efficient Mortgage Program established in 1980.¹⁹ New Zealand's Healthy Home Loan Package, since 2019²⁰ offers discounts to home buyers who can demonstrate energy-efficient features in their homes. The program is similar to Australia's National House Energy Rating System (NatHERS) that certifies the energy rating of a house thereby allowing the house to be financed through green loans. In Europe, European Energy Efficient Mortgages Initiative (EeMAP) was launched in 2017, with a pilot group of 37 banks. The biggest contributor to the green bonds market is the program known as Fannie Mae Green Building Financing in the US that has over USD 75.²¹

¹⁵ AFIA Working Capital Division (Debtor & Invoice Finance Group) Report (2016)

¹⁶ Consists of six entities: Capify, GetCapital, OnDeck, Moula, Prospa and Spotcap

¹⁷ <https://www.financingyoursmallbusiness.com.au/>

¹⁸ Green loans Australia and New Zealand available at: <https://www.macquarie.com/assets/macq/perspectives/cbi-green-loans-anz-report-oct-2020.pdf>

¹⁹ https://www.hud.gov/program_offices/housing/sfh/eem/energy-r

²⁰ <https://www.anz.co.nz/personal/home-loans-mortgages/loan-types/healthy-homes/>

²¹ <https://www.fanniemae.com/research-and-insights/publications>

Increasing funding in green loans could be a boon for the off-site manufacturing industry as reduced embodied carbon, reduced waste, streamlined supply chains, and overall construction efficiency are some of the main deliverables of manufactured homes. With increasing certifications and codifications for prefabricated construction, we can expect that more and more capital and consumer financing products would be rolled out that could benefit the entire OSM industry.

UK Overview

The UK has seen substantial growth in research and awareness of prefabricated buildings from 2010 to 2020. Critics argue that this hasn't yet transformed into consumer uptake of the technologies as many challenges around design, cost, quality remains resolved unsatisfactorily. The number of companies operating in but not limited to bathrooms/pods, cladding and façade, light steel frames, pre-cast panels, timber frames, volumetric permanent/temporary structures has doubled from 2010 to 2019.²² Off-site manufacturing in the UK reached about £6.78 bn in 2018 contributing 5.9% of all the new constructions in 2018. According to the study, there were 382 active companies working in the prefabricated sector in the UK as of 2019.

'Build offsite property assurance scheme' (BOPAS) provides a construction method accreditation to the owners, developers, manufacturers, suppliers, lenders, and investors for non-conventional building manufacturing processes. BOPAS certification can help demonstrate added security for lenders to their mortgage loans to manufacturers and developers. BOPAS certification is recognized by a wide range of lenders in the UK such as Aldemore Bank, Bank of Ireland, Barclays, Bath Building Society, Building Societies Association, Cambridge Building Society, Royal Bank of Scotland, UK Finance, and many more.²³

Lenders might also need to know the exact timeline of construction and if they are easily comparable with each other. In this way, the lenders can use the same financial products with similar assumptions that are implicit.²⁴

Australia/NZ Overview

The unwillingness of banks due to risk aversion to funding the off-site manufactured (OSM) projects has been a major hindrance for Australian prefab manufacturers. A ground study conducted in Western Australia (WA) by Jordan et al, found that WA manufacturers face considerable hardship in securing bank loans for their projects. Only projects that have clients' financial backing seem to be getting ahead. That, according to the authors, was also because banks do not have a sufficient number of successful OSM implementations to instil required confidence in their lending.²⁵

Banks are aware of the challenges faced by capital financing and consumer financing when it comes to prefabricated buildings, and they are working on it all around the world in different capacities. The issue of security and ownership can be solved by contractual agreements and securities governed by Personal Property Securities Act 1999. PPSA 2009 provides superior priority once granted to the lenders only if the lender's money is directly used to acquire the 'personal property' under consideration.²⁶ If the lender provides funds towards the 'working capital of a business' the PMSA does not provide title or leasing rights to the lender for the property under PMSA 1999-2009.

The issue of builders going bankrupt can still be resolved using direct agreements with banks wherein banks fund the project through capital financing and fund the homebuyers through consumer financing. Such direct agreements also allow the banks to own the manufacturing business and complete the project if the manufacturer defaults on construction or goes bankrupt. With such agreements, the manufacturer can employ capital restructuring to fund the operations. There are several private consultants in the business to bridge the gap between the manufacturers who need financing and the lenders.

22 Taylor, M.D., 2020. A definition and valuation of the UK offsite construction sector: ten years on. *International Journal of Construction Management*, pp.1-9.

23 <https://www.bopas.org/industry-news/bopas-lenders-supporters/>

24 <https://avamorecapital.com/modular-construction/>

25 Correia, J.M., Sutrisna, M. and Zaman, A.U., 2020. Factors influencing the implementation of off-site manufacturing in commercial projects in Western Australia: A proposed research agenda. *Journal of Engineering, Design and Technology*.

26 *Personal Property Securities Act 2009* at: <https://www.legislation.gov.au/Details/C2021C00105>

Chapter 2 - Consumer finance for home – buyers

Overview

United States

- 65% of the borrowers that own the land took a chattel loan to finance manufactured home.²⁷
- Manufactured home loans cost higher to the consumer with higher interest rates. Around 68% of the borrowings for manufactured houses were marked as 'higher-priced mortgage loans' (HPML) that are considered sub-prime.
- Homeowners can choose between mortgage loans or chattel loans for their prefabricated house based on their preference with upfront costs vs lower total cost.

Japan

- Manufactured houses can be financed by mortgage loans with a 35-year fixed-rate mortgage.²⁸
- Japanese mortgage loans are recourse loans. This means that if the loan value exceeds the housing value and if the borrower cannot pay the mortgage loan, the lenders have a contractual authority to recover the remaining mortgage through collateral and unencumbered asset.
- The maximum value of the loan is calculated proportionally to the value of the land.
- Offsite manufacturers provide a 10-year warranty to the manufactured houses.

Sweden

- Sweden also offers a mortgage loan pathway to finance manufactured houses.
- The average loan to value ratio (LVR) was found to be 64% in 2016.²⁹

Public sector funding in boosting OSM is not a safe option to rely on even if it is imperative, says Solutions Asset Finance (SAF), UK. Ever growing need to meet the demand in social and public housing can only be met with the high functioning offsite construction industry in the UK. To mitigate this issue, private sector finance must pitch in to boost the industry with suitable financing models.

Australia/NZ

The Australian housing sector has outstanding lending of about 1.4 trillion.³⁰ More than 50% of the debt is not mortgaged. In Victoria, only about 33% of the housing loans are mortgaged against.³¹ Commonwealth Bank, Westpac group, Australian New-Zealand banking corporation and National Australian bank are the top four financial institutions contributing about 80% of the lending in the Australian housing market.³² None of these institutions has shown the readiness to finance offsite construction as yet. Post GFC, banking institutions have grown warier of unconventional construction finances. OSM with its inherent uncertainties and yet unproven track record on mass scale builds a case for the lenders to reserve the support for it.³³ Australia seems to have been stuck in a negative feedback loop where lack of funding inhibits the required growth in the sector which further constricts the funding.³⁴ It is observed that the countries that have seen a large uptake of offsite construction have strong public sector funding and a push from the financial institutions.³⁵

Progress drawing

Progress claims must be carefully negotiated with the banks. In current practice, banks release the payment for foundations, delivery of modules, installation, and condition check, supplies and amenities, ready for occupation. Any additional disbursements between the first and the second stage are very difficult to negotiate with the lenders due to

27 Consumer finance protection bureau CFPB (2014) *manufactured-housing consumer finance*

28 Japan Housing Finance Disclosure booklet 2014, <https://www.jhf.go.jp/files/300196956.pdf>

29 *Housing in Sweden: An Overview*. Turner Center for Housing Innovation, UC Berkeley.

30 Kitson, Erin, Kate J Thomson, and Vera Chaplin. "An Overview of Australia's Housing Market And Residential Mortgage-Backed Securities," *Standard and Poors Ratings Services*, (March 2015).

31 Valadkhani, Abbas. "The Pricing Behaviour of Australian Banks and Building Societies in the Residential Mortgage Market." *Journal of International Financial Markets, Institutions and Money* 26 (October 2013): 133–51.

32 Rowley, S., Costello, G., Higgins, D. and Phibbs, P. "The financing of residential development in Australia", AHURI Final Report No. 219, Australian Housing and Urban Research Institute Limited, Melbourne.

33 US, H., 2019. *Prefabricated housing in Australia: identifying the financial barriers*. *International Journal of Civil Engineering and Technology*, 10(3).

34 Khalfan, Malik M. A., and Tayyab Maqsood. "Current State of Off-Site Manufacturing in Australian and Chinese Residential Construction." *Journal of Construction Engineering* 2014 (2014): 1–5.

35 McDonald, Stephanie., "Barriers to Prefab Construction in Australia (and How to Break Them): XSite Modular Consulting's Amy Marks." *Online Article, Architecture and Design*. (May 2015) <https://www.architectureanddesign.com.au/features/comment/barriers-to-prefabconstruction-in-australia-and-h>

the uncertainty that exists between them. Some builders claim to be able to negotiate with the lenders directly on behalf of the consumers so that lenders and builders can come up with bespoke progress drawing plans.³⁶

The manufacturer typically wants the payment before the module is installed on the site, making it a part of the real estate. The conversion of the building module from a 'product' to a 'real-estate' considerably complicates the legal obligations for the manufacturer. Whereas the financial lenders such as banks want this to happen for the very reason that additional consumer protection legality brings an additional layer of security over the lending.

Monty et al analysed cashflows of two OSM projects based in WA in 2019 and documented two strikingly different cashflow patterns from the manufacturer's perspective as shown in Figure 6. In case 1, the manufacturer could be seen in negative cash flow territory for the most duration of the project. Case 1 had 6.5% upfront deposit from the consumer and 93.5% of the second payment after the delivery of the project. Case 2 had payments distributed over 5 milestones with payment schedules given by:

- 6.5% deposit
- 34% at the material procurement stage (2 weeks before build start date)
- 29% at structure completion in the factory
- 15.5% at internal works of the modules
- 10% on arrival of the modules to the site
- 5% handover stage

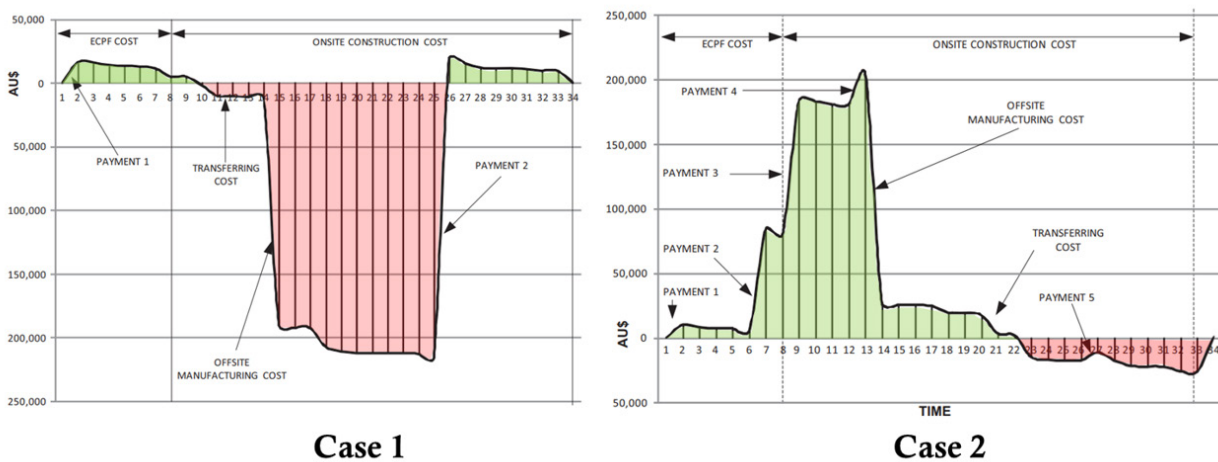


Figure 6 Cash flows from two OSM case projects in WA³⁷

Authors identified that case 2 cash flow significantly improved the manufacturer's ability to manage the OSM. Such cash flows need to be negotiated carefully with each client based on individual project merit.

Finance products

Kit-homes and modular homes

The difference in terminologies from the lender's perspective affects the kind of financial product they can offer to the buyers. Kit homes are flat pack subsystems that need assembly on site. The buyer can act as an owner-builder and manage the assembly or can hire a licensed builder and get the assembly done. The banks do not generally provide any loan assistance for the owner builder pathway since the success of the project entirely depends on the skills and the ability of the buyer acting as the builder in this case. If the kit homes are assembled by a licensed builder, few banks may offer loan assistance with lower LVRs (loan to value ratio).

The modular homes are prebuilt homes where almost 80% of assembly is done offsite. These homes are then delivered to the site on trucks and are installed in their pre-designated places. With this method, many financial products have been developed. Still, the loan disbursement suffers from an important drawback that is, the banks do not allow a big proportion of the loan draw until the modules are delivered and installed on the site. This requires the buyer to arrange for all the upfront costs that the manufacturer (builder) requires.

³⁶ <https://www.evokelivinghomes.com.au/latest-news/modular-homes-and-financing-an-honest-approach>

³⁷ Sutrisna, Monty, Barry Cooper-Cooke, Jack Goulding, and Volkan Ezcan. "Investigating the cost of offsite construction housing in Western Australia." International Journal of Housing Markets and Analysis (2019).

Chattel Financing

In the US, people can title their property and go for a real estate home loan option or declare the manufactured house as their personal property and opt for chattel financing. In a survey, 65% of the American buyers serviced their manufactured home finance through chattel loan option between 2001 – 2010.³⁸ Trade-offs between chattel home loans and real estate property financing are to be mitigated. Interest rates on chattel loans are considerably high and the loan duration is comparatively shorter than real estate finance. The manufactured home qualifies for a mortgage loan only after it's declared as a real-estate property affix on the land. A mortgage loan has a much higher upfront cost in the form of 'down payment', lesser interest rates and typically lasts much longer than a chattel loan. A mortgage loan is secured against the land and the real-estate property combined whereas the chattel loan takes only the personal asset that is the manufactured home as the collateral.

Guarantor's loan

Lenders usually do not release full payments before the building is shipped and erected to the site. Till this time the buyers have to finance the house to the builder by themselves. There are some financial products such as guarantor's loan where parent's properties could be offered as collateral to secure the entire value of the prefab construction project (land + construction) and the lender, in this case, can release the entire payment to the buyer before the house is shipped to the site. Once the house is installed, it can be reassessed financially, and the guarantor's property can be freed from the loan security and the security could be tied with the land and the building. This refinancing facility could help first home buyers who do not have enough funds to pay for the prefab house or enough equity with the existing assets.

Mortgage loan

Obtaining a mortgage loan for manufactured housing in Australia isn't a streamlined process yet. Manufacturers like MODSCAPE aids the consumers in securing bank financing. Many other manufacturers have tie-ups with private or institutional lenders that mitigate house financing for consumers.

Green home loans

Modular homes financing can also come through a relatively newer channel of housing finance called 'green loans'. A consumer is eligible for such loans for a variety of home improvements or even for buying a real estate property if the property or activity being financed is a step towards reducing the carbon footprint on the planet. It includes upgrades such as solar panels, battery systems, greywater treatment, water tanks, insulation, home ventilation and so on. Various financial institutions are incentivising such loan products by reducing interest rates. In Australia, various banking institutions are offering such finances to consumers such as Australian Military Bank, Bank Australia, Bendigo Bank, Beyond Bank, Commonwealth Bank, and so on.³⁹

Home loans are offered under 'Clean Energy Finance Corporation (CEFC)⁴⁰ where a manufactured home must obtain green certification against the criteria set in 'Nationwide House Energy Rating System' (NatHERS)⁴¹

38 *Manufactured housing consumer finance in the U.S.* available at <https://www.consumerfinance.gov/data-research/research-reports/manufactured-housing-consumer-finance-in-the-u-s/>

39 <https://www.canstar.com.au/personal-loans/green-loans/>

40 <https://www.cefc.com.au/about-our-finance/>

41 <https://www.nathers.gov.au/owners-and-builders/nathers-certificate>

Emerging technologies

According to the PWC report published in 2020, it is predicted that:⁴²

1. FinTech will drive the new business models
2. Sharing economy will be embedded in every part of the financial system
3. Blockchain will shake things up for payments and contracts
4. Digital will become mainstream
5. 'Customer intelligence' will be the most important predictor of revenue growth and profitability
6. Advances in robotics and AI will start a wave of re-shoring and localisation
7. Cyber security will be one of the top risks facing financial institutions
8. Regulators will turn to technology as well

In an interconnected world, consumers may not turn to banking systems for financial support. Newer networks enabled by IT platforms will connect lenders and buyers more efficiently. Some of the emerging technologies in payment and contracts that may be relevant to the construction industry are introduced in the following section.

Peer-to-peer lending

Financial institutions are typically seen as the entities initiating and managing a financial transaction from end to end, typically investing their capital with risk. The newer breed of FinTech companies coupled with traditional financial institutions is offering platforms for peer-to-peer (P2P) lending. In P2P lending the intermediate platform validates the creditworthiness of the borrower and secures the lender. With no formal banking institution in place, the transaction time and charges are greatly reduced which in turn increases the economics of the financial burrowing for the lender as well as the burrower. Allied market research report pointed that the P2P lending market generated \$67.9 billion in 2019 and is expected to generate \$558.9 billion by 2027 with a CAGR of 29.7% from 2020 to 2027.⁴³

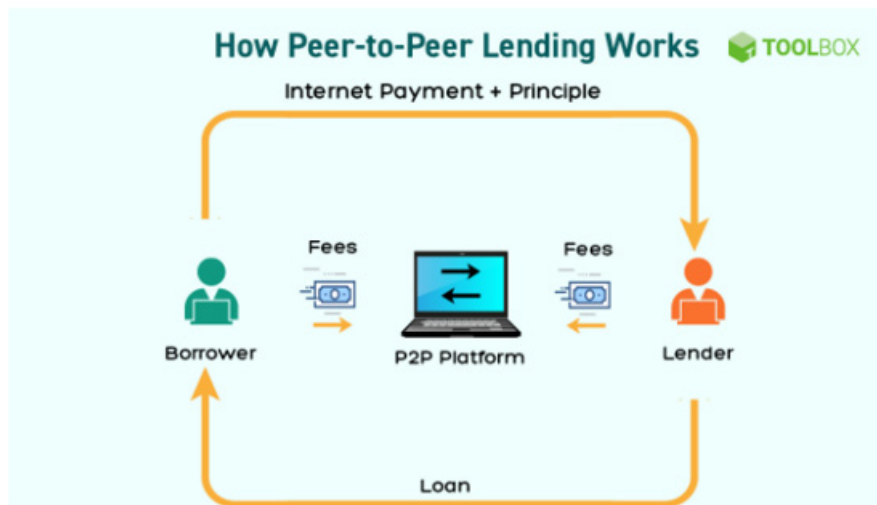


Figure 7 Peer to peer lending concept (source: <https://www.toolbox.com/finance/fintech/articles/the-role-of-peer-to-peer-lending-in-fintech/>)

The advantages of the P2P lending system are realized in the form of decreased time for a loan application, decreased associated application costs and therefore increased rate of returns. Although this form of payment system is still in its infancy, its use in construction could be imminent.

⁴² Financial Services Technology 2020 and Beyond

⁴³ <https://www.alliedmarketresearch.com/peer-to-peer-lending-market>

IoT

Internet of Things is a broad term used for sensors collecting information from the surroundings and relaying it to the central network for further processing. Mobile phones are the biggest source of a vast pool of behavioural information about an individual that rightly is hidden behind the privacy laws. But within the realm of available public information or contractual personal information, an individual shares unimaginable quantities of data related to geolocation, service networks, movements, health data, wireless transactions, eating habits, spending habits and so on. Financial institutions are using the transaction data of each user to tailor different kinds of financial products individually. Telematics is being deployed in the United States and increasingly in Australia to monitor the driving behaviour of a car owner that facilitates insurance companies to adjust the car insurance premium better. The information about vehicular health, driving conditions, overspeed, accidents and so on are directly relayed to the insurance companies upon the owner's consent and the insurance premiums are tailored to an individual.

The use of IoT sensors is proliferating rapidly in the construction industry for various kinds of monitoring including but not limited to indoor air quality, indoor illumination, temperature, HVAC adjustments etc. One could imagine the use of IoT sensors to monitor the progress of prefabricated building manufacturing inside a factory to alert relevant lending bodies to disburse agreed progress payments. IoT could be directly interlinked with blockchain-based smart contracts to monitor the building completion inside a factory to ensure that payments are released on time.

Smart Contracts

Blockchain

Blockchain can be conceptualized as a chain of information packets that are encrypted using a kind of mathematical function (hash) that makes it traceable and tamper-proof. It is a well-known form of distributed ledger technology where each participant (node) guarantees the security and validity of the chain of information being passed on. It is practically impossible to change an entry in the information chain (blockchain) without broadcasting that change request to the entire participatory network of nodes (users) of that blockchain. This aspect of distributed ledger system makes it open, transparent and fraud-proof. With an increasing number of participatory nodes in the chain, the blockchain becomes increasingly more resilient to hacking, data leak, privacy compromise and theft. It is therefore used as a backbone of emerging markets of cryptocurrencies.

Fraud proof, open ledger and internet cloud architecture for instant connectivity are all the right ingredients necessary for a smart contract. Ethereum (one of the widely known cryptocurrencies) is a technology that is increasingly being deployed for smart contracts.

Contracts

Typical construction projects involve a large number of contractual stakeholder relationships. A contract is truly honoured when the agreed quality work is completed in the agreed amount of time and the services are paid at agreed time intervals. In a realistic scenario, late payment is a common problem. Long credit lines in themselves stretch some businesses to their limits and when late payments stack up, they create a loss of trust amongst stakeholders. Smart contracts based on blockchain technology could potentially revolutionize the subcontracting and payment process by interlinking it with the BIM platform.⁴⁴

Smart contracts could be used in invoicing and contract verification processes effectively. A smart contract is a term associated with the contracts executed through blockchain 'public ledger technology. Canada's National Research Council launched a trial of Ethereum blockchain to administer government contracts.⁴⁵ EY report states that blockchain technology could revolutionize construction project contracting issues such as sub-contractor management, earthworks, public-private partnerships and so on.⁴⁶ A three-way match between purchase order, certified progress and master-project data could be used to execute a blockchain based smart-contract transaction.

44 Sigalov, K., Ye, X., König, M., Hagedorn, P., Blum, F., Severin, B., Hettmer, M., Hückinghaus, P., Wölkerling, J. and Groß, D., 2021. Automated payment and contract Management in the Construction Industry by integrating building information modeling and Blockchain-based smart contracts. *Applied Sciences*, 11(16), p.7653.

45 "Exploring blockchain for better business," National Research Council Canada website, www.nrc-cnrc.gc.ca/eng/stories/2018/blockchains.html, accessed 6 September 2018

46 "Smart contracts using blockchain technology: a better way to deliver construction projects"

A team at Griffith University has been working on developing a blockchain-enabled prefabricated construction supply chain management (PSCM) model to optimise the PSCM system. The main objectives of the study are as follows:

1. To review the literature of current PSCM and identify the ways to combine blockchain technology with PSCM
2. To design a workflow for establishing a conceptual PSCM framework
3. To integrate the blockchain with the conceptual PSCM framework to develop a blockchain-enabled PSCM model, which can improve the information management, on-time payment, and delivery of PSCM
4. To apply the blockchain-enabled PSCM model to case study and validate the feasibility of the model

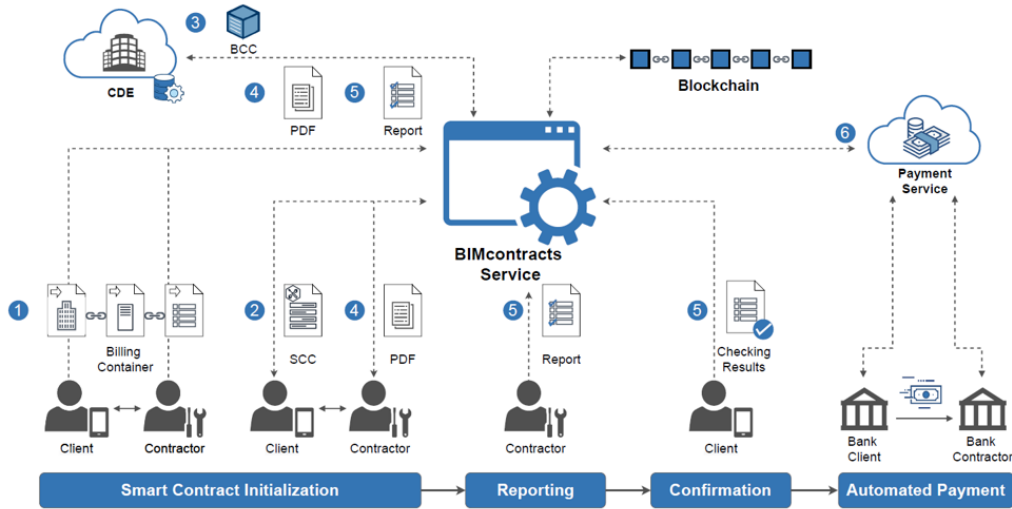


Figure 8 BIM contracts integrated with blockchain technology

Conclusions

There have been multiple instances in the past where attempts have been made to conventionalise manufactured housing. However, unlike those past instances, the current wave of manufactured housing is supported by the technological revolution in data, optimisation, tracking, automation in manufacturing and the push for low carbon living. Offsite manufacturing has become a prominent field of research from technology, integrity, quality, management and supply chain, finance, and policy perspective. Despite claimed qualitative benefits of off-site manufactured houses, its uptake in the industry in most parts of the world remains low. Financial mechanisms to boost the uptake amongst manufacturers and consumers are being studied across the world. The current report highlights some of the issues and opportunities in capital financing options for manufacturers and housing finance products for consumers in Australia/ NZ with a background worldview.

Accreditation of OSM housing can pave way to instil confidence in financial institutions in Australia, much like the BOPAS in the UK. Clean energy consortiums with the industry partners and financial institutions can create a financial ecosystem that could boost certified manufacturing of houses in Australia. Absorbing this newer trend in construction into a risk averse traditional banking system in Australia will take time and all-round efforts are needed to standardize the process. Australian Building Codes Board (ABCB) produced National Construction Code could integrate manufactured housing to provide better quality assurances, standardizations, and reliability. Certification schemes such as NatHERS could be extended to provide structural and production approach rating matrix that would enable lenders design financial products around such added layers of security.

Modern methods of construction have also modified the supply chain associated with them. These methods are rendering conventional capital lending structures incompatible. Advances in IT and FinTech can bring about the required structural changes in the ways the payments are made, and contracts are executed. Use of blockchain, smart contracts, IoT and various forms of lending and burrowing can significantly boost the productivity in prefabricated building manufacturing sector.

With more capital available to manufacturers, the SMEs could invest in productivity improvements thereby producing greener and market friendly products that would set out a positive feedback loop for the offsite manufacturing sector in Australia.