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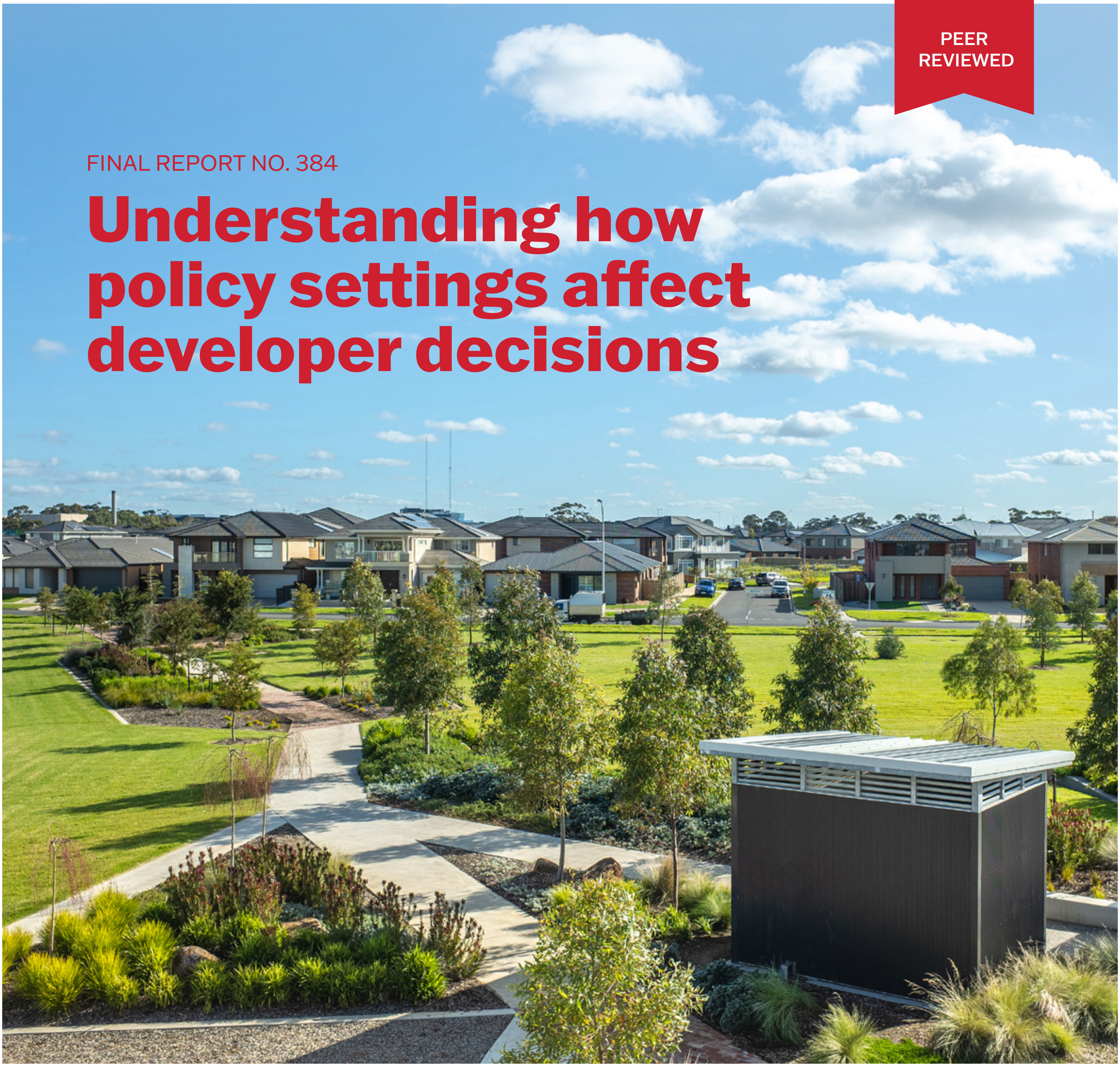
Understanding how policy settings affect developer decisions



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AHURI

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Acronyms and abbreviations used in this report

ABS	Australia Bureau of Statistics
ACT	Australian Capital Territory
AFC	Age-Friendly Cities
AHA	Australian Housing Aspirations Survey
AHURI	Australian Housing and Urban Institute
APRA	Australian Prudential Regulation Authority
AR	Augmented Reality
BIM	Building Information Management
CHO	Community Housing Organisation
DfMA	Design for Manufacturing and Assembly
DVA	Development Viability Appraisal
EoI	Expression of Interest
EMDF	Argus Estatemaster Development Feasibility
HIA	Housing Industry Association
IRR	Internal Rate of Return
LGA	Local Government Area
MBA	Master Builders Association
NCC	National Construction Code
NHFIC	National Housing Finance and Investment Corporation
PCA	Property Council of Australia
PRS	Private Rental Sector
RLV	Residual Land Value
TRR	Target Rate of Return
UDIA	Urban Development Institute of Australia
UK	United Kingdom
VR	Virtual Reality

Executive summary

Key points

- **Private sector residential development is driven by profit. Developers want policy certainty so they can factor these policy settings into their assessment of the potential financial feasibility of a development site.**
- **The complexity of the development process, the structure of development organisations, the variety of products delivered, and land ownership issues mean the development decision-making process varies by organisation and site by site. Therefore, it is too simplistic to assume policy settings will have exactly the same impact on each and every developer and on each and every site.**
- **Housing market conditions drive private sector development. Policies that stimulate or restrict market demand will impact levels of housing supply.**
- **Once a developer has purchased land for development, any new costs introduced through regulation will impact profitability. Developers will try and pass these costs onto consumers through higher prices in order to maintain profit but their ability to do so will depend on market conditions.**
- **Reducing development costs will not automatically result in a more affordable end product. Such cost reductions could end up in a higher price paid for the land, additional profits for the developer or a combination.**
- **Reducing development approval timelines has a positive impact on profitability outcomes. New construction technologies that reduce development timelines can also have a positive impact on profitability outcomes.**

- **Affordable housing contributions required from a development site need to be known by a developer well in advance of land purchase so they can be factored into assessments of profitability and land price.**
- **Mandatory affordable housing contributions are the most likely source of large-scale affordable housing contributions in Australia and many sites would be able to absorb the costs of such delivery under a well-designed, efficient and consistent policy.**

Key findings

This research examined how policy settings affect developer decisions, necessary to provide policy makers with an understanding of how private sector housing supply is likely to react to settings and events which affect development costs, revenues and timeframes. The research also examines the issue of new construction technologies and processes to establish their potential for reducing development costs and timelines, improving affordability.

The development industry is incredibly complex, made up of hundreds of different organisations with a myriad of different structures. As such, a project like this can only take a broad-brush approach to highlight the impact of a range of settings on traditional approaches to development. The general findings show the importance of market conditions in driving supply and how factors such as infrastructure costs, delays in development approvals and construction timelines have a negative impact on profit outcomes if they cannot be factored into a developer's initial assessment of site profitability. Such assessments are conducted through a discounted cash-flow based feasibility modelling process. Factors that are certain to the developer, such as prevailing taxes and construction costs, can be carefully considered in a decision to develop, it is the unknowns that developers fear. Clear and consistent policy settings, certainty in development timeframes and certainty in policy advice create the ideal conditions for development. The rest is dependent on market conditions.

Private sector development is driven by profit, specifically the balance between risk and return. There are a number of factors that affect this balance:

- **Market conditions:** strong demand, rising prices, cheap and accessible credit and high levels of consumer confidence are the perfect conditions for developers. Unexpected price rises during a development period will result in higher than anticipated profits for a developer.
- **Risk:** there are a number of factors developers consider when assessing risk and the level of return required to compensate for that risk. Market conditions is one, with the others being related to costs and timelines that a developer in unable to fully predict in their feasibility modelling. Those settings are fixed and easy to predict, and therefore assess. If costs are too high for the level of return required from a given site, the site will not be considered profitable and no development will occur. It is those factors that may vary after a developer has set the development process in motion that are problematic. Unforeseen delays caused by development approval processes, unexpected infrastructure costs, new taxes, labour and/or supply shortages, weather events and changes to design requirements can mean an increase in costs or a decrease in revenue and result in a lower than expected return.
- **Landowner expectations:** landowners will often be well aware of prevailing market values in an area and will engage consultants who will adopt feasibility modelling processes to come up with what they believe is a realistic price. Add additional costs into the development process and a developer may not be able to meet the landowner's price expectations, preventing development on a site until the landowner lowers their expectations, a developer is somehow able to reduce costs or predicted revenues rise. The current model of determining land purchase price benefits the landowner rather than the developer as the landowner benefits from the uplift in value associated with re-zoning and development approval. Reducing the land cost input

could enable a developer to deliver a dwelling product to the market at a lower price. However the prices of new dwellings are generally set with reference to the comparable products in the local market, meaning there is little incentive for the developer to price below market other than to increase sales rates.

- **Cost certainty and price setting:** the costs of development will be factored into the price a developer pays for land. Unexpected cost increases post land purchase will need to be either absorbed by the developer in the form of lower profits, or passed onto the end consumer to maintain predicted profit levels. In some cases, developments will be profitable enough to absorb unexpected increases, but in a competitive development industry these are the exception rather than the norm. While the development industry often states that increased costs will end in higher prices for the end consumer, the ability of developers to pass on these costs depends on market conditions. Prices are determined in the local market and unless the developer has created an entirely new market with no local competition, that market will determine prices, i.e. how much consumers are prepared to pay. In a market with strong local supply and weak local demand, a developer will be lucky to maintain prices predicted at the start of the development process let alone increase prices to absorb costs.

This research conducted feasibility modelling to examine how changes to key input variables affect development return outcomes. The modelling was based on a developer purchasing the land upfront with their own equity. While there are many other models of the development process and the timing of land purchase, this is considered the most common. The modelling outputs can be summarised as follows:

- Small increases or reductions in end sales prices have major implications for Internal Rate of Return (IRR) outcomes. A 10 per cent fall in revenue can mean a 50 per cent drop in the IRR. This means end sale prices are the biggest risk factor in the development process.
- Small increases or reductions in direct costs of construction can also have major implications for returns. A 10 per cent increase in costs can mean a 40 per cent reduction in the IRR.
- Significant reductions in the time taken from the commencement to completion of construction can have a positive impact on feasibility. Even a one or two month reduction in a 24 month build time can mean the difference between a profitable and unprofitable development.
- An increase in the time taken for development approval after land purchase will have a modest, negative impact on return outcomes. The longer the delay, the greater the impact.

Policy development options

Stimulating the market

The Australian Government's response to COVID-19 through HomeBuilder and associated state government grants showed how quickly demand side incentives can stimulate the housing industry and deliver new housing supply. Grants increase a consumer's capacity to buy while also increasing confidence in the market. This reduces risk for the developer, which along with higher prices, stimulates the development of new sites.

If governments are to use such spending to stimulate housing markets in the future, they must learn from HomeBuilder and how sharp increases in supply puts pressure on the building industry through labour shortages and material price increases. Smoothing housing supply over a longer period rather than a HomeBuilder-like rush would help the industry cope and avoid capacity constraints. A stimulus scheme operating across the entire industry, rather than concentrating on detached homebuilding, would also be more equitable. But what HomeBuilder has shown is demand side grants are an effective way of boosting housing supply in the short term and bringing forward development activity reliant on greater certainty and improved market conditions.

Inclusionary zoning

The introduction of affordable housing contribution requirements through inclusionary zoning can have a major impact on development feasibility. While density and height bonuses can help replace revenue, the developer needs to be able to pass costs onto the landowner and that means knowing well in advance what such requirements are likely to be. It will then be up to the landowner to determine if the resulting land price is sufficient to stimulate a sale. On smaller sites, the land price could fall by as much as 50 per cent if there is no capacity to increase the number of market units. If the developer already owns the land, the introduction of new contribution requirements will have a major impact on returns. Policy makers need to be conscious of the impact of such policies on development profitability and ensure they don't stifle supply. Carefully designed schemes, long lead in times and flexibility around site by site negotiations are essential. Such mandatory affordable housing contributions are the most likely source of large-scale affordable housing contributions in Australia, and many sites would be able to absorb the costs of such delivery under a well-designed and consistent policy.

Taxes and infrastructure

The costs of upgrading local infrastructure can prevent development so state and local government needs to determine whether there is merit in co-funding such infrastructure, otherwise they risk no development occurring. This is true of both infill and greenfield sites. Upfront investment in infrastructure can unlock sites for development which would otherwise be unviable for individual developers. A strategic approach to infrastructure investment to ensure a steady supply of developable sites is essential.

Stamp duty is widely perceived as a barrier to household mobility, impeding transactions. From a developer's perspective, not only does the upfront stamp duty on land purchase add to costs but stamp duty removal would likely boost demand, increasing sales rates and impacting on end sales prices. Certainly, the removal of stamp duty would have a positive impact on development industry activity by reducing end sales risk. Foreign duty surcharges also impact the development industry by making it harder to secure sales, particularly pre-sales for apartments. In some developments, particularly those with strong overseas investment interest, this has a negative impact on viability.

Urban regulation

To operate efficiently and deliver housing supply where it is most needed, the development industry needs a steady supply of sites that are financially viable to develop. This requires long term strategic thinking by all levels of government and a mechanism where investment in infrastructure is coordinated and shared between government, landowners and developers. Improvements to strategic planning with the setting and delivery of housing targets at the local level, both market and affordable dwellings, are essential.

The general complexity of the regulatory system with multiple layers of plans and approvals adds to uncertainty as a development could be blocked at any time. Timeframes can slip, which impacts on development viability. The growing complexity of the environmental approvals process state by state adds to development risk and can be a barrier to supply. Improved clarity of procedure and defined timelines can reduce risk for the developer. Changes to national construction codes (NCC) and local design guidelines can also add to costs and make certain types of development in certain local markets unviable when prices are too low to generate a profit for the minimum development cost.

Appropriate zoning that considers market demand is another important factor in stimulating development. Consideration for the economics of development within the planning framework is essential. This is also the case for any proposed inclusionary zoning policies.

COVID-19

Rising prices and changing patterns of housing demand driven by COVID-19 potentially create new development opportunities and new challenges for policy makers who must react to changing demand. Ensuring adequate land supply and supporting infrastructure to cope with demand pressures in regional areas is essential to allow the development industry to respond.

The study

The private sector now delivers over 98 per cent of Australia's annual housing supply compared to around 80 per cent in the mid 1950s (ABS 2021). This project was designed to understand how developers make decisions and, though the use of case studies, identify how changing policy settings can impact the supply decision. The project addressed four research questions:

- **RQ1:** What methods do developers use to determine the viability of residential development and set the selling price of the residential product?
- **RQ2:** What factors determine a developer's decision to develop and how important are the various inputs to the decision such as required returns, local prices, construction costs, infrastructure charges etc. across a range of different products?
- **RQ3:** Can new building technologies and processes reduce the total cost of construction, increase efficiency and feed through into improved affordability outcomes?
- **RQ4:** Given the key inputs to the development decision, to what extent can policy settings influence the cost of development, development returns and therefore housing affordability?

The methodology comprises three inter-related parts. First, we conducted 12 interviews with developers from a range of different development organisations delivering different types of housing and land product. From these interviews we were able to determine the feasibility software used by developers, the key inputs to their feasibility models and how policy settings affect development outcomes.

The second stage of the methodology concentrated on one aspect of the feasibility modelling process, construction costs, to discuss whether it was possible to reduce the cost input through new building technologies and processes. A series of interviews was conducted with organisations, nationally and internationally, using innovative processes to uncover how such processes could affect the delivery of developments. Eight interviews were conducted with organisations delivering a range of different products. Additionally, seven case studies were developed from the interviews, designed to highlight how new technologies and processes can deliver quality outcomes and potential cost savings.

Finally, the interviews conducted during the research informed the development of five case studies covering five different development products:

1. land subdivision
2. detached dwellings
3. townhouses
4. apartments
5. mixed residential development.

These case study developments reflected typical development schemes and were modelled using Argus Estatemaster Development Feasibility (EMDF) software (industry standard software used to calculate development feasibility) with price and cost inputs derived from comparable developments. Development return outcomes were calculated for each development and then key variables changed to simulate the impact of different policy settings on profitability outcomes.

1. Introduction

- **Australia is almost totally reliant on the private sector to deliver housing. Previous research has shown that patterns of housing supply are uneven and are dependent upon site availability (Rowley, Gilbert et al. 2020). Given this reliance on the private sector to deliver housing supply, policy makers need to be aware how their decisions impact on development outcomes.**
- **Government needs to ensure a pipeline of developable sites for the private sector to deliver housing supply. The private sector will determine whether these sites are actually developable, and the key determinant of developability is the ability to generate an adequate return to compensate for the risk of development.**
- **This research explores how developers make decisions to develop. It models how different policy settings impact various inputs to the decision and how such settings can stimulate or hinder development activity.**

1.1 Policy context and existing research

The private sector now delivers over 98 per cent of Australia's annual housing supply, compared to around 80 per cent in the mid 1950s (ABS 2021). With Australia increasingly reliant on private sector housing delivery, it is vital that policy makers understand how policy settings impact on a developer's decision to build housing or subdivide land. To do this we need to know how developers make decisions in the first place. This project is designed to plug this knowledge gap by first exploring how developers make decisions and second, through the use of case studies, identifying how changing policy settings can impact the supply decision. The research also examines the issue of new construction technologies and processes to establish their potential for reducing development costs and timelines, improving affordability.

It is important to note that developers can only deliver housing when they have access to development sites. Thus it is essential that state/territory and local governments facilitate access to land for development. If land opportunities are available, the private sector can then determine whether to supply housing or not. If there is no steady pipeline of available site, or sites take too long to go through an approval process, the system gets blocked and the supply of housing dries up. It is essential for government and the private sector to work together to ensure a supply of developable land that meets the needs of a growing population.

The Australian Housing and Urban Research Institute (AHURI) have funded recent work addressing the issue of housing supply and affordability (Ong, Dalton et al. 2017; Rowley, Gilbert et al. 2020) yet little research has explored in detail how developers make decisions to deliver housing. These decisions are primarily based on the potential of the development scheme to deliver an acceptable level of return (Rowley, Costello et al. 2014; Ong, Dalton et al. 2017). Without projected returns (Internal rates of Return or Returns on Equity) meeting a developer's TRR the development will not proceed. In times of strong housing demand, supply is also strong because the revenue that can be generated from the development increases, making projects more viable while also reducing sales risk. What is missing from the evidence base is a detailed examination of development viability/feasibility as the basis for developer decision making and the extent in which controlling the cost side (through land, construction costs and other inputs) has the potential to impact on end dwelling prices, and consequently new housing affordability. Little is also known about the way developers set the prices of dwelling products and therefore the potential impact of policy settings on affordability.

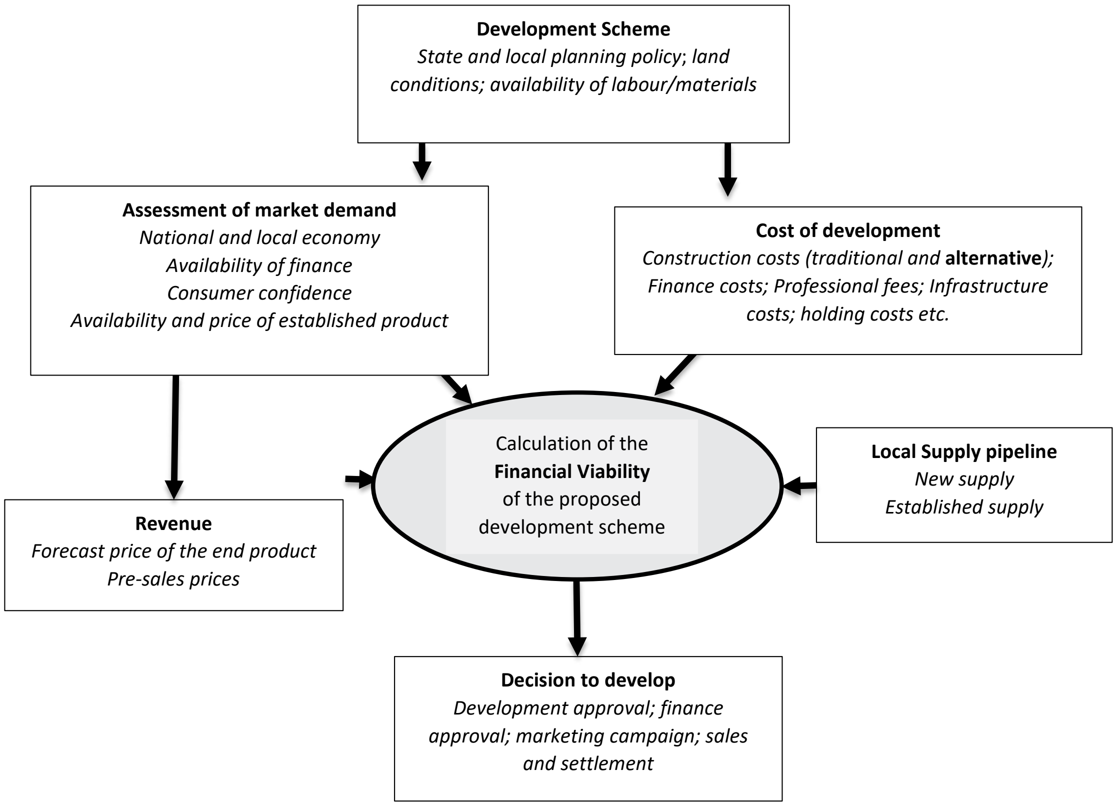
Rowley, Gilbert et al. (2020) explored patterns of housing supply across the period 2006–2016, highlighting the uneven production of housing across states and what government could do to encourage more housing supply. The research found how increased supply is determined by the availability of potentially profitable development sites. It is not as simple as just releasing new land, or re-zoning land, and expecting housing supply to increase as because land may not deliver profitable outcomes. Governments can improve the prospects for profitable development by reducing input costs and creating certainty in the development approval process. However, market forces, which determined revenue, are the key driver. This issue is highlighted in Chapter 2 of this report. If a developer cannot sell the end product at a price which will deliver the revenue necessary to secure the required hurdle, or target, rate of return, development will not occur. The reason behind the 2021 to early 2022 surge in housing supply (particularly detached housing supply) is the increase in demand caused by the COVID-19 stimulus package, notably HomeBuilder grants (Rowley, Crowe et al. 2020; Leishman, Aminour et al. 2022). This increased demand generated the conditions necessary for profitable development and developers stepped up land-subdivision activities as a result. Builders also responded to the demand for new project homes. We have not seen a similar increase in built form outcomes, notably apartments, because it takes time for price increases to feed through into new supply due to development timelines. Growing construction cost pressures and an element of COVID-19 driven uncertainty around demand for higher density products in some areas have also had an impact.

Rowley, Gilbert et al. (2020) conducted a number of case studies within Local Government Areas (LGAs) to identify the key drivers of high and low supply outcomes. They found in LGAs that delivered relatively high rates of housing supply growth enacted zoning policies that enabled developers to respond to strong housing demand conditions. This was seen to be a key factor in supporting supply growth. The availability of large greenfield or brownfield sites conducive to larger scale, master-planned development, alongside supporting infrastructure, increases the potential for housing supply. Proactive local planning for growth (outer ring) and urban renewal (inner ring) were also key factors in driving supply.

The long-term nature of the urban development processes, including infrastructure provision or augmentation, means that it can take years before re-zonings and project commitments result in new housing supply. Additionally, the capacity of infrastructure and services is an important consideration for councils in planning for future growth. In some high-growth LGAs—where housing development over the study period exceeded anticipated levels—infrastructure that is at, or exceeding, capacity may have implications for future growth. Rowley, Gilbert et al. (2020) made a number of recommendations that could support residential development including strategies around site availability and assembly, urban regulation, infrastructure costs and timing and alternative approaches to development. This research project builds on that research by asking if development sites are available, and how developers make the decision to develop.

This test of financial viability is the first hurdle for a potential development scheme. If the potential scheme will not deliver the developer's TRR, the developer will proceed no further in the analysis of its development potential. Figure 1 describes how developers assess financial viability or feasibility (the terms tend to be used interchangeably in Australia).

Figure 1: The feasibility modelling process



Source: Authors.

Feasibility or viability is a function of the revenue that can be generated from sales of the completed development. What can be delivered on the site for sale is determined by the planning system but also crucially by market demand. The extent of consumer demand and the availability of competing products in the local market will affect the price developers can secure upon project completion. Developers will try to forecast the price of the end product and this forecast is critical to the viability calculation, yet little is known about how developers determine this price across different markets. Do dwelling prices always need to be maximised in order to generate sufficient returns for the developer or is there is scope to increase affordability by reducing asking prices if cost can be reduced?

On the cost side, the developer needs to calculate exactly how much it will cost to deliver the project. This involves an assessment of the cost of purchasing the land, preparing the site for development, infrastructure provision, the actual cost of construction and associated costs such as professional fees and finance.

The feasibility modelling approach identified in Figure 1 can also be used to calculate the maximum price a developer can pay for a development site. The traditional method of valuing land is through the residual method, which is the difference between revenue and total cost (including profit). This means that the land, being an immobile factor of production, gets what is left over – the residual. Yet little research has been undertaken on just how developers price land and, again, whether there is scope within policy to impact the land input and deliver affordability benefits to the end housing consumer.

Theoretically, a reduction in the cost side of the viability equation should, if everything else remains equal, allow reductions on the revenue side while maintaining the same level of profit. For example, the use of alternative construction technologies and processes could reduce the amount of revenue required to deliver a land price acceptable to the landowner while maintaining a return acceptable to the developer. This should allow developers to reduce the price of new housing, assuming housing is priced with reference to input costs rather than established prices in the local market. However, in a competitive market, reducing construction costs might simply result in a higher land price for the original landowner or a higher developer's profit, therefore have little impact on the house price. This research focuses on new construction technologies and processes as a potential route to improved affordability outcomes through reduced costs and timelines. Through case studies and other examples, we highlight what is happening nationally and internationally in this space and the potential for innovation to reshape aspects of the development industry.

The complexity of land and price setting means it is essential to approach this research from two angles. First, can reducing costs, through development efficiencies such as new construction technologies and reduced direct and indirect cost inputs, lower the dwelling prices required to deliver a viable project outcome. Second, would such reductions in construction costs actually feed through into lower dwelling prices or simply result in greater profit and higher land values? To do this we conducted a series of interviews with developers and builders to understand how they make decisions and then constructed five case study developments to simulate the impact of changing policy settings on profit outcomes, as anything that increases or decreases potential development returns has the potential to stimulate development or cause a developer to walk away from a project.

The use of feasibility models to simulate the impact of policy settings on developer decisions is not new in Australia. For example, Rowley, Costello et al. (2014) modelled the impact of finance on profit outcomes and Randolph, Troy et al. (2018) used such modelling to understand the financing of affordable housing developments. As discussed below, feasibility modelling has been used as the basis for discussions around affordable housing delivery in the United Kingdom for many years with planners unpicking the financial submissions of developers in order to assess what developers can, and cannot, afford to contribute from a development site.

1.1.1 Feasibility modelling

An assessment of a site's financial feasibility or viability is an essential stage at the beginning of the development process. The purpose is to establish whether the site has the potential to generate a developer's TRR or to calculate the maximum land value a developer can pay to secure the site and still generate their hurdle rate. Any policy setting that affects inputs to the feasibility modelling has the potential to make a development unprofitable, leading to no development. Conversely, a policy setting that can speed up the development process, increase revenue or reduce costs has the potential to make a previously unprofitable site ripe for development.

Development is driven by profitability (Ong, Dalton et al. 2017, 49) with a developer's return typically calculated as a proportion of the total development costs or gross development value. Anything that affects the revenue or costs of development will affect development profit outcomes (Rowley, Costello et al. 2014, 28). In an Australian context, Rowley, Gilbert at al (2020) demonstrate the varying ways in which development profitability can be measured. The most simplistic is the development margin, which is net development profit as a percentage of total development costs. Many developers would use this as an early indicator of whether a project is likely to be feasible and, depending on the state of the market, the development sector and risk involved in the project, an acceptable minimum margin may range from 10 to 25 per cent.

The second measure of profitability is the return the developer can generate from the equity they invest in the project. The required return on equity will depend upon the individual developer and the potential return from other investments of comparable risk. The developer would need to decide whether the calculated return is acceptable given alternative investment opportunities.

The IRR on a project is a third measure of profitability, which allows a comparison of overall project returns with the developer's TRR. The TRR is based on the requirements of the individual developer and the market/property specific risks of the development (Rowley, Costello et al. 2014, 28).

Evidence from the UK shows that developers expect profits in the range of 16–25 per cent of gross development value (Crosby and Wyatt 2016, 1719). While Internal rates of return for development are often in excess of 20 per cent per annum, '*These very high target returns are to quite rightly compensate for the extreme risk of development which comes from the residual nature of the profits*' (Sayce, Crosby et al. 2017: 44).

To assess the level of potential return, financial modelling is required. A development viability appraisal (DVA) is a term used in the UK for a feasibility appraisal and is where much of the recent discussion around such modelling has occurred. A DVA is a financial model, using a discounted cash flow (DCF) approach, that is typically based on the residual method of land valuation, (Crosby and Wyatt 2016; McAllister 2017; McAllister 2019; Byrne, McAllister et al. 2011) calculated by the deduction of development costs from the end value of a development (Sayce, Crosby et al. 2017: 6).

The residual model is based on the assumption that an element of latent or residual value is released after development has taken place (Byrne, McAllister et al. 2011). The DVA and residual models are basically the same, the only difference being whether the land cost is known or not. Where the price of land is known—that is, set by the landowner—the developer will determine whether a project can generate a sufficient return to compensate for the risks of undertaking development. Where a land price is not known, feasibility modelling will deliver a residual value that is the amount that can be paid for land while delivering a predetermined level of developer profit (Crosby, McAllister et al. 2013). In competitive land markets, developers are more likely to be successful in acquiring sites for projects that generate the highest residual land value (Gilbert, Rowley, et al. 2020, 14).

Box 1: Key concepts

- **Discounted Cash Flow (DCF)** - a method used to estimate the value of an investment based on its expected future cash flows. Future cash flows are discounted back to a present value using a defined discount rate which usually reflects the developer's required return from the development.
- **Internal Rate of Return (IRR)** - the discount rate at which the sum of the discounted negative cash flows equals the discounted positive cash flows, i.e. the discount rate at which the NPV equals zero. Simplistically, the IRR represents the annualised return on funds invested.
- **Net Present Value (NPV)** - the sum of the present values of all project cash inflows and outflows over the life of the project. A positive NPV infers an IRR greater than the discount rate.
- **Simple feasibility example**

  Development of 10 townhouses generating a projected net revenue from sales of $5 million.

  Projected total cost of developing the 10 townhouses including land, finance, fees and all construction costs is $4.5 million.

  Developer generates a total profit of $0.5 million (difference between revenue and costs).

  The development takes 18 months so a DCF model is used to calculate a number of return metrics to test whether the development delivers the required level of return for the perceived level of risk.

  The developer's target (or hurdle) project rate of return is 15 per cent, reflecting the project risk and returns available on other assets. The DCF model generates an IRR outcome of 23 per cent and the NPV $150,000.

  If the developer used their own equity to pay for the land ($1 million) the IRR would also equal the developer's return on equity (RoE). The total monetary return on equity would be the developer's profit ($0.5 million) divided by the equity invested ($1 million), so 50 per cent.

  The developer's return (the IRR) exceeds their target rate of return therefore generates a positive NPV. This development would be considered feasible because of the positive return outcomes.

A DVA can be characterised as a simple rule-based, data model that attempts to provide a well-defined representation of the expected input-output behaviour of a system. (Byrne, McAllister et al. 2011: 250). Models predict the level and timing of all financial inflows and outflows and therefore need to accurately simulate both the timing and amount of actual monetary receipts and expenditures (Byrne, McAllister et al. 2011: 250).

A DVA attempts to answer three key questions:

- Is the land value sufficient to entice the owner to sell?
- Is the land value sufficient to outbid all other offers in relation to alternative uses for the site?
- Is the profit sufficient to incentivise the developer to proceed with the development given its risk profile?' (Byrne, McAllister et al. 2011: 253).

DVAs sprang to prominence with the introduction of negotiated affordable housing contributions under Section 106 agreements, typically known as planning obligations (see Crook, Henneberry et al. 2016). In this regard, planning obligations or development contributions impact the profitability of a development, which can prevent a proposed development from proceeding (Sayce 2017; Crosby and Wyatt 2019). In a market-led economic system, McAllister (2017) notes it is critical to understand the central role of profit in the development-making process. In theory, DVAs are used to determine how land value uplifts could be distributed between landowners, developers and the community. In this regard, in addition to construction costs and developer's return, the cost of planning obligations such as affordable housing contributions must be deducted from the development value (Cosby and Wyatt 2016; Cosby and Wyatt 2019; Sayce, Crosby et al. 2017).

A viability test is required to ensure that planning obligations do not reduce profit margins to the extent that landowners and developers are deterred from bringing development online (Crosby and Wyatt 2019: 368). When a DVA indicates that a development is not economically viable, the initial developer contributions/planning contributions can be reduced in negotiations (Sayce, Crosby et al. 2017: 4) but the process requires accurate and transparent feasibility models are released for assessment. '*This viability test has become a contested issue since its formal introduction in 2012; developers have been able to reduce planning obligations, and the amount of affordable housing in particular, by influencing input parameters and model assumptions of the financial viability appraisal'* (Crosby and Wyatt 2019: 368).

Additionally, it has been long recognised that the residual method of development appraisal is prone to challenge because the output is typically a function of inputs that are highly uncertain. (McAllister 2019: 447–448).

While assessments of viability using a discounted cash-flow based modelling approach has its problems, it is the technique used by developers in the industry to assess the potential of development sites. Thus, it is important to understand the inputs to the process and how the outputs determine development decisions and how policy settings can affect these outputs.

1.1.2 Economic Context

In academic literature, the behaviour and organisation of the construction industry, and its interactions with the land and housing markets, are not often put forward as being important to the determination of housing prices or affordability. The principle arguments are that planning and urban regulation affect housing prices indirectly, by reducing the elasticity of new-build housing supply. In a recent review of the literature, Molloy (2020) notes that a large number of studies have found a correlation between the extent of regulation and housing prices (Cheshire and Sheppard 1989; Cheshire and Sheppard 1996; Hilber and Vermeulen 2014; Mayer and Somerville 2000; Mayo and Shepard 1996), but also argues that both theory and empirical evidence about the impact on rental costs and land values are vague, and highlight these areas as requiring further empirical research. This study unpacks a number of dimensions to residential construction regulation. In addition to zoning, regulation includes height and density restrictions, growth controls, and requirements for open space or amenity land. The costs of compliance can be substantial (approximately $80,000 per dwelling).

Quigley and Raphael (2004) observe that government regulation includes habitation standards and urban renewal processes that have led to an increase in construction costs and the reduction of housing supply in some areas. There are also consequences for housing costs, with higher rents both reflecting higher quality housing in consumption, and reduced supply elasticity. In a comparative study, Malpezzi and Maclennan (2001) found evidence that supply elasticity in the UK is much lower than in some more lightly regulated countries which, at the time, included Canada, the US and Australia. A more recent study by Kendall and Tulip (2018) found that, over a period of decades, zoning has increased housing prices by between 42 and 73 per cent above the marginal cost of construction in Australia's main metropolitan cities.

A third strand of literature emphasises the behaviour of key actors in land and housing markets and planning systems. Adams, Leishman et al. (2009, 2012) and Leishman (2015) show that intense competition in the market for land leads developers to bid aggressively to secure land, then build out slowly to allow rising housing prices to deliver the minimum profit margins they require. However, the dynamics of land and housing systems in Australia, where land development and housebuilding are distinct processes, and where purchasing new-build off-plan requires a substantial forward commitment from home buyers, is very poorly understand and under-researched.

1.2 Research methods

This project is designed to answer four research questions.

- **RQ1:** What methods do developers use to determine the viability of residential development and set the selling price of the residential product?
- **RQ2:** What factors determine a developer's decision to develop and how important are the various inputs to the decision such as required returns, local prices, construction costs, infrastructure charges etc. across a range of different products?
- **RQ3:** Can new building technologies and processes reduce the total cost of construction, increase efficiency and feed through into improved affordability outcomes?
- **RQ4:** Given the key inputs to the development decision, to what extent can policy settings influence the cost of development, development returns and therefore housing affordability?

The research methodology is comprised of three inter-related parts. The first is designed to answer research questions 1 and 2. Here we conducted 12 interviews with developers from a range of different development organisations delivering different types of housing and land products located in Western Australia and South Australia, where the research team have excellent industry contacts. Two states were deemed sufficient as the development decision-making process is uniform across the country being based on feasibility modelling. From these interviews, we were able to determine the feasibility software used by developers, the key inputs to their feasibility models and how policy settings affect development outcomes. Findings from the interviews are discussed in Chapter 2.

The second stage of the methodology concentrated on one aspect of the feasibility modelling process, construction costs, to discuss whether it was possible to reduce the cost input through new building technologies and processes. A series of interviews were conducted with organisations using innovative processes to uncover how such processes could affect the delivery of developments. Twelve interviews were conducted with organisations delivering a range of different products. Additionally, six case studies were developed from the interviews designed to highlight how new technologies and processes can deliver quality outcomes and potential cost savings. Chapter 3 reports the findings of this element of the methodology with case studies reported in Appendix 1.

Finally, the interviews conducted during the research informed the development of five case studies covering five different development products: land subdivision; detached dwellings; townhouses; apartments and mixed residential development. These case study developments reflected typical development schemes and were modelled using the EMDF software with price and cost inputs derived from comparable developments. Development return outcomes were calculated for each development and then key variables changed to simulate the impact of different policy settings on profitability outcomes. The findings from the case study analysis are reported in Chapter 4. The final Chapter draws on some policy development options from the research findings.

2. Development feasibility and decisions to develop

- **Developers use discounted cash flow-based feasibility models to calculate the profitability of a proposed development. To be feasible, the projected return must exceed the developers hurdle rate of return.**
- **Revenue and costs are the key components of the feasibility model. Any policy settings that impact on the selling price of the end product and/or the cost of delivering that product will affect the profitability of a development.**
- **The biggest risk factor for developers is market conditions. Such conditions impact end sale prices and sales rates and the ability to generate pre-sales to secure funding.**
- **Policy settings that create uncertainty are problematic. Such uncertainty could result in lower than expected revenue, higher than expected costs and/or a longer development timeframe.**
- **Reducing development costs could deliver a number of outcomes depending upon land ownership issues including an increase in the land price, an increase in development return, a cheaper end product or a combination.**
- **The complexity of the development process, the structure of development organisations, the variety of products delivered, and land ownership issues means the decision-making process varies by organisation and site by site. Therefore, it is too simplistic to assume policy settings will have exactly the same impact on each and every developer.**

Understanding how policy settings affects developer decisions is predicated on knowing just what drives developer decisions in the first place. As established earlier in this research, feasibility, or viability modelling is the tool used by developers to determine the level of profitability from a site. To unpack exactly how developers use such modelling to make decisions, we interviewed 12 developers across WA and SA in a variety of different development organisations delivering a range of different products (Table 1).

While the interviews were conducted in only two states, the methods used to assess development feasibility are uniform across the country and are developers' decision-making processes (Ong, Dalton et al. 2017). Many of the developers identified in table 1 are national organisations who adopt the same feasibility approach across the country. Therefore we are confident the twelve interviews provide outcomes that are applicable nationally.

While the approach to calculating feasibility is the same across the country, using a discounted cash flow base to calculate return measures, there are differences in inputs in different States. For example, local taxes and developer contribution rates, and key inputs such as costs, land values and prices will vary by location. However, given the methodology used to assess project outcomes is the same across location and industry types, the impact of changing policy settings will be uniform in terms of direction, if not exactly scale, due to variations in the balance of the various inputs. To give just one example, the rate of developer contributions may be proportionally higher in one state than another so simulating a 10 per cent increase in such contributions will impact the return outcomes in the same direction, i.e., they would fall, but the scale would be different if developer contributions represent a greater proportion of total costs in one state compared to another.

The interviews were conducted virtually and semi-structured in nature. Some interviewees did not want to be recorded so quotes are used sparingly in the discussion below. The interviews were designed to answer three main questions:

- How do developers establish the inputs to their feasibility models?
- What are the key risks considered during the feasibility models?
- Which policy settings have the biggest impact on feasibility outcomes?

Table 1: Developer interviews

State	Development type	Developer size and type
WA	All forms of residential development	Consultant to small, medium and large developers
WA	Land subdivision and some built form	Large, national developer
WA	Land subdivision and some built form	Large, national developer
WA	Land subdivision and some built form	State development agency
WA	Apartments	Large, State based developer
WA	Apartments and townhouses	Small, State based developer
WA	Land subdivision and built form	Medium sized, State based
SA	Apartments	Medium sized, State based
SA	Apartments and townhouses	Medium sized, State based
SA	Land subdivision and low density housing	Large, State based
SA	Land subdivision and medium density housing	Medium sized, State based
SA	Land subdivision and low density housing	Medium sized, State based

Source: Authors.

2.1 Modelling feasibility – software and inputs

Different developers use different feasibility software to calculate potential returns or land value. Software is usually structure with a data input interface, which feeds into a cash flow to produce the model outcomes. EMDF software was the product most commonly used by the interviewees, for example five out of the seven WA respondents regularly used EMDF. Other respondents had developed their own in-house spreadsheet models. All models use a monthly discounted cash flow based approach to discount revenues and costs in order to determine a project and equity IRR. The discount rate is based on the developer's target, or hurdle, rate or return. The other typical measure of return used is the developer margin, also known as profit on costs, which is the developers profit divided by the total project cost.

One developer was critical of the project IRR measure saying it over represented return for short projects. This developer preferred to calculate the equity IRR, which provided a better reflection of the actual return on the developer's capital. Developer's margin was often used for very short projects with a return required somewhere between 15 and 25 per cent of costs.

The required rate of return is based on an assessment of risk for the particular site with the return on built form product generally higher than land subdivision because there is more risk due to being more capital intensive.

> On longer-term acquisitions on greenfield we will be looking at a 15 per cent equity IRR and a minimum of a 25 per cent development margin and that is because there is so much more risk in the longer term projects. In a quicker infill project, we maintain a 20 per cent margin but in the current low interest rate environment the IRRs can be as low as 10-12 per cent. (Medium, state-based developer)

Time is also a big factor in return requirements:

> Anything less than 12 months it's got to be 20-25 per cent equity IRR. If it was a land thing you might get away with 12-15 per cent equity IRR. (Large, national developer)

The required return also depends upon the structure of the developer themselves and whether they are a listed company and work to returns set by the board.

> The board sets a hurdle rate across the various disciplines, for example greenfield, medium density, apartments etc, and from there it is for our CEO to assess the risk on a site by site basis then we add a risk premium so we get the best risk adjusted returns. (Large, state-based developer)

The main inputs into the feasibility model can generally be classified as either revenue or cost. The most important input was considered to be end sales prices, as this drives revenue. Understanding market demand and what the market can absorb is critical. Development projects can take many years and generally developers estimate what their products would sell for in the current market using comparable evidence to determine potential sales prices and then apply a revenue escalation figure to try and forecast the actual sales price on project completion. This is fraught with difficulty due to price fluctuations even in the short term, let alone on development projects which may span 10 years. Developers usually adopt a conservative approach to price escalation to avoid overestimating revenues and delivering inflated return projections.

The use of revenue escalation varies by developer. Some developers will use a worst-case scenario approach and may, in fact, de-escalate revenues while others will simply maintain current prices. Zero escalation is common in flat markets and short-term projects (two years or less) whereas a growing market would see some escalation built into revenues. Underestimating end sales prices is not necessarily a problem as it will mean additional profits. However, it can mean the difference between a project considered viable and one that doesn't go ahead. It could also impact on the potential to secure finance.

Key model inputs derived from the interviews are summarised in Table 2. These align closely with the inputs into the EMDF software. Outside prices and revenues, actual construction costs were highlighted by interviewees as important, but not particularly difficult to estimate. Costs are often sourced from in-house expertise, particularly when the developer is part of a broader organisation which includes a construction company. Past projects also provide a good source of evidence for less complex projects.

> Construction costs were reflective of what you were building and your consultant costs reflected what you were building. Because we were working within a construction company and the guys were continually tendering they knew what the rates were. (Large, national developer)

Where in-house expertise is not available, consultants are used, especially when there are complex environmental, engineering and/or planning issues.

Table 2: Development feasibility modelling inputs

Input	Source and details
Price per unit or m²	Estimate of the potential selling price of a dwelling or land product. Primarily based on comparable sales of similar properties in the local area.
GST	GST calculation (normal method or margin method). GST payable on property sales.
Marketing costs	Costs of marketing the property for both pre-sales and post completion campaigns. Amount depends on the type of product and extent of marketing required. Usually based on past projects or consultant/in-house marketing team estimates.
Sales commissions	Commissions payable on the sale of lots/dwellings. Usually based on past project rates.
Stamp duty	Cost of acquiring the land for development. Estimated from State revenue duty calculator.
Land holding costs	Costs of holding onto the land while it is being developed and up until final disposal. This will include land tax liabilities, council rates and charges, utility charges, strata fees on unsold apartments, security etc. Estimates from past projects and the various charging authorities.
Construction costs	The cost of actually constructing the buildings and/or subdividing the land. Costs estimated from past projects or through consultants and/or in house specialists.
Site works	Costs of preparing the site and delivering non-building components of the development such as car parking, landscaping etc. Costs estimated from past projects or through consultants and/or in house specialists including engineers.
Professional/ consultant fees	The costs of consultants involved in the development process including engineers, architects, quantity surveyors etc. Usually based on past projects and direct estimates from consultants.
Finance costs	The costs of funding the development project. This will depend on the type of funding required (project specific or balance sheet for example) and will include a loan establishment fee, line fee and interest on the debt.
Revenue and cost escalation	Figures built into the model to account for price and cost growth over the development period. These figures are estimates of market changes based on market projections going forward.
Pre-sales rates	Built into the model is the proportion of pre-sales required in order to secure finance. Rates will depend on the type of funding and funder but can often be at levels required to cover 100 per cent or more of debt funding.
Statutory costs	Costs to cover the development approval process including statutory fees.
Land cost	The cost of purchasing the land for development. The price of the land may come from a variety of sources or through negotiation. Alternatively, the feasibility modelling process can be used to calculate the maximum the developer can afford to pay for the land and deliver their required rate of return.
Land acquisition costs	The costs of acquiring the land. Usually based on past projects.
Development period	The anticipated timeframe for the development, required to determine the inputs for a range of variables including escalation, finance and holding costs. The timeframe will depend on a range of factors including the scale and complexity of the development and will be estimated based on past projects.

Source: Authors.

Infrastructure requirements were based on past projects and conversations with the relevant authorities. As long as costs were clear and could be factored into modelling, infrastructure wasn't considered much of a problem, although it could add considerably to the overall cost of a project.

> Government fees in their various forms could be twice the construction costs… for land subdivision. (Medium, state-based developer)

> In 20 years I only remember two projects that got stuffed by infrastructure. (Large, national developer)

The availability and cost of finance can be an issue depending on the size and structure of the developer (Rowley, Costello et al. 2014). Banks can quickly withdraw funding or make it too expensive, rendering a project unprofitable. Our interviewees expressed few concerns around securing finance in the current climate with some self-funding, while others used their balance sheet to generate funds.

Generally, developers were pretty confident they could accurately estimate the inputs to feasibility models. While there was uncertainty about how inputs could change over the length of a development period, many of the other inputs were easily forecast based on past projects and experience. Unless an unexpected event occurred, feasibility modelling was viewed as being an accurate way of predicting the profitability outcomes of a project.

Feasibility modelling needs to be accurate. This is because lenders closely scrutinise the inputs in their assessment of risk. If lenders do not believe the inputs are realistic (such as sales prices that are projected to be too high), they will not finance the project. Banks are often conservative, requiring substantial profit margins. In this way, if there are any unforeseen problems with the project, the developer is still able to pay off their debt.

Finally, land is another critical input to the feasibility model. Developers purchase land in a number of ways. The preferred method of purchase is 'off market', so dealing directly with a landowner before the land is advertised for sale.

> Our preference is to secure sites off market, having to do EOIs tend to be beneficial for the vendor and we'd rather direct deal. We get projects from agents and consultants we work with. They bring a site … and have an in with an owner or the ability to facilitate an outcome so it is mutually beneficial. (Large, national developer)

The Expression of interest (EoI) process is another way to access land, particularly government-owned land.

> Government tender processes is another one and we are selective as they are very expensive, inefficient and time consuming. (Large, national developer)

In terms of calculating the price of the land in an EoI process or a negotiation there are a number approaches taken by developers. For an EoI:

> You do your own analysis and if you are pretty close with your offer there will be discussions. (Large, national developer)

More generally:

> To determine the land value it is what is the maximum we can pay to generate our minimum hurdle rate. (Large, national developer)

> We arrive at a land value through feasibility but that's not the end of it as we have to look at realistic prices in the local market. We may have to reduce our margin if we really want the land. We have a general sense of what the landowner wants. (Consultant to small, medium and large developers)

Landowner expectations play a critical role in determining whether a site is developed or not. Developers have a general sense of market value, gained via previous experience and comparable evidence. However, in WA:

> Land owners have not really changed their sense of the value of their land over the last five to six years in relation to the market. Their anchor point maybe 10 years ago. (Large, State based developer)

2.2 Market conditions and calculating revenue

Current, and future predictions of market conditions play a major role in determining the feasibility of a development scheme. Market conditions impact:

- calculations of revenue through estimating end sales prices
- sales rates of pre-sales and completed product
- the mix of product within a scheme
- the timing and sizes of stages within a scheme
- the level of revenue escalation built into a feasibility model
- the level of pre-sales required by the financier
- the equity contribution required from the developer
- landowner expectations
- the level of cost escalation built into the feasibility model
- the developer's hurdle rate of return.

While the planning system will determine what a developer can deliver on a site, the greatest uncertainty comes through market conditions. While developers will estimate the potential revenue generated by the development, market conditions can change quickly during the development period and can have a major impact on projected profitability. Large price rises not factored into the model will result in returns much higher than projected due to a combination of increased prices and sales rates, while the reverse is also true. Prices may fall, those with pre-sales contracts may attempt to get out of them if the deposit is less than the fall in price, and dwellings may take much longer to sell, increasing finance and holding costs. The scale of the impact will depend on a number of factors, including the:

- extent of price movements over the period
- proportion of units pre-sold so protected from price movements
- nature of the product itself, with lot prices more stable than prices of built form product.

One of the major flaws of feasibility modelling is that revenues are based on current prices and then forecasts are made of how prices could change up to project completion. Conservative developers will not build any price escalation into their models and if prices do grow over the development period this will increase profits. Conservative revenue escalation predictions reduce the amount the developer can pay for the land and consequently may be outbid for the site. Current market conditions are important in setting escalation levels. For example, a WA developer commented they had not used revenue escalation in their modelling since 2012. The WA developer attributed this to Perth market conditions. However, market conditions are starting to change given current, strong levels of price growth.

But how do developers estimate selling prices in the first place? The estimating process is complex; it requires a combination of price levels of comparable properties in the established market, reverse engineering lot prices from the established market or (if evidence is limited in the local established market) creating a price point with a new product.

The most common way to established end selling prices is through a comparable price approach:

> During the high level stage we use valuers who keep a finger on the market. They look at historical sales. For the detailed case we get valuation advice on our concept plans and they provide an estimate of lot price. (Large, state-based developer)

> Established land sales are very important. Sales evidence from similar product in similar markets is a massive influence. New subdivisions tend to attract a premium over and above existing vacant land sales so the best evidence is to look at other new subdivisions as they provide a bit of excitement and momentum for people buying into new locations. (State development agency)

The use of comparable evidence is a well-established valuation methodology used by the valuation industry, particularly when delivering mortgage valuations for banks. If there is plentiful comparable evidence available and market conditions do not change significantly, developers can deliver an accurate assessment of the potential selling prices of their dwellings.

Problems arise when there is limited evidence of newly developed product comparable to the developer's project.

> 'You have to be cognisant of the established market but you have to have a look at the type of product you are selling against so if the established product is not comparable to what you are trying to sell you would have to look further afield and make judgements. If there are no new projects you can't compare new project to established product so you have to look at new product elsewhere and then make relative adjustments. If in doubt you get as much information as you can and make a value judgement.' (Large, national developer)

> 'The thing we are finding harder is evidence around townhouses and what we are finding hard is when you do a comparable evidence approach there isn't a lot of that product in Perth and what you are comparing against is duplex, triplex and ones that are very different to a townhouse. You are having to pioneer.' (Large, national developer)

Lack of comparable evidence results in two potential approaches to setting the price of lots. The first approach involves reverse engineering the price based on older dwellings in the established market. The second approach involves setting prices in relation to what can be purchased in the local established market, regardless of its comparability.

> We work backwards from the established market in that area. The reality for 99 per cent of our sites is it is not the purchaser buying the site it is the bank so we have 2 licensed valuers so we reverse engineer the land price based on established sales. (Medium, state-based developer)

For the sale of lots, some developers will look at selling prices of houses in the established market and work backwards to calculate a competitively price. For example, if a four-bedroom house is selling for $600,000 in the local market and would cost $300,000 to build new, the lot price would be set around $300,000. The lots would not sell unless a consumer can build a new house cheaper or around the same cost as purchasing an older dwelling in the same market. This is very simplistic example and other factors would be taken into account when setting the price, but the established market will deliver a guide.

The importance of the established market cannot be underestimated. If prices are rising in the established market, this will be reflected in the pricing of new developments. It will also be reflected in the land value expected by the landowner. Increased revenue means the developer can bid a higher price for the land and still deliver their hurdle rate of return. However, if the developer already owns the land, a rising established market pushing up the price of new dwellings will result in a higher return.

In a weak market:

> … you do whatever you can to get a sale and (the) finished product can be well below the pre-sales, which leads to valuation issues for the pre-sales. If the market is really strong then it is a profit maximisation strategy. You might discount 5-10 per cent to keep sales ticking over but when you sell for a loss you're burning equity. (Large, national developer)

There is a delicate balance when developers are struggling with sales. Any discounting will impact on profits. However, a longer sales period increases costs, so some discounting is often necessary to exit a project. This discounting will then be reflected in mortgage valuations for subsequent sales, or even pre-sales settlement. As such, there is a limit to how much discounting can occur without affecting all sales.

Aside from end sales prices, strong market conditions will deliver more favourable lending conditions as there is lower risk for lenders. Pre-sales rates fall, and less equity is required from the developer as the bank is willing to lend at a higher loan to value ratio. Both factors increase chances of a development scheme proceeding. Changing market demand may alter the mixture of units on a site. As such, a developer may—planning permitted—try to obtain more yield from a site, knowing that sales rates are likely to be strong at completion. Stages in a land subdivision may be larger and released closer together as a strong market is likely to absorb more supply. On the downside, landowner price expectations may rise, and the developer may have to pay more for the land. Generally, strong market conditions will increase development activity as it delivers less risk for the developer, and the lender, so more certain, although not necessarily higher, returns.

2.3 Risk factors and the impact of policy settings

Interviewees consistently identified that the key to successful development was the ability to deliver the required rate of return while minimising risk. It is not a case of maximising return at all costs. Rather, interviewees focused on ensuring the hurdle rate of return was achieved, with anything else considered a bonus. But what were considered the greatest risks within the development process?

Market demand, sales prices and sales rates were considered by many interviewees as the main risks. Access to finance was not considered a major issue in the current development climate.

> Market demand is the key one. We don't look at sites based on what the feasibility says but based on sales risk. If we can't sell it we won't go near it. There are certain markets we won't touch and where we have been burnt before. (Medium, state-based developer)

> It is about demand so you need to produce a product people want and also the costs of bringing it to the market. (State land developer)

> What we are doing now is producing a high-quality product for a slightly lower price than our competitors that will allow us to maximise our sales rates. Brand is becoming increasingly important and has been on the East coast for a while and developers sell their apartments on the back of brand. (Small, state-based developer)

Being unable to sell dwellings on completion means a developer cannot pay off debt, has ongoing holding costs and may eventually be forced to discount units in order to sell. These factors will reduce return. Predicting market demand is fraught with difficulties because markets can change very quickly. As such, most developers rely upon tried and trusted areas, as well as products with which they are familiar, to reduce risk.

The second biggest risk factor identified by interviewees was the planning process.

> Obtaining planning approvals and what may be imposed upon you. We work very closely with consultants and councils to achieve something feasible while not pushing the boundaries too hard. (Small, state-based developer)

> Planning certainty and timeframes, environmental considerations, approvals to clear vegetation and confidence on community perceptions. Community backlash can affect reputation so if public company it is sometimes not worth the fight … Developer contributions provide a level of uncertainty and that is why certain areas in the Perth area haven't started to develop at the rate government would have hoped as there isn't certainty on costs around developer contributions. (Large, national developer)

> We will avoid certain areas because of the planning authority. We know the ones that are easy to work with and the ones that will be difficult, from first-hand experience. When we are doing acquisitions, we do a lot of engagement with state and local government at both an officer and member level so we understand the risks around planning approvals and timing outcomes. (Large, national developer)

Planning policy settings determine what a developer can do on a site. This means that the political stance of the local planning authority can actually deter a developer from operating across the whole of an LGA. Two of the WA based developers highlighted how there are certain local governments where they will not work because of the uncertainty created within the planning approval process. The potential for timelines to blow out or last-minute changes forced upon developers increases risks and can reduce return, leading to developers avoiding these areas all together.

When asked about the impact of policy settings on development activity, discussion centred once again around planning. In South Australia, recent planning reforms were widely seen to have had significant impacts on the spatial patterns of housing development. In particular, the 30 year growth boundary requires planning to promote urban infill, and this has stimulated a great deal of development activity by smaller builders. Typically, builders active in this segment target opportunities to acquire one or two dwellings in an up-zoned area, and redevelop three to six townhouses. Therefore, this adds value through redevelopment at higher density, and through subdivision.

Planning settings around infill development caused particular issues, notably around time:

> Local authority approval processes within the inner ring are broken so we don't work there. So a feasibility could stack up but if the approval process took 4 years it kills the project and takes all the profit. (Medium sized, state-based developer)

> Time is the biggest killer of most projects because land tax is so big and if you are purchasing the land with debt then interest will eat all of the equity. Especially in infill projects you should be getting 6 months approval process, if that turns into two, three, four year process you have a site which if you haven't bought with equity you will probably go under. (Medium, state-based developer)

> Biggest amount of risk from planning is time – answers and information, and also not allowing the NIMBYs to get involved. (Large, national developer)

> If we know a planning authority is difficult we will increase our planning costs and maybe our legal costs and our timeframe for development which increases our holding costs. (Small, state-based developer)

Generally, it comes down to certainty in the planning process. If that certainty is there, particularly around timelines, developers can work with the local planning authority and deliver a scheme that is mutually beneficial. Inconsistent planning decisions, and big variations across LGAs cause problems. If a project is likely to be too time consuming, expensive and uncertain, developers will not proceed. Continued lobbying around planning reform across the country is centred around delivering certainty to the developer and this was echoed in the interviews. Not all the developers were negative about planning authorities; a number had very good working relationships with the planning authorities. It was those planning authorities that seemed *'anti-development'* (a stance often driven by political leanings) that grabbed the headlines and drove tension.

Other policy settings considered to have an impact on the development process were regulations related to issues like bushfire protection and design codes. According to some interviewees, these issues added to development costs and failed to achieve the outcome for which they were designed. One apartment developer noted that changes to the NCC added significant costs to a particular type project, so that it is no longer financially feasible. The same developer commented how design guidance adds to costs but can deliver a better quality outcome and, therefore, higher sales rates.

Taxes were also an issue for some developers, particularly around land tax, GST on sales, stamp duty and foreign investor surcharges. Land tax was a particular issue for projects with longer development timeframes and the introduction of new taxes post land acquisition of real concern.

Requirements for infrastructure contributions late in the development process which could not be factored into the original feasibility and therefore profit projections were problematic:

> You can't really engage with providers at feasibility stage as you have to have detailed plans as to what you are doing. When it comes to developer contributions, where the precinct is quite large there are real issues because the nexus between your site and what the monies are going to be used for breaks down. (Large, state-based developer)

Again, it came down to certainty. If developers know what they are going to be required to contribute for infrastructure it can be factored into the feasibility and a decision made on profitability and land value.

2.4 Development and affordability

One of the key questions asked of interviewees was the impact of a reduction in development costs on the price of the end product. Would a reduction in such costs feed through into greater affordability? This proved to be a very complex issue, with few developers in agreement. Some believed reducing costs could allow developers to sell the end product cheaper and maintain their TRR, while others thought cost savings during the development would simply result in additional profit for the developer. Other interviewees believed if costs were reduced across the industry, it would simply result in higher land prices. Some developers thought sales rates were the key and any small price reductions would increase sales rates so maintaining hurdle rates of return. A small number thought cost reductions during the development process would be passed onto consumers and make the end product more affordable.

One of the key issues surrounding developer behaviour is their role as price setters or price takers. Many believed price to be dictated by what the market was prepared to pay, limiting the potential of a developer to pass on unanticipated costs to the end consumer, or indeed, pass on savings.

A developer could achieve a reduction in development costs in a number of ways:

- lower land price
- lower building cost (site engineering, building construction, infrastructure and so on)
- lower finance costs
- reduced development timeframe
- reduced costs of regulation (taxes, development approval and so on).

The impact of such reduced costs will depend upon timing and competition. If a developer is able to reduce the cost of development compared to a competing developer (such as through lower construction costs), they would be able to pay more for the land in a competitive bidding process. The developer could secure the land by passing on some of the cost savings to the landowner in the form of a higher land price. Assuming the developer adopted the same hurdle IRR as a traditional project, the remaining savings could then be passed onto the consumer in the form of lower end sales prices, or could result in additional profit. In the same scenario where the original land price was fixed, the developer could pass on more of the cost savings to the end consumer, deliver a higher profit, or a combination of both.

Table 3 presents a number of potential scenarios and the outcomes that could eventuate if a developer was able to reduce development costs through the introduction of new construction technologies. The table highlights the complexity of the decision and how different developers can take different positions. If all developers benefited from reduced development costs (such as through a uniform cut in land tax), the most likely outcome would be a higher land purchase price. For those sites already in ownership, costs could be passed onto the end consumer in the form of lower land prices, or the developer could achieve a higher rate of return.

Table 3: Potential impact of a reduction in development costs

Scenario	Land price outcome	End sales price outcome	IRR outcome
Base scenario, traditional development, developers compete to secure land	Developer pays maximum land price up to limit imposed by target IRR	Maximum price the market will pay	Developer secures target IRR
Early technology adopter, reduction in development costs, developers compete to secure land	Developer pays land price slightly higher than base scenario to outbid competition, but below maximum bid price	Developer reduces end sales price slightly to increase sales rates	Developer secures target IRR (set slightly higher than base due to increased risk of new technology)
Early technology adopter, reduction in development costs, developers compete to secure land	Developer pays land price slightly higher than base scenario to outbid competition, but below maximum bid price	Maximum price the market will pay	Developer secures IRR above target rate
Early technology adopter, reduction in development costs, land price fixed	Developer pays fixed land price, well below maximum bid price	Developer reduces end sales prices	Developer secures IRR above target rate
New technology widely adopted, developers compete to secure land	Developer pays maximum up to limit imposed by target IRR. Increase return for landowner compared to base scenario	Maximum price the market will pay	Developer secures target IRR
Developer already owns land, purchased before new technology adoption	Land already owned by developer	Developer reduces end sales price	Developer secures IRR above target rate
Developer already owns land, purchased before new technology adoption	Land already owned by developer	Maximum price the market will pay	Developer secures IRR well above target rate

Source: Authors.

The table shows how a reduction in development costs could play out in terms of land value and end sales prices. Numerous different outcomes could eventuate, depending upon land ownership, and whether the developer is seeking to maximise returns or comfortable with the original hurdle rate of return. The number of scenarios above represents the variety of different views expressed by developers.

One developer commented how developers will not sell something cheaper just because it cost less to build, instead they will let the market determine how much it will pay for the product.

> … there is a certain section of the market which would take the additional profit. It is more than likely the land price would go up and land vendors are pretty savvy so if they see the cost of development goes down then land prices will push up, they will want a higher land price as they know what similar apartments are selling for and they know they profit so they would take their extra chunk. (Medium sized, state-based developer)

However, there were a number of developers who thought cost reductions would result in lower end sales prices, mainly because lower sales prices would increase sales rates, which would compensate for the lost revenue:

> Everyone wants to deliver project cheaper and maintain their returns. All about maintaining profit margins but if you can get out of the project quicker through higher sales rates that would be ideal. If everyone is consistently the same you can almost guarantee everyone would want to sell it cheaper. (Large, national developer)

> We would reduce the price accordingly because if you have a cheaper product you would get more sales. (Medium, state-based developer)

> … if we could reduce the price point and increase our volume then we would do that. We would rather take a lower price point and generate a higher volume rather than maximise price and peel away five a month. Time is more important than pushing price limits. (Large, national developer)

> Anything you can do to reduce the costs is ether going to be extra margin to the developer, happy with just making the hurdle rate of return and get out of the project quicker. You are not going to give them away to increase sales rates. (Consultant to small, medium and large developers)

> If we could deliver the built form quicker it would be more profitable from our side of things and it would be more affordable for the customer. (Large, state-based developer)

Increasing sales rates and quicker project delivery allows the developer to exit the project quicker, reducing interest costs and risk.

The development industry often comments that increasing costs of development will force them to push costs onto consumers. If a developer has already paid for the land based on their TRR, the developer would need to increase revenue, or exit the project more quickly, in order to avoid a reduced profit. However, in a weak or normal market:

> We don't set prices and this is the biggest misunderstanding from government. (Medium sized, state-based developer)

Consumers will determine the maximum they are prepared to pay for a dwelling or a piece of land. In a strong market, with weak supply, developers can increase prices to tap into this demand, but again the consumer will determine just how much they are prepared to pay. If costs increase prior to land purchase, they can be passed onto the landowner, but this is only likely to be the case if every developer is operating on the same assumptions. If costs are unable to be passed onto the landowner, or the end consumer, they will need to be absorbed by the developer in the form of a reduced profit. If the site is still potentially profitable after increased costs, it is likely to still go ahead but if such costs render the site unprofitable, development will not occur in the proposed form.

2.5 Summary

Market conditions and certainty were the issues of most concern to developers. While issues will vary around the country depending upon local policy settings, having certainty around costs and timeframes is critical in reducing risk and making development more likely. The complexity of the development process, the structure of development organisations, the variety of products delivered, and land ownership issues means the decision-making process varies by organisation and site by site. Therefore, it is too simplistic to assume policy settings will have exactly the same impact on each and every developer. Likewise, the way developers react to reduced cost inputs will vary. Some may pay more for the land, others may take increased profits while there are those that would seek increased sales rates achieved through lower prices. Developers are first and foremost committed to generating their TRR. If this can be achieved while delivering more affordability in the market through lower prices, some developers will take this approach. Other developers will seek to maximise profits. There is no one size fits all approach.

3. New construction technologies, costs and timelines

- **New construction technologies and processes are emerging in Australia and have the potential to reduce costs and development timeframes.**
- **To improve the uptake of such innovations, current policy settings could be improved to further facilitate the cost and time saving benefits. Social housing could act as an exemplar for new construction technologies.**
- **Prefabricated construction methods have great potential to reduce development timelines. There is currently insufficient evidence available to determine the impact on cost.**
- **Interviewees suggested that building reform is occurring and not adequately considering new technologies, which could hinder innovation. Policies often do not anticipate technological innovations and, as a result, could present encumbrances.**

As discussed in the previous chapter, reducing the costs of delivering housing has the potential to reduce the end sales price of the product and increase affordability. It is a complex equation with many potential outcomes, but anything that can reduce costs is likely to be beneficial to the end consumer. One aspect where the housing industry has some control is the reduction in the direct costs of delivering housing. This can be achieved through reducing building costs and/or a shorter development timeframe, lowering finance and holding costs such as land tax. A shorter development timeframe also increases the IRR measurement of profit, increasing the chances a developer will meet their hurdle rate of return.

While there is emerging innovation in Australia, traditional methods of construction dominate, with certain frame and wall materials popular with the construction of houses and apartments. They include blocks (aerated, concrete, sandcrete and lightweight composite panels), concrete (cast on-site, or precast but assembled on-site), double brick, brick veneer, timber and various claddings such as fibre cement sheets. In addition, some site conditions may also require the use of piles (concrete, steel and timber, or a hybrid thereof). Containerised modular residential units and other forms of portable accommodations are becoming more common[1].

1 See Container Homes (Containerised Residential Units) - Prefabricated Modular Steel Structures (modsteel.com) – retrieved October 1, 2021.

Different building framing materials are popular in different parts of Australia. An example of this is reported in a recent report (UDIA 2020) by the Western Australian office of the Urban Development Institute of Australia on modern methods of housing construction. According to the report, double brick is more popular in Western Australia's housing construction with 76 per cent of detached residential dwellings using this construction method compared to just 5 per cent in Victoria and 2 per cent in NSW. Conversely, timber-framed cladding houses are most prevalent in NSW, VIC, QLD and SA with over 80 per cent of detached residential dwellings using this construction form. Lightweight steel is most common in Queensland at 18 per cent. In WA, detached housing construction using anything other than double brick would be seen as something of an innovation.

Factors affecting choice of construction methods and materials include:

- site constraints arising from ground conditions
- cost
- resource availability
- government regulations
- cultural norms
- invested technology
- knowledge limitations
- weather
- client requirements
- project complexity.

There are many models of development and construction. While some larger developers have their own in-house construction companies (such as in the case of Mirvac), other developers put projects out to tender and engage a building company. A contract price will be agreed for product delivery. In either case, a lower overall cost or quicker delivery will have a positive impact on feasibility. In this chapter we discuss how the construction industry is embracing new technologies through a number of interviews and illustrative case studies both nationally and internationally. These interviews and case studies highlight a range of innovations slowly being adopted and are likely to become common practice. First, we explore some of the existing research around new technology innovations and processes.

3.1 Existing research

3.1.1 Cost reduction

Studies on cost reduction have proliferated in recent years. Some have looked at cost control theories and some critical elements of related technical practice, whilst others have looked at methodical issues and the broad causalities of overruns. Whilst some studies have criticised the industry on cost variability, Ahiaga-Dagbui, Smith et al. (2015) argue cost reduction research is over-saturated, superficial, replicative and stagnated. Most narratives on the subject of cost reduction seem to agree that cost reduction is not likely a question of method, rather a question of methodology.

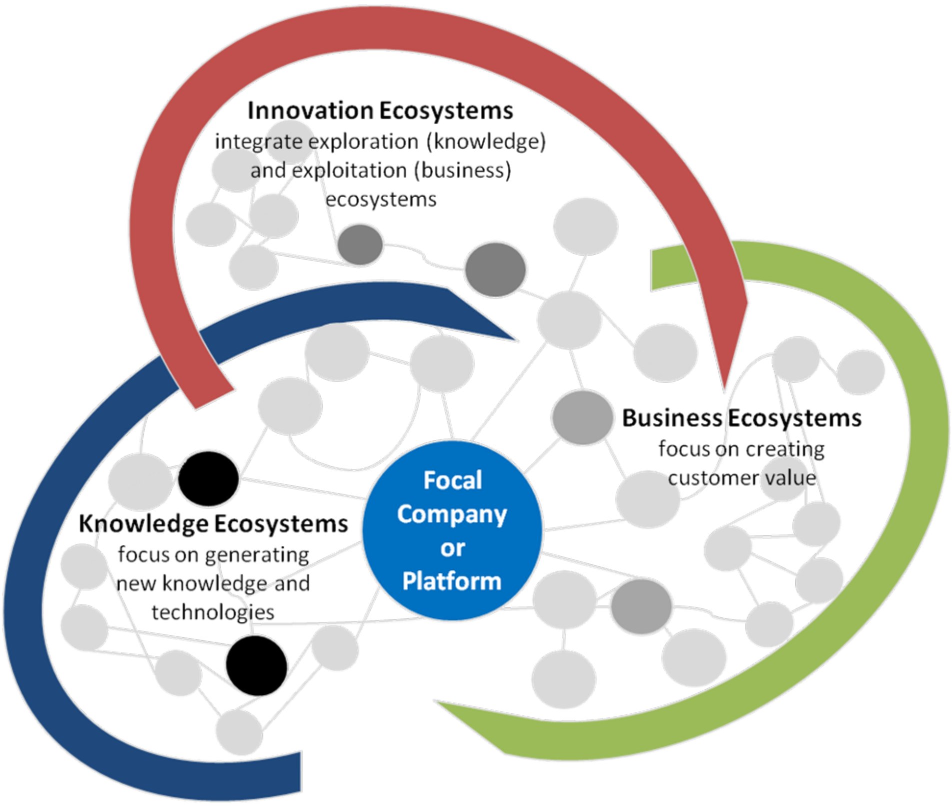
Cost reduction during construction is possible through efficiency gains in:

- supply chain management that limits the cost impact of middlemen on input procurement, and shortens delivery times
- deployment of technologies that add value to design and construction processes, such as digital modelling, lean philosophy, tracking and sensing technologies, robotics and drone, automation and actuation techniques and so on

- relationship management that ensures stakeholders rely upon collaboration and value sharing, rather than confrontationism
- design options that target reduced cost outcomes, such as design for low cost housing, and industrialised mass production of housing rather than bespoke solutions
- lean business management practices
- innovative construction technologies such as hard equipment that improves operational efficiencies and safety management, as well as motion studies and time series technologies
- local economic situation i.e. builders show thirst for higher volume of work than their usual capacity.

No single piece of research has brought these issues together. However, the overall premise is illustrated in Figure 2, using an innovation ecosystem theory by Katri (2015). Katri (2015) suggests innovation is possible when business processes embrace innovation as an ecosystem that is built around empirical knowledge.

Figure 2: Concept map for innovation ecosystem of asset development business



Source: Katri, 2015.

3.1.2 Efficiency gains, innovation and new technologies

Certain philosophical and technological options have been espoused to reduce costs and confrontations in project development processes, and increase productivity (Love, Mathews et al. 2014). Lean construction, for example has numerous theories that inspire development stakeholders to identify and eliminate activities, processes or materials that have low additionality in projects (Ballard 2008). It is important to note that lean construction is a philosophy. For greater clarity, despite the huge volume of work on lean construction over the past three decades, there is no empirical evidence to help tell the difference between a lean project and a non-lean project in terms of costs, productivity or technology.

All novel solutions to construction issues are driven by technology and methodological philosophies. For example, solutions such as digital modelling help designers to store robust design data with the intention that other disciplines may use them without much confusion or content dissipation. The assumption is that this helps to avoid estimation errors and conflicts. However, this is not always true. For example, Amor and Faraj (2001) and Amor, Jiang et al. (2007) are emphatically clear: actual capabilities of digital modelling tools are not exactly as they are promised theoretically.

Another dimension to this is in the limitations of the modelling and estimating software platforms. Estimating outcomes are shaped or limited only by the possibilities within the boundaries of the software applications that are operated in (see Yu, Olatunji et al. (2014) on the limitations of parametric and geometric modelling platforms). Users of authoring tools in the platforms cannot be more creative beyond whatever the platform they use is able to offer. In addition, digital modelling offers clients and the project team the platform to work with high-level dimensional digital artefacts that facilitate a wide range of simulation outcomes. This includes virtual walkthroughs whilst designs are being developed, as well as simulations of safety, progress and cashflow outcomes. All these impact project bottom-line positively.

Building Information Management (BIM), for example, can help to reduce costs. One way to achieve this is through value management procedures: design development requires comprehensive analysis of possible options regarding inputs and development processes. BIM facilitates virtual simulation of design options so that developers can consider designs based on initial costs as well as lifecycle costs such as maintainability, functionality, aesthetics, longevity, safety, sustainability and so on. Virtual reality (VR) also helps to determine what construction, contracting, procurement, supply chain, project management methods may be best in terms of costs. VR may show:

- whether construction inputs are best as precast or as in-situ (i.e. speed vs cost)
- whether concrete will the serve same structural objectives as steel (i.e. cost vs spatiality)
- whether convertible partitioning serves housing outcomes better in a circumstance than fixed-in-place solid walls (i.e. cost vs value)
- whether openings and glazing can serve the purpose of steel grills and solid walls (i.e. cost vs security and aesthetics)
- whether services can be smart or analogue (i.e. green vs costs)
- or whether a certain method of finishing or finish material will serve developer's outcomes more than another (i.e. cost vs aesthetics).

Design analysis using BIM also helps with clash detection. This does not mean all drawings must have clashes or that all clash resolutions will involve cost reduction. However, when they are resolved on-screen, solutions will become readily available during construction, therefore avoiding delays even if this does not lead to immediate cost benefits. Moreover, BIM helps with communication, and communication helps with crisis management – see Loosemore and Hughes (1998) and Dainty, Moore, and Murray (2007).

It is important to surmise:

- New technologies always come at a cost, the immediate implication of which may not reduce production costs; however, deploying new technologies will facilitate innovation, efficiency and cost gains in the long run.
- BIM is innovative, and it works well with other autonomous technologies and philosophies to benefit projects; this may not necessarily be in terms of lowering construction costs but in terms of adding value to asset life.
- Critical contributions to project costs are in the nature of materials, labour and equipment; soft technologies may not change these.

3.1.3 Adoption of construction innovations in Australia

Many technologies have been developed (and are currently available) in Australia to make construction innovations happen. For instance, deployment of digital technologies during construction has been espoused to deliver certain economic benefits, including '*a reduction in construction costs, improved quality of design information, integration of project systems, data and teams, a reduced propensity for change orders, improved interoperability, and whole life-cycle asset management*' (Love, Mathews et al. 2014: 1). These espoused benefits have clear policy implications. For example, BIM has been mandated in many countries; target benefits from this include openness to costing, an end to adversarial procurement and storage of digital information underlying projects. Similarly, smart construction (e.g. using tracking and sensing technologies) and green (e.g. solar) energy sources are also being incentivised. Policy makers only have to extend efforts targeted at encouraging construction innovation to design for manufacturing and assembly (DfMA) methods e.g. through effective approval methods and by encouraging the market for pre-assembly processes.

It is not clear whether certain contemporary construction methods are peculiar to specific Australian states and regions. However, specific examples can be drawn from various parts of the country suggesting appropriate know-how is present in Australia, and the nation will profit if market drivers receive the right triggers.

Figures 3, 4 and 5 provide examples of how Australia has considerable capacity for housing construction products that are exceptional in aesthetics, form and functions, and can achieve cost effectiveness and speedy construction through click-on DfMA methodologies. Contemporary construction methods help reduce cost, increase safety and improve energy performance. It helps the industry work towards safer, more affordable, lower embodied energy houses by better passive design techniques, more efficient processes and materials. Six additional case studies are provided in Appendix 1, which illustrates national and international examples of innovative housing delivery, detailing the innovations and, where possible, impacts on costs and timelines.

Figure 3: Timber-look aluminium in Ausmar Homes by DECO Australia (NSW)

Attributes: *Can be used for residential construction as cladding, decking, sun shading and so on. Benefits include: durable, low-maintenance, weatherproof, non-combustible, easily installed, lightweight, UV resistant, marine-grade finish*

Certifications: *ISO 9001:2015, QUALICOAT, ISO 14001. Australian Certifications: AS 1530.1, AS 1530.3, AS3715, AS3837*

Marketing catalogue: *https://neufert-cdn.archdaily.net/uploads/product_file/file/88583/deco_australia_catalogue.pdf*

Source: www.archdaily.com/catalog/us/products/19542/timber-look-aluminium-in-ausmar-homes-deco-australia - retrieved October 04, 2021.

Figure 4: Aluminium click-on cladding by Sculptform (VIC)

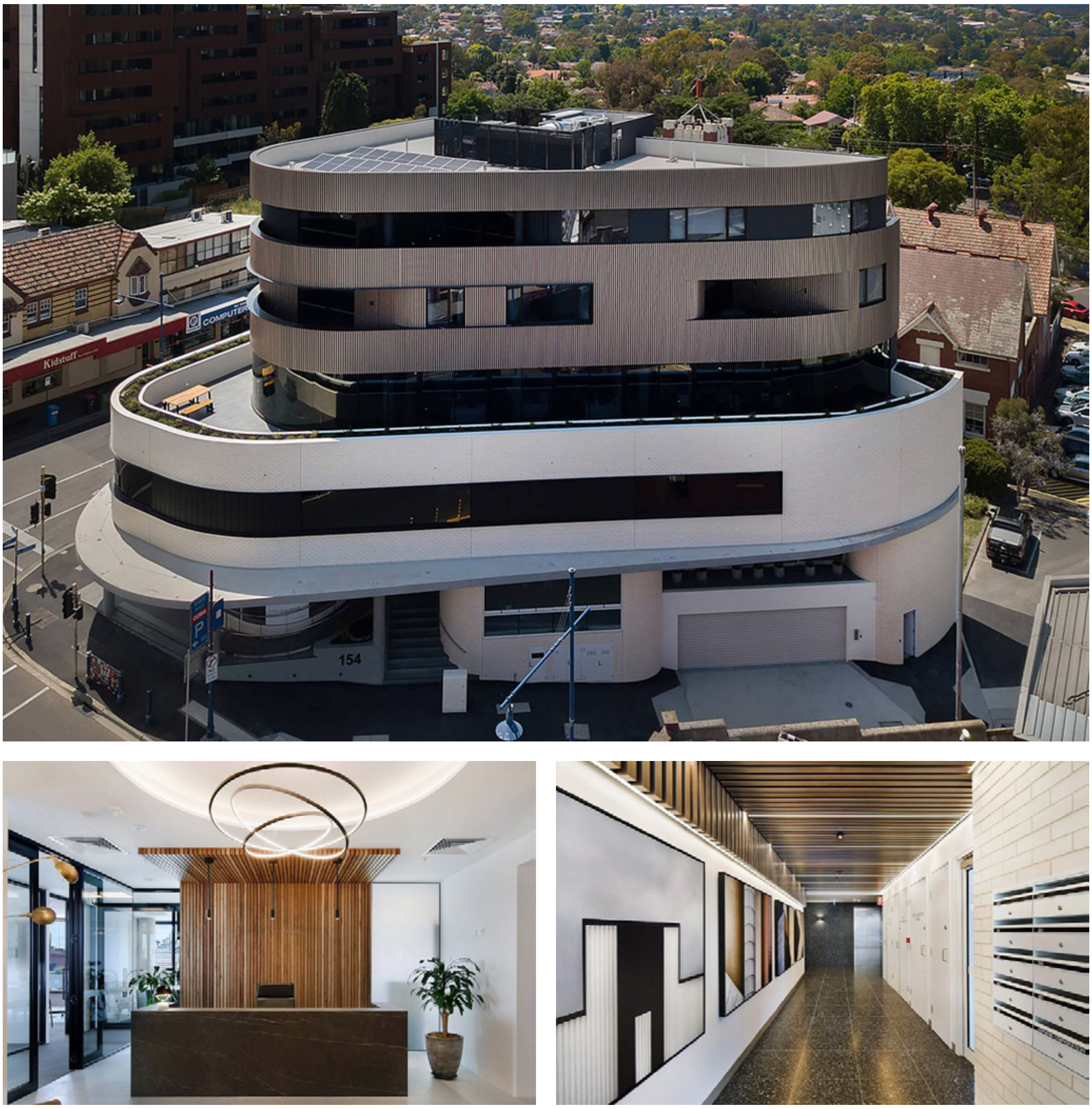
Attributes: *Extruded Australian Aluminium, non-combustible metal cladding, click-on technology, cost effective, sustainable, available in anodised, powder coated, wood finish aluminium, real timber veneer. It is applicable for indoor and outdoor use.*

Certification: *Group 1 fire rating as per Section 9 (n) of AS 5637.1-2015, based on AS/NZS 3837-1998 test. The material is NOT deemed COMBUSTIBLE according to the test criteria specified in Clause 3.4 of AS 1530.1-1994*

Marketing catalogue: *https://neufert-cdn.archdaily.net/uploads/product_file/file/77654/Sculptform_Company_Brochure_Archdaily_2020.pdf*

Source: https://www.archdaily.com/catalog/us/products/17945/aluminium-click-on-cladding-sculptform?ad_source=neufert&ad_medium=gallery&ad_name=close-gallery

Figure 5: Ivanhoe Apartments, Melbourne designed by Martino Leah Architects, and built by Aspyer Group



Technology: *Click-on battens (designed by Sculptform); used in claddings & facades, interior and exterior in multi-use buildings. Quick and easy installation, concealed fixing.*

The project: *Completed in 2020, the project comprises a three-level basement, ground floor retail outlets, two levels of offices, and apartments on the two upper levels. Site is a constrained location –surrounded by three busy public roads, and this posed a major logistical challenge during construction. Click-on battens had meant construction is quick and installation is easy. Components were manufactured for flexible application and for beauty.*

Source: https://www.archdaily.com/catalog/us/products/24679/click-on-battens-in-ivanhoe-apartments-sculptform?ad_source=neufert&ad_medium=gallery&ad_name=close-gallery

Improving build timeframes reduces costs for the end consumer as well as the developer as progress payments can be made sooner and the client can get into the home earlier. The ability to substitute and be agile also helps with efficiencies. It is all about taking more off site and into the office which streamlines processing and enables faster timeframes.

Below is a list of innovations in technologies, processes and materials that have been implemented in the Australian residential sector and are considered to deliver cost and/or time savings benefits.

Technologies

- CAD drawings, rather than hand drawings
- computerised cost estimating programs, rather than manual take-off
- 3D design and modelling, BIM for clash detection
- modular design and construction
- computerised onsite tablet supervision programs
- innovative building techniques that save time such as wrapping the house so brickies can lay bricks on the outside while work continues inside at the same time
- visualisation tools to enable clients to see the product some builders do this to a higher degree enabling time poor clients to buy online. Improved estimating tools and software.

Processes

- in-factory and modularised construction: steel frames, roof trusses and pryder program systems (rather than timber tables and 'stick build')
- imported bathroom modules
- processes: new streamlined systems have been introduced over the past decade to create greater efficiencies in streamlining scheduling of product delivery and trades, ordering materials, invoicing and so on
- some builders and supply companies outsource including overseas like estimating or drafting. This expands their resources, and they can flex up and down and change with market conditions.

Materials

- raft footings and screw piles, in lieu of strip footings
- wall panelling in lieu of brick such as lightweight board, Hebel, Renderpanel (coated foam), aluminium sandwich and Bondor refrigerator panels
- cross laminated Timber (CLT) to replace framing and wall panelling
- double glazed, high efficiency glass for windows
- instantaneous hot water services and solar or heat pump hot water services rather than electric storage tank HWS
- recycled plastic-wood (modwood) in lieu of timber for outside decking.

To improve the uptake of such innovations, current policy settings could be improved to further facilitate the cost and time saving benefits. For instance, the current NCC does not have any contents related to modular construction or DfMA. Similarly, NCC does not cover the use of recycled and reused building materials.

In terms of public procurement, the procurement guidelines could pay more attention to sustainability. In addition, tender weighting criteria could award innovative solutions that yield efficiencies while public projects could serve as showcases.

At the moment, some cost savings from the innovations (e.g. energy efficiency, the use of solar panel and batteries) are enjoyed by the households rather than by the developers. Some policies such as carbon credits could motivate more developers to adopt innovations in their housing developments. Social housing could serve as exemplar for government's leadership in adopting innovations in the residential sector, e.g. energy efficiency, solar power and battery, use of recycled materials and building components, etc.

Indeed, it is crucial to engage various stakeholders (such as end users, community, state governments, local councils and so on) into construction innovations. With a better understanding of the process and outcomes, it is more likely to gain support from these stakeholders to facilitate the construction innovations for cost and time saving benefits.

3.2 Construction innovations: technologies and processes – an industry view

To understand how construction innovations are being adopted nationally and internationally, we interviewed a total of twelve industry professionals in Australia, China and the UK. Interviewees worked within a variety of types of businesses such as contractors and developers and roles from project manager to senior executive. All these interviewees have extensive professional experience in the construction industry, especially in the housing sector. The profile of interviewees is shown in Table 4.

Table 4: Interviewee profiles

Title	Working organisation	Country
Senior Executive	Contractor	Australia
Senior Project Manager	Contractor	Australia
Senior Project Manager	Contractor	Australia
Senior Executive	Contractor	Australia
Project Manager	Contractor	Australia
Project Manager	Developer	China
Technology Director	Contractor	China
Senior Executive	Developer	China
Development Manager	Developer	UK
Building Design Director	Architectural firm	Australia
Professor	University	Australia
Chartered quantity surveyor	5D estimating service	Australia

Source: Authors.

3.2.1 Innovation for efficiency

Interviewees suggested that many innovations have been introduced into the construction process to make it more efficient through cost reduction and time saving benefits. It seems that innovations are more likely to be employed in more complex, larger scale projects. Meanwhile, some innovations such as prefabrication and smart technologies were used more in overseas projects than Australia, although their use is growing quickly.

For building prefabrication, panelised, volumetric and traditional construction solutions were deployed based on a project by project basis. The use of such methods has significant benefits, especially in time savings. In South Australia, a large number of school projects have adopted modular/prefabrication methods, as endorsed by the education authority.

Software technologies including virtual and augmented reality, as well as rigorous BIM procedures were common features. BIM has been used for assisting the management of design and construction processes, such as time management, cost management and safety management. Meanwhile, interviewees suggested that use of advanced technologies such as VR has greatly facilitated the communication between client and the design and construction team. It has also helped to improve efficiency. There is great potential for modifying design simultaneously with a client's changing demands. Meanwhile, simulation allows checking for potential difficulties in construction as well as monitoring the progress and expenditure.

Interviewees showed significant awareness of sustainability issues in housing development, e.g. waste recycling, energy efficiency, green space, etc. but were also cautious around the balance between cost and benefit. Features becoming more common and designed to reduce dwelling running costs include double glazing and solar systems. Solar can be designed and structured to develop systems with batteries to make them more energy efficient and in some instances, self-sufficient where they are not relying on external energy resources.

Reverse build is a process where essentially both inside and outside work can be conducted simultaneously, which will save time. It provides a protective weather barrier that allows trades to carry out work inside a house before the facade is constructed.

3.2.2 New processes and costs

All interviewees highlighted the impacts of new processes that influenced development costs. Some of them focussed more on capital cost, whilst others were more concerned with ongoing operation and maintenance costs. One interviewee described a number of benefits around new processes:

> Modular construction is quicker to construct but overall more expensive than traditional construction. Value here is activating built forms in an accelerated manner.
>
> Software technologies reduce risk and therefore reduce overall build cost. This is achieved at the principal contractor and subcontractors level.
>
> Quicker build times improve development costs and activate transactions quicker and more profitably or rather more competitively.
>
> Value engineering has activated developments otherwise not feasible. (Senior Executive, contractor, Australia)

Not all interviewees shared the same view though. This was particularly the case for interviewees from overseas. A UK development manager suggested that development costs are approximately 15 to 20 per cent higher with prefabrication construction but they did reduce timelines. This is supported by other overseas interviewees in that using prefabrication does not save money but does have significant time saving benefits.

However, an Australian based contractor suggested:

> Our value engineering and alternate design approach typically yields anywhere from four per cent to eight per cent in reduced project cost while preserving extent of space and quality outcomes. Modular construction is most beneficial when the modules are designed to be reused and relocated. Benefits also exist where acceleration is needed or where the geographic location of the project tips the value/project cost to modular opposed to traditional construction. (Senior Executive, contractor, Australia)

As far as the prefabricated structure is concerned, its design can be divided into five levels:

1. structural design based on the splitting of prefabricated components
2. structural system design based on construction and combination
3. building system based on system integration design principles
4. engineering design based on the integration of design, production, and construction
5. the whole process of design, implementation, and control integration based on the whole life of the building.

Other benefits of new processes include a better working environment for trades and quality assurance. As there is less demand for on-site storage, this is also a cost saving. An Australian based estimation expert commented that some key players in the housing market (e.g. local authorities in charge of development approvals and operators of the insurance and finance sectors) do not adequately understand these technologies. Thus, they do not know how to assess, encourage, support or facilitate them.

3.2.3 Development timeframes

According to interviewees, new processes have significant impacts on the development timeline. A senior executive suggested panelised modular construction was quicker by 30 per cent and volumetric quicker by 50 to 60 per cent depending on the project. Additionally, BIM assists to help reduce errors and increase the efficiency of procurement.

Similarly, using innovative methods can generally improve the project schedule performance. An Australian based senior project manager suggested that his company invested resources in developing VR and Augmented Reality (AR) for tendering process where a BIM model was incorporated. The client representative was able to use the VR/AR technology to navigate the entire design and the design can be amended straight away. This has helped to reduce the time required for communication related to design brief and consultation. Consequently, the development timeline can be reduced significantly.

The selection of materials was also highlighted by interviewees as a 'new' process that has influenced the development timeline. Because of current supply shortages of timber material, many companies have moved to the use of alternative materials, such as steel (e.g. for framing) or composite materials that reduced the demand for virgin wood.

While interviewees suggested that new techniques can result in time savings that allow transactions to occur quicker there can be issues with securing finance:

> [It is] more difficult because lenders see it as an unusual form of construction and riskier because we have to pay for modules before they arrive on-site. (Development manager, UK)

This view was shared by other interviewees. The risk reverse attitude was cited by interviewees as one of the main obstacles of financing development projects using such new technologies.

Some interviewees observed that the use of smart technologies have allowed clients to see the simulation of construction and finished products (such as building and its subsystems). This could be used as part of the documentation submitted to lenders, which may facilitate quicker approval. Other interviewees suggested that new procurement/delivery strategies have significant impacts on the financing of developments as well.

All interviewees suggested that new processes have many advantages, delivering products that would not be possible using traditional technologies and also reduce risks associated with the impact of bad weather. Similarly, the use of smart technologies has allowed real time monitoring of various aspects of development such as time, cost, energy consumption, waste generation, safety, quality, and so on. This could not be achieved if traditional technologies were utilised.

3.2.4 Policy settings

All interviewees agreed that policy is one of most critical factors that affects the uptake of new technologies, materials or construction methods. These impacts could be negative or positive. Interviewees suggested that building reform is occurring and not adequately considering new technologies. This reform is needed but could hinder innovation and new technologies. Indeed, interviewees commented that public policies often do not anticipate technological innovations sufficiently, and often do not keep pace with such innovations. As a result, they could present encumbrances unwittingly. Another dimension to this is the issue of blanket mandates—governments making it mandatory for industry operators to use one technology or the other.

Interviewees commented that this is counterproductive and against the ethos of competition. When systemic problems become visible and policies are not able to trigger seamless amicable solution, then there is a problem. The insightfulness of this is in finding the courage to determine whether extant policies provide sufficient coverage around digital design, modularisation and client's value-chain.

The construction industry has seen several blanket mandates by governments as certain innovative technologies draw their attention. For example, BIM has been mandated by many countries in the last decade. Edirisinghe and London (2015), Jiang, Wu et al. (2021), Hadzaman, Takim et al. (2015), and Ho and Rajabifard (2016) have reported mandates and national roadmaps in Australia, Finland, Singapore and the United States of America. Similarly, BIM has been espoused to facilitate exceptional success in industrialised building systems through design for manufacturing assembly [DfMA] processes, which has also gained popularity in the last decade (Alfieri, Seghezzi et al. 2022; Bakhshi, Chenaghlou et al. 2022; Din, Bahri et al., 2012).

The second part of the extract from the report is about industry's reaction to such mandates. The interviewees confirmed an argument by Olatunji (2014) that drew insights on whether a strict compulsion of what technology should be used does not stagnate innovation and market competition. Another aspect of the criticism of blanket mandates is whether free markets should be allowed to determine technology uptake. In such a case such technologies would have proven themselves and adopters could be convinced about what they are doing rather than being mandated to do what may not be suitable to their approach to work. For example, why should a business use BIM? Many reasons have been given. However, such reasons seldom manifest the exact outcomes for all adopters simultaneously. Where a blanket mandate puts an adopter in difficult situation, such mandates should be clear on compensation and rewards.

Council planning requirements was a policy factor suggested by interviewees that could affect the uptake of new technologies. If council policy was to have a certain percentage of modular buildings as a target, then uptake would increase.

Similarly, the use of a solar power system is endorsed within social housing developments. The residents are able to enjoy the benefit of a much lower energy bill without even paying for the upfront cost. The 'new' business model with the industry (such as battery manufacturing) has facilitated such new developments. This applies not only to new developments but also the retrofitting of existing social housing stock.

Some interviewees highlighted the role of sustainable procurement in public housing developments as well. For instance, the technical standard of recycled construction materials can play a crucial role in facilitating greater use of alternative materials. A recent initiative in South Australia saw a database of recycled products developed and local authorities were encouraged to use these products. Yet only nine out of 19 local authorities in Adelaide metropolitan areas participated. The scheme intended to facilitate the demand for recycled content products using the councils' joint purchasing power. With the initiative aiming to establish a tangible circular economy, each council acts as an economic body to buy back products containing waste generated from its administrated suburbs. For instance, the ultimate target is to buy back 50 per cent of council-collected waste plastics in terms of weight in the form of remanufactured products.

One interviewee commented that some key players in the housing market such as local authorities in charge of development approvals and operators of the insurance and finance sectors, do not adequately understand new technologies. Thus, they do not know how to assess, encourage, support or facilitate them. An interviewee thought policy must assist the industry to *'see value return'* in innovation; thus, should see innovation beyond immediate cost returns.

3.2.5 Affordability

According to interviewees, the impact of new technologies is mixed when it comes to housing affordability. While the use of these new technologies is more likely to increase the upfront cost, it will very likely reduce timelines through efficiency. A common phrase used by interviewees was *'time is money'.*

3D printing of houses in a repetitive simplistic format can yield affordable construction outcomes. This was echoed by many other interviewees. However, it was widely acknowledged the need for scale needed to achieve such benefit in terms of affordability. If the scale is too small, e.g. a few houses or the design has to change constantly, the impacts on housing affordability could be negative rather than positive.

It was acknowledged by interviewees that there is growing awareness of environmental sustainability from the public, developers and tenants. This has, and will continue to, drive the use of new technologies, materials and construction methods that will lead to better sustainability outcomes.

3.2.6 COVID-19

Interviewees were asked about the impact of COVID-19 on their development activities. COVID-19 restrictions required construction systems and measures to be developed to accommodate social distancing and other health requirements. The number of people per floor had to be managed to reduce the interaction between trades. For example wall framing contractors would be working on level 3 with possibly the services trades, while painters and tilers would be working on level 2. The amount of lunchroom space allocated per person was increased, meaning the contractors had to get additional lunchrooms on-site and stagger lunches per trade to ensure the required separation.

Every time someone came to site, the contractor needed to understand who they were and what possible exposure they would have to treat. Specialist trades required from interstate, might have to be tested and isolate before working on-site, assuming they are allowed entry to the state in the first place. The lack of labour mobility creates issues and labour shortages result.

Contingencies were to be put in place to cope with material delivery delays imported products with some purchasing early and storing locally, adding additional project cost. When COVID-19 first impacted the sector in February 2020 there was a product supply issue with materials coming from overseas. Glass factories in China shutdown, for example. Supply issues converted to productivity issues with state border shutdowns and safe working distances being implemented. The situation went from supply delays to productivity constraints. The COVID-19 stimulus programs such as HomeBuilder resulted in considerably more activity than expected causing a material shortfall in the residential sector.

Business continuity plans were implemented with project teams remaining separate so as not to contaminate other projects. This was in an attempt to ensure if one site was affected by a COVID-19 exposure event, the rest of the business and projects could continue unaffected.

There were many lessons learnt by the industry and there has been a general improvement in hygiene and social distancing as a result. COVID-19 has caused developers to think more carefully about what makes a community, and has increased the emphasis on how people actually live in dwellings.

3.3 Summary

There are many examples of innovative construction methods and processes being adopted in Australia and overseas. While evidence is growing on how such processes can reduce development timelines, and thus costs associated with finance and holding periods, evidence is less clear around reductions to direct construction costs. Instead benefits lie more with the outcomes from developments in terms of ongoing maintenance and running costs rather than reductions in upfront capital costs. Innovations are moving at a faster pace than policy settings and such settings are hindering the wider uptake of new technology.

4. The impact of policy settings on feasibility outcomes

- **Using case studies representing five different types of development projects, this chapter models the impact of a range of policy settings on development profitability.**
- **The use of new building technologies and processes that reduce construction costs by 5 per cent and the development timeframe by 10 per cent could reduce end sales prices if savings were passed onto the end consumer.**
- **A more efficient development approval process would increase IRRs and make development more profitable. This could increase housing supply.**
- **Policies that increase development costs can result in higher end prices for the consumer or prevent development altogether. However, over time the market should adjust to absorb such costs.**
- **Affordable housing contributions of 20 per cent or more can significantly reduce development profitability unless developers are able to take such contributions into account before land purchase and adjust the price they pay for the land accordingly.**

This chapter uses industry standard software, EMDF, to model the impact of key variables on development feasibility outcomes. The objective is to simulate, across a variety of different development products, how policy settings can alter inputs to the feasibility model and deliver very different return outcomes. Such settings can be the difference between profitable and unprofitable development. Consequently, understanding how different settings affect development profitability, and hence the feasibility of the development scheme, is very important when developing policy designed to influence housing supply.

4.1 Modelling feasibility

As discussed in Chapter 2, EMDF is software regularly used in the development industry to assess whether a site is financially feasible or to calculate the maximum land price a developer can pay for a site at their required hurdle rate of return. For this modelling exercise, five case study sites have been constructed, which illustrate typical Australian development projects. Each case study has been developed from discussions with industry representatives, including the interviews reported in Chapter 2.

The assumptions for each case study are laid out in Table 5. These are hypothetical case studies based on prevailing market price and cost data to deliver a realistic development scenario. Price and cost escalation varies depending on the hypothetical location, with price growth kept conservative as its standard within the industry. Cost escalation reflects the market at the time of scenario development (mid 2021). The case studies are intended to provide examples of how changes to variables will affect IRR outcomes. They are not intended to be anything other than illustrative of the direction of change as all developments will have different sets of inputs resulting in different balances between revenues and costs. They are useful in providing an indication of the scale of impact the change to a policy setting can have on return outcomes. As shown in the results, the impact on the different types of developments varies quite significantly. As such, it is important to read the outcomes as illustrative only, rather than as a definitive calculation of how the change to a variable will affect all developments.

The table shows the IRR outcome at a given land purchase cost. Such outcomes range from well above the developer's hurdle rate of return (house and land package) to slightly below (apartments). The case studies have been developed using industry standard inputs. However, each case study had to deliver an IRR outcome that could move up or down when various settings were altered; there was no point starting with a negative IRR outcome as policy settings would make little difference.

The EMDF inputs were changed from the default set of variables for each case study to identify the impact of a variable change on the IRR outcome. Comparing the resulting IRR with the original IRR calculates the impact of the change on feasibility. For example, increasing total construction costs by 10 per cent for a particular site would decrease the IRR from 20 per cent to 15 per cent, so a 25 per cent fall in the IRR outcome. We can therefore conclude, for this particular development site, that increasing construction costs by 10 per cent reduces the IRR by 25 per cent. In general terms, from this we can conclude that increases in costs will have a significant, negative impact on return outcomes for similar sites. Policy settings that increase construction costs by 10 per cent therefore have the potential to render a development unprofitable assuming the developer's TRR in this example was 20 per cent.

The land subdivision case study reflects a fairly large, greenfield development producing a variety of lot sizes over a period of three years, with an 18-month timeframe to sell the lots reflecting the scale of the development. A 54-unit apartment development on a 2,000m^2 site delivers a variety of apartment sizes with a relatively long development period reflecting the development approval process for an infill site. Around 40 of the 54 apartments need to be pre-sold to reflect the requirements of the lender with the remaining apartments available for sale on development completion, with a maximum disposal period of 12 months.

A small 10-lot townhouse development assumes a level of pre-sales sufficient to satisfy the lender (usually covering 80 to 100 per cent of debt) with a short disposal period to sell the remaining four units. A house and land package development of 20 detached dwellings has a relatively short construction and disposal period representing a strong market. Finally, a mixed residential site comprises lots, townhouses and a 40-unit apartment development, of which 30 are pre-sold. This has the longest development timeframe of all five developments to reflect the staged delivery of the product.

As the modelling is designed to reflect the impact of government based policy settings on development outcomes, finance is kept simple for each development. It is assumed the developer uses equity funding to purchase the land and the remaining costs are debt funded through a single lender at a fixed rate of interest over the development period. Line and loan establishment fees are included in the finance costs. The impact of finance costs on feasibility outcomes has been modelled in previous research (Rowley, Costello et al. 2014).

In this chapter we model the impact of the following key variables on IRR outcomes:

- construction costs
- revenue
- development timeframe
- disposal period.

The chapter then goes on to examine variable combinations to simulate how various policy settings could impact on IRR outcomes. The policy settings are:

- innovative construction methods
- developer contributions
- density bonuses and affordable housing contributions.

Table 5: Feasibility case studies

Type	Land Subdivision	Apartments	Townhouses	House and land	Mixed residential
Number and type of units	200 lots between 240 and 550 m^2	54 apartments of mixed size	10 townhouses of 160m^2 each	20 house and land packages on 400m^2 Single storey dwelling	20 townhouses, 80 lots and 40 apartments on a 5 hectare site
Development timeframe	39 months	38 months	24 months	22 months	43 months
Construction timeframe	14 months	16 months	12 months	10 months	20 months
Disposal period	18 months	12 months	6 months	6 months	13 months
Pre-sales	None	40 from 54 units	6 from 10 units	0 units	30 apartments
Finance	Equity funding of land acquisition costs + senior debt from single lender	Equity funding of land acquisition costs + senior debt from single lender	Equity funding of land acquisition costs + senior debt from single lender	Equity funding of land acquisition costs + senior debt from single lender	Equity funding of land acquisition costs + senior debt from single lender
Hurdle rate of return	IRR 20%	IRR 18%	IRR 20%	IRR 15%	IRR 20%
Revenue and cost escalation	3% and 2%	0% and 3%	0% and 5%	3% and 3%	2% and 3%
Land purchase cost (excl GST)	$10,000,000	$4,000,000	$1,000,000	$3,000,000	$6,000,000
IRR outcome	21.64%	15.72%	20.18%	31.18%	23.97%
Developer margin	26.29%	14.16%	13.96%	26.40%	21.09%
RLV at target rate	$10,695,000	$3,545,962	$1,000,438	$3,898,366	$7,169,729

Source: Authors' calculations.

4.1.1 The impact of construction costs

Construction costs include the physical costs of subdividing land and/or constructing built form product. It excludes developer contributions, professional fees, statutory fees, land holding costs and any costs associated with land purchase. Construction costs can rise sharply in times of high demand, which has been the case during 2021 and into 2022 where the supply pressures resulting from the HomeBuilder COVID-19 stimulus grants have pushed up the costs of labour and materials across the country. In more stable markets, construction costs may rise by CPI. Many developers will build in a cost escalation factor to account for cost growth over the development period, so the total cost of construction built into the model accounts for such cost increases. For this modelling exercise we assume starting construction costs rise, or fall, by 10 per cent. A rise could be caused, for example, by high demand for building companies affecting the tender price or a new building code requirement introduced at short notice increasing costs. Alternatively, a delay post site purchase could result in costs having risen by 10 per cent by the time the site is ready for development. The results are shown for the five case study developments in the table below.

Table 6: Impact of a 10 per cent change in construction costs

	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
10% increase in costs					
IRR change	-18.6%	-42.0%	-42.1%	-32.7%	-30.1%
Change in end sales values to maintain IRR	5.2%	7.3%	6.8%	5.7%	7.0%
Change in RLV to maintain IRR	-17%	-34%	-37%	-16%	-34%
10% decrease in costs					
IRR change	18.7%	42.4%	42.5%	33.3%	30.2%
Change in end sales values to maintain IRR	-5.2%	-7.3%	-6.8%	-5.9%	-7.0%
Change in RLV to maintain IRR	17%	34%	30%	16%	34%

Source: Authors' calculations.

The table shows a 10 per cent increase in construction costs has a major impact on the resulting IRR with the original IRR outcome falling between 19 and 42 per cent depending on the type of development. Land subdivisions are less affected because the physical cost of subdividing the land is a smaller proportion of overall costs when compared to a capital-intensive built form product such as townhouses or apartments. A 10 per cent decrease in costs has an almost identical, opposite effect in IRRs, increasing potential return outcomes significantly across each development type. Clearly, any policy setting, or construction innovation, has the potential to increase IRR outcomes if all other variables remain fixes.

Also included in the table is information on sale prices and the residual land value. In order to maintain the original IRR for each case study, the end sales values would have to increase by between 5.2 to 7.3 per cent if construction costs rose by 10 per cent. This means that in order to maintain the original profit outcome a developer would need to increase product prices to absorb the increased costs. Increasing costs would need to be passed onto the consumer in order for the developer to maintain the original forecast return. Whether the developer would be able to pass these costs on to the end consumer would depend on the strength of market demand and local competition. If costs increased during development and developers could not pass the costs on to end consumers, profits would fall.

The table also shows how the land value would need to change to, again, maintain the original project IRR. To absorb an increase in costs, a developer would have to pay between 16 and 37 per cent less for the land, effectively passing the increased costs onto the landowner. If the developer already owned the land at the point of the cost increase, i.e. when they went out to tender and found construction costs were 10 per cent higher/lower than originally anticipated, it would be too late to recoup costs through negotiating a lower land price. When bidding for land, if the landowner was not prepared to accept the lower land price the development would not proceed.

The table shows how sensitive development outcomes are to construction costs. Therefore, if new building processes and technologies were able to reduce costs, this could potentially result in lower end prices for consumers, ceteris paribus. In the subdivision example, lot prices could fall by 5 per cent and the developer would still achieve the original, projected IRR. Apartment prices could fall by as much as 7.3 per cent. This assumes the developer passes the full cost savings onto the end consumer and does not reflect cheaper construction costs in a higher bid price for the land. If no cost savings were passed on to the landowner or end consumer it would mean higher profits for the developer.

CoreLogic's Cordell Construction Cost Index (CCCI) for Q4 2021[2] showed construction costs increased nationally in 2021 by over 7 per cent, which is the highest rate of growth since 2005. Increasing cost escalation in each of the case studies to just 5 per cent shows a decrease in the IRR by between 3 and 13 per cent, depending upon how cost intensive the development is. For example, cost escalation will impact apartment developments more than land subdivision because construction costs are a higher proportion of total development costs. In WA, the Property Council surveyed 21 apartment developers and found cost escalation was causing major delays in the supply pipeline, estimating 10,000 apartments were on hold[3]. The only way developers can absorb increasing development costs is through increasing the revenue generated through sales meaning higher prices for consumers. If consumers are not willing to pay higher prices, developments will not proceed because they are not profitable.

While some developers have internal building organisations that deal with the actual construction, many developers will put the construction element of a project out to tender. Developers can minimise the risk of cost escalation by using fixed price contracts, passing the risk of cost increases onto the builder. The rate of cost escalation, as well as labour and material shortages, are then the problem of the builder who has to absorb any losses resulting from increased costs. This makes them very vulnerable to sharp cost increases. If builders do collapse, the developer will also suffer loses as construction times blow out as a new builder is contracted, at a price reflecting prevailing building costs.

4.1.2 Revenue

As discussed in Chapter 2, developers estimate the sales revenue of the end product using information about the current market and then account for changing market conditions over the development period. This revenue escalation will not affect any dwellings pre-sold. Our second scenario models a case when end sales revenues are 10 per cent higher or lower than expected, in other words the initial prices expected in the feasibility model are adjusted to reflect a market that is much better or worse when sales are finalised.

As would be expected, a 10 per cent increase in revenue has a massive, positive impact on the IRR outcomes. For example, the IRR for the apartment development rises from 15.7 per cent to 24.6 per cent (a 57 per cent increase on the original IRR) and the IRR for the land subdivision rises from 21.6 per cent to 29 per cent (a rise of 34 per cent). Similarly, significant rises also occur in the other three case studies. A 10 per cent fall in revenue would have disastrous consequences for return outcomes. The IRR for the apartment development falls from 15.7 per cent to 6 per cent (a 62 per cent fall) and the IRR for the land subdivision rises from 21.6 per cent to 13.5 per cent (a fall of 38 per cent).

2 https://www.corelogic.com.au/news/construction-costs-rising-fastest-annual-pace-2005
3 https://www.propertycouncil.com.au/Web/News/Articles/News_listing/Web/Content/Media_Release/WA/Skills_shortages_crippling_apartment_pipeline.aspx

The analysis shows how sensitive development is to end sales prices. Market changes can deliver both positive and negative outcomes depending on the way the market moves and is the single biggest risk factor given developers have no control over market outcomes. While pre-sales can help protect against price falls during the development, there is always the chance the purchaser will walk away from their contract if the fall in price is higher than the deposit. Conversely, pre-sales mean developers miss out on any potential price growth over time. Regardless, pre-sales rates are set by a lender for those developers that require debt funding. Those developers financing through equity are less constrained by pre-sales requirements.

The risks around end revenues and their impact on profit outcomes makes certainty in the development timeline very important. The longer the project, the greater the uncertainty around prices. Any policy setting than extends development timelines adds to risk and the impact of changing timelines is modelled later in the chapter.

Policy settings that stimulate demand are likely to have a positive impact on development profitability, unless there is existing supply available in the market to absorb such demand. For example, demand side grants such as first home owner grants or the HomeBuilder grants do stimulate demand and can lead to consumers paying more. Developers are normally careful not to overestimate revenue so are unlikely to factor into their price forecasts the potential impact of newly introduced grants or interest rate cuts which may also stimulate demand, although they will factor such variables into sales rates. Instead, higher prices resulting from increased demand will end up with a higher than anticipated IRR.

Demand side measures can also decrease the time it takes to sell a product at the pre-sales stage or the end of the disposal period, which, as shown in the section below, also has a positive impact on IRR outcomes. Non-government policy settings such as interest rate rises or lending restrictions can also dampen demand. If such settings are in place before the developer begins the development process, they can be factored into the feasibility model. It is policy settings that change during the development period, which the developer is unable to price into their project that will have a major impact on profit outcomes. For example, tighter lending restrictions imposed by the Australian Prudential Regulation Authority could reduce demand through restricting the number of eligible purchasers. If restrictions were tight enough, prices could fall impacting on development profitability. For developments in progress, this will have a negative outcome on returns. For potential new projects, the reduced demand may make a development no longer feasible.

4.1.3 Sales periods

The sales or disposal period represents the time it takes for the developer to sell lots or dwellings upon project completion. In a weak market, the sales period will be longer to reflect difficulties in selling dwellings, while a strong market would see dwellings sold quickly. The situation is complicated by the need for pre-sales, particularly for built form products, necessary to demonstrate a market for the product in order to satisfy lender requirements. If, for example, there is a requirement for 70 per cent pre-sales this would mean the sales period would need to reflect the time it would take to sell the remaining 30 per cent. The larger the development, the longer the sales period. A large subdivision across multiple stages would have multiple different sales periods if the developer employed a strategy of selling all, or the vast majority, of stock before moving on to the next stage.

The longer the disposal period, the longer it takes to pay off debt finance so the greater the interest costs. Other holding costs also reduce the IRR. If revenue escalation has been built into the model, prices will continue to escalate over the disposal period, but such escalation would not be appropriate if a lengthy sales period was incorporated to reflect a tough sales environment. If revenues are expected to fall over the disposal period, or discounts were necessary to deliver sales, this would have a negative impact on returns.

In the table below, a 40 per cent increase in the disposal period, from 10 to 14 months for example, has a relatively minor impact on the original IRR. The highest impact is on the mixed residential development, but this is limited to a 12 per cent fall, which would mean the development would still meet the hurdle rate of return. End sales values would need to rise slightly to compensate for the longer sales period, unlikely if the developer is struggling to dispose of the stock. The price paid for the land would need to fall between 3 and 16 per cent to compensate for the increased costs resulting from a longer sales period.

A reduction in the sales period has a greater impact on the IRR with an increase of over 17 per cent for mixed residential and 12.5 per cent for land subdivision. Apartments and townhouses have pre-sales attached so the impact of a shorter sales period is lower as the revenue is assumed to be received in the month after completion. Any policy setting that would decrease the disposal period through an increase in consumer demand, and this could include the introduction, or modification, of demand side grants or the removal of stamp duty, would therefore have a positive impact on developer returns. If developers sought simply to maintain their IRR, this would mean a reduction in the sales price required.

Table 7: Impact of sales period on IRR

	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
40% increase in disposal period					
IRR change	-9.7%	-4.6%	-4.4%	-7.6%	-12.6%
Change in end sales values to maintain IRR	3.1%	0.8%	0.7%	1.5%	3.4%
Change in RLV to maintain IRR	-10%	-4%	-3%	-4%	-16%
40% decrease in disposal period					
IRR change	12.5%	5.3%	4.3%	9.0%	17.6%
Change in end sales values to maintain IRR	-3.0%	-0.9%	-0.7%	-1.5%	-3.4%
Change in RLV to maintain IRR	10%	4%	3%	4%	17%

Source: Authors' calculations.

Developers themselves can decrease the sales periods and increase sales rates by making their product more competitive in the local market by reducing prices. The reduction in price compensated to some extent by the shorter development period. Some developers, as discussed in Chapter 2, will employ this strategy as it would allow them to exit the project quicker and move onto the next one. If sales are slower than expected and the sales period blows out, developers may have no choice but to cut prices, which will lower the IRR outcome.

4.1.4 Construction period

The construction period reflects the time between the commencement of physical construction and construction completion. A reduction in the construction period will reduce interest and land holding costs and bring forward the disposal period. The impact of shortening the construction period will depend on the length of the period in the first place, the level of debt funding and the extent in which construction costs are expected to escalate over time. Delays in the construction period could arise from labour shortages or disputes, material shortages, weather issues or other unexpected environmental circumstances. COVID-19 has resulted in periodic shutdowns on many construction sites at various points over the last 18 months. This extends the construction period and reduces profitability. While the IRR is affected more than the developer margin, as this return measure is time sensitive, the developer margin will also fall as a result of additional costs associated with a longer time period, notably holding costs and debt. Fortunately for many developers, the strong price growth across the country will offset many of the losses resulting from an increased construction period. The extent to which this is the case will depend on the type of project and level of pre-sales. However, as can be seen from Table 8, substantial price increases of between 4 and 10 per cent are necessary to offset a 25 per cent increase in the construction period. Time blowouts during construction have a significant impact on profitability.

Table 8: Impact of construction period on IRR

	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
25% increase in construction period					
IRR change	-23.8%	-33.5%	-29.5%	-18.1%	-29.3%
Change in end sales values to maintain IRR	9.4%	8.5%	6.9%	4.2%	10.1%
Change in RLV to maintain IRR	-27%	-36%	-28%	-11%	-43%
25% decrease in construction period					
IRR change	45.7%	56.4%	44.0%	44.0%	73.3%
Change in end sales values to maintain IRR	-8.3%	-6.3%	-4.9%	-5.3%	-9.7%
Change in RLV to maintain IRR	29%	32%	23%	16%	52%

Source: Authors' calculations.

Construction processes that reduce the construction period from the expected duration would have a positive impact on the IRR. It is highly unlikely there would be significant time savings during a construction period already set within a feasibility, however the analysis does indicate how incorporating a shorter construction period would have a positive impact on profitability and could make a previously unprofitable project commercially viable. Chapter 3 refers to some of the construction efficiencies that could reduce building timelines and, as shown in the table, shortening the construction period can increase an IRR by around 50 per cent, due to the shorter cash flow period and reduced costs; costs that also have a positive impact on the developer margin. To maintain the original IRR, a shorter construction period would allow price reductions of between 5 and 10 per cent.

4.2 The impact of policy settings

The previous section examined the impact of key, but individual, variables on development feasibility. When new policy settings are introduced, or existing settings modified, they can affect more than one variable at a time. In this section we simulate the impact of a variety of settings on feasibility outcomes for the five case study developments with the aim of unpicking just how policy settings can impact developer decisions.

4.2.1 New construction methods and technologies

As discussed in Chapter 3, new construction technologies and processes have the potential to reduce direct construction costs and the construction period. Off-site modular construction and on-site assembly, BIM processes etc. can add cost savings and efficiencies, particularity when it comes to complex projects. Appendix 1 provides a number of case studies illustrating the impact of innovation on project outcomes. For more traditional projects, illustrated through the five case studies, research has yet to quantify just what impact new methods and technologies could have on project outcomes.

Below, we simulate two possible scenarios where construction costs and the construction period are positively affected by new technologies and processes. These are hypothetical examples as the case studies were unable to determine exact inputs to the model. What Table 9 does show is how reducing input costs and the construction period has a major impact on development feasibility when compared to the base scenario. For example, a 5 per cent decrease in construction costs and a 10 per cent decrease in the construction period for the land subdivision example would increase the IRR from 21.6 per cent to 27.3 per cent. The developer margin would also increase by 15 per cent. If a developer paid the land price of $10 million and was then able to implement cost and time savings, lot prices could be as much as 6 per cent lower to achieve the original IRR projection. Of course, if such construction methods were the industry standard, the developer could pay up to $12m to secure the land and still generate the 21.6 per cent IRR. The question remains, would any cost savings through new technologies and processes simply result in a higher price for the land, a higher profit for the developer or would it be passed on to the end consumer through lower prices? Chapter 2 discussed some of the possibilities, in particular whether a developer would price slightly lower than the market if it were to lead to a shorter sales period.

Table 9: Potential impact of new construction technologies on development feasibility

5% decrease in costs, 10% decrease in construction period	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
IRR change	26.3%	48.9%	46.3%	39.1%	38.0%
Developer margin change	15.4%	40.5%	33.7%	28.4%	26.0%
Change in end sales values to maintain IRR	-6.3%	-6.9%	-6.2%	-5.8%	-7.4%
Change in RLV to maintain IRR	20.8%	33.4%	28.4%	16.6%	36.8%

Source: Authors' calculations.

4.2.2 A more efficient development approval process

The overall length of the construction timeframe includes the actual period of physical construction and also the time leading up to construction commencement. As such, the time taken to secure development approvals has an impact on construction timeframes and will have an impact on all return measures, notably those impacted by time such as project and equity IRRs. Table 10 describes the impact of shortening the period to construction commencement to simulate a shorter development approval process within the five development case studies.

A more efficient development approval process, including planning, infrastructure and environmental approvals, which reduce timeframes have the potential to provide a major boost to project profitability. Not only is the construction period shortened, reducing the impact of cost escalation, but the sales period is brought forward meaning debt is paid off quicker. Finance and land holding costs also fall. There is a varying impact across the five case studies as the construction timelines vary, as do the input costs affected by shortening the timeline. In all cases there is a significant impact on the IRR, ranging from 12 to 22 per cent. This could mean the difference between a developer meeting or not meeting their hurdle rate of return. If a developer has factored into the feasibility model a defined timeframe to construction and has purchased the land on this basis, a subsequent shortening of the development approval process, assuming it occurs after land purchase, will have a positive impact on returns. Several factors will determine the extent of the positive impact, including: the timing of land purchase, the land purchase arrangements (such as a joint venture), and the structure of any finance.

Table 10: Impact of a reduction in period to construction on feasibility

Reduction in period to construction commencement	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
Original period to construction commencement	14 months	10 months	6 months	6 months	12 months
New period to construction commencement	8 months	6 months	3 months	3 months	6 months
IRR change	20.8%	14.1%	18.7%	12.3%	21.8%
Developer margin change	-0.2%	6.8%	9.0%	1.1%	5.0%
Change in end sales values to maintain IRR	-4.6%	-2.2%	-2.7%	-1.9%	-4.1%
Change in RLV to maintain IRR	16%	11%	13%	6%	22%

Source: Authors' calculations.

Any delay in the development approval process after land purchase will have a negative impact on profit outcomes and—if the developer is to maintain their projected hurdle rate of return—will result in higher end prices. Table 11 demonstrates the impact of a six month development approval delay. IRRs fall between 11 and 27 per cent, depending on the length of the original timeframe and other key variables. In order to compensate for lower returns, end prices would have to rise by between 3.5 and 5.4 per cent, so an impact of around $25,000 on a $500,000 dwelling. As noted, the ability to pass additional costs on to the end consumer will depend on the strength of local demand and supply of competing products. The analysis shows clearly how development delays have the potential to negatively affect affordability.

If the developer knew in advance of land purchase that the development timeframe would be extended by six months, they would need to pay between 10 and 22 per cent less for the land to maintain their original IRR.

Table 11: Impact of a six-month delay in development application approval

6-month delay in period to construction commencement	Land subdivision	Apartments	Townhouses	House and land	Mixed residential
Original period to construction commencement	14 months	10 months	6 months	6 months	12 months
New period to construction commencement	20 months	16 months	12 months	12 months	18 months
IRR change	-11.1%	-17.4%	-27.0%	-16.3%	-15.8%
Developer margin change	0.2%	-10.7%	-18.1%	0.5%	-5.9%
Change in end sales values to maintain IRR	3.7%	3.5%	5.4%	3.8%	4.4%
Change in RLV to maintain IRR	-11%	-15%	-22%	-10%	-19%

Source: Authors' calculations.

4.2.3 Developer contributions

Developer contributions to infrastructure take a number of forms, from basic infrastructure (such as roads, water, power and open space), through to broad community infrastructure (such as community centres and libraries and, occasionally, affordable housing). A recent report by the National Housing Finance and Investment Corporation (NHFIC) (NHFIC 2021) highlighted the lack of transparency and consistency, concluding that such contributions can amount to between $25,000 and $85,000 per dwelling in NSW and $29,000 to $42,000 in QLD, or 8 to 11 per cent of total construction costs (NHFIC 2021). Clearly such contributions can have a major impact on feasibility outcomes.

We model the impact of different rates of developer contributions on feasibility outcomes using the land subdivision and apartment case studies. The results are shown in Table 12. The analysis shows the impact of additional developer contribution requirements on the potential profitability of a development. The modelling simulated these increased costs, however, it should be noted, end sales were not amended to reflect the potential impact on sales prices. As noted by NHFIC *'Funding a much wider array of social infrastructure through developer contributions deliver broader community benefits but confer fewer clear, direct and immediate private benefits to new home buyers. This means developer contributions increasingly act like a tax on new housing, which can impede new housing supply and reduce housing affordability for buyers and renters.' (NHFIC 2021: 3)*

The original case study scenario for land subdivision had developer contributions at $25,000 per lot and delivering an IRR of 21.7 per cent with an average lot price of $271,743. A local policy change increasing developer contributions to $50,000 per lot would reduce the IRR to 12 per cent, which is well below the developer's hurdle rate of return. Any developer investigating the feasibility of the site with a fixed land price and this new level of contribution would determine the development unfeasible and walk away. The only way the developer could make the development work would be to pass the costs onto the landowner, reducing the original land price from $10 million to $5.75 million or to pass the costs onto the end consumer by increasing the price of the lot by $30,000. Alternatively, the costs could be split between the landowner and end consumer. Ultimately, this depends on the minimum price the landowner will accept and the maximum the market is prepared to pay for lots of this nature. In this scenario, if a developer had already purchased the land for $10m and a policy change resulted in increased contributions, the developer would either need to pass costs onto the end consumer or absorb the additional costs themselves, reducing their IRR to well below the rate determined acceptable for the level of risk.

Table 12 also shows how a reduction in developer contributions can make a development more feasible, and potentially making a previously unprofitable site profitable to develop. A reduction in developer contributions from $25,000 to $10,000 could increase the IRR from 21.6 per cent to 28 per cent or savings could be passed onto the end consumer with prices falling to $251,908 if the developer was willing to stick with the originally forecast IRR. Of course, this relies on a change in policy after land purchase. If it were prior to land purchase, much of the potential savings may end up in a higher land price with the developer able to bid up to $12.5m for the land and still deliver their original IRR.

Table 12: Impact of developer contribution increases on feasibility

	IRR	Land cost to maintain IRR	Net end sales price to maintain IRR
Land subdivision			
Developer contributions at $25k per lot	21.64%	$10,000,000	$271,743
Developer contributions increase from $25k to $50k	12.05%	$5,755,000	$304,832
Developer contributions increase from $50k to $75k	3.61%	$1,496,000	$337,922
Developer contributions fall to $10k per lot	28.04%	$12,543,000	$251,908
Apartment			
Developer contributions at $13,333 per lot	15.72%	$4,000,000	$501,482
Developer contributions increase to $20k	14.15%	$3,676,000	$510,217
Developer contributions increase to $30k	11.80%	$3,192,000	$523,288
Developer contributions fall to $5k per lot	17.69%	$4,402,000	$490,611

Source: Authors' calculations.

The apartment case study starts with a smaller level of developer contributions at $13,333 per lot. The outcome patterns are similar to land subdivision, but less dramatic. Developer contributions are, in relative terms, a smaller proportion of overall construction costs. This is due to the more capital-intensive nature of built form development in comparison to land subdivision. Regardless, an increase in developer contributions from the original figure to $20,000 would have a negative impact on the IRR. If costs we passed onto the end consumer, this would increase apartment prices from $501,482 to $510,217, an extra $10,000 for the consumer to find.

The analysis above shows how developer contributions can be an important factor in preventing housing supply. If developer contributions are set too high, developers may not be able to generate their hurdle rate of return and development would not occur. If, during the development process, local government tries to increase the level of contributions, this could have a negative impact on affordability, assuming the developer is able to adjust prices. Local governments that have a clearly defined and transparent contribution schedule, which developers can factor into their feasibility before land purchase are more likely to see development occur.

4.2.4 Density bonuses and Affordable housing contributions

Although inclusionary zoning is not widespread, there are some local voluntary schemes and some mandatory schemes within Australia (Gurran, Gilbert et al. 2018). Often density bonuses are attached to try and offset some of the revenue lost due to the provision of affordable housing products. Table 13 provides analysis of the potential impact of a density bonus on profitability. The model increases the number of lots or units by 20 per cent, and making adjustments to the remainder of the site. Unsurprisingly, an increase in the number of units increases revenue and therefore the IRR. Where a density bonus could prove problematic is when the size of the development triggers an additional cost due to a building regulation. For example, increasing the number of storeys in an apartment development may require the introduction of a lift or sprinkler system. This would increase costs significantly and may actually result in a reduction to the IRR.

In the five case studies, no additional costs are imposed so additional yield delivers a higher return outcome. The impact ranges from 32.7 per cent in the mixed residential development to 18.8 per cent for apartments. The positive impact would be much lower if costs were to increase, or revenue fell due to increased density. Conclusions can also be drawn about the impact of density restrictions at a set land cost, with any decision reducing the number of units on a site reducing the IRR. Outcomes are all dependent on the cost of the land. If the density bonus is approved after the developer has secured the land, then the IRR will rise, and the developer could potentially reduce end sales prices and still maintain the original forecast IRR. If landowners and developers know density bonuses are available on a site then the additional profitability of that site is likely to be capitalised into a higher land price, benefiting the landowner and certainly not the end consumer.

Table 13: Impact of density bonuses and affordable housing contributions on feasibility

IRR change	Land Subdivision	Apartments	Townhouses	House and land	Mixed residential
20% density bonus	18.5%	18.8%	26.4%	16.7%	32.7%
20% affordable housing contribution	-38.0%	-45.0%	-81.4%	-68.2%	-51.4%
Reduction in land cost to deliver AH at TRR	-26.5%	-44.4%	-51.2%	-20.4%	-35.6%
20% discounted market sale	-8.3%	-24.2%	-25.2%	-22.7%	-15.8%
Reduction in land cost to deliver discounted market sale at TRR	-0.6%	-29.7%	-17.3%	1.3%	0.8%

Source: Authors' calculations.

Table 13 also shows the impact of a 20 per cent affordable housing contribution on the original IRR. The model assumes 20 per cent of the market dwellings are instead transferred to a Community Housing Organisation (CHO) at cost so the revenue for the developer is simply the cost of delivering the units. The model assumes no negative impact on market sales prices. Although simplistic, the analysis clearly shows how a 20 per cent affordable housing contribution imposed on a developer after land purchase has a devastating impact on the IRR. It shows falls of between 38 and 81 per cent of the original IRR, depending on the size of the project and whether the project is land or built form. The only way a developer could sustain such as affordable housing contribution is for the requirement to be clear and transparent before land purchase and then the contribution can be taken off the cost of the land. As shown in the table, the price of the land would need to fall between 20.4 and 44.4 per cent in order for the developer to maintain the original IRR. The question is whether the reduced price would be sufficient to prompt the landowner to sell or whether they would hold out and wait for a change of policy to remove the affordable housing contribution.

An alternative affordable housing contribution is also shown in table 13. In this scenario, the developer sells 20 per cent of units at a 20 per cent discount on market value. These sales might be direct to consumers, to CHOs or government. The 20 per cent discount has a much less severe impact on IRR outcomes when compared to transferring units at cost. IRRs fell from their original level by between 8 and 25 per cent. Two of the scenarios, house and land and mixed use residential, still generated an IRR above the TRR so they would be considered feasible while a third, land subdivision, was marginal. These outcomes are shown in the final row of the table through the change in land cost required to deliver the TRR. The build form products, apartments and townhouses, showed substantial reductions in the original IRR.

Comparing the IRR change for the 20 per cent density bonus and 20 per cent affordable housing contribution, the density bonus would not deliver sufficient additional revenue to compensate for the affordable housing. However, it would certainly make a difference and allow the developer to pay more for the land and producing a scenario more likely to deliver housing. However, in most cases, the 20 per cent bonus would offset the lost revenue from a 20 per cent contribution, at a 20 per cent discount to the market.

The extent to which developments can absorb affordable housing contributions depends upon a number of issues, including: the structure of the development in terms of land or built form; the revenue that can be generated by the affordable land and dwellings; and the ability to cross subsidise from the market element of the site. If affordable housing requirements can be factored into the feasibility modelling from the outset and reflected in the offer price for the land, it is entirely possible for market developments to deliver affordable housing contributions profitably. If the developer has already purchased the land prior to the introduction of an affordable housing requirement the impact on profitability would need to be taken into account during negotiations. On government sites, adjusting the land price to ensure the development remains profitable (while still delivering a significant proportion of affordable housing) is an effective way to subsidise affordable housing supply. In the private market, the ability of developers to pass affordable housing contributions onto the landowner depend upon landowner expectations, and firm planning policy ensuring the site cannot be developed without such a contribution. Of course, some sites will never be able to generate a revenue sufficient to contribute affordable housing because of the revenue cost balance so policy needs to be sufficiently flexible to deal with such sites.

4.3 Summary

Due to the complexity of developments and the range of different development organisations and products, this analysis has assumed a relatively simplistic approach. It uses just one model of the development process, whereby land is purchased upfront with developer equity. The outcomes modelled here only reflect the potential return outcomes for this particular development structure. However, the analysis does present evidence of how policy settings can impact on development profit outcomes and how end sales prices could change if developers were willing to pass savings onto consumers. Further research could model different outcomes for a range of different development structures.

A major issue governing the impact of policy settings on profit outcomes is the timing of land purchase. If a developer is able to factor in all costs to their model, they can adjust the land purchase price to a level that will generate the required hurdle rate of return, whether the landowner will accept the price is another matter. If a developer pays too much for the land given cost and revenue inputs, profitability will suffer. Our analysis assumes the developer already owns the land and subsequent adjustments to costs and revenues impact on profit outcomes. However, it calculates the maximum purchase price for land necessary to maintain returns. There are complex patterns of land ownership. Many developers bank land and wait for it to be financially feasible to develop, while others purchase land for immediate development. As such, the timing of policy changes will have very different impacts on outcomes.

For example, the introduction of mandatory affordable housing contributions could deliver profitable development outcomes. This assumes that the developer could pass much of the cost onto the landowner and the landowner was still willing to sell at the new price. It would be a very different story if a developer had already purchased land and then had to absorb an affordable housing contribution. Such a contribution would need to come from potential profits. This goes some way to explaining the resistance to mandatory affordable housing contributions and why such a policy would need to take careful account of the characteristics of each site, so as not to stifle housing supply.

The chapter shows how policies that extend or shorten development timeframes, increase or reduce costs or stimulate demand can have a major impact on development profitability and therefore decisions to develop. There are policy levers available to stimulate housing supply by making it more profitable, with the impact of HomeBuilder a perfect example. Policy makers need to carefully consider the implications of new policy settings that increase costs, however well intentioned, on short term housing supply. While the industry can adjust over time, assuming landowners are willing to accept lower prices, the immediate implications for sites already in developer ownership are significant.

5. Policy development options

- **Policy settings that stimulate market demand will stimulate housing supply through increasing potential revenue and sales rates within development schemes.**
- **The development process is predicated around maximising the land price which, in turn, requires maximising revenue from sales. This benefits the landowner, not the end consumer.**
- **Certainty in policy settings reduces risk. New costs or taxes imposed during the development process will result in either reduced profit for the developer or will be passed onto the consumer where possible.**
- **Delays in development approval timelines are a major risk factor as they increase costs. Adequate resourcing of approval agencies and clear decision timeframes would reduce risk and aid development.**
- **Affordable housing contributions need to be known by a developer in advance of land purchase so they can be factored into assessments of profitability and land price. Imposing contributions post land purchase has a major impact on scheme viability. The market will take time to adjust.**
- **Reform to stamp duty has the potential to increase housing supply in the short term by increasing the potential profitability of sites through higher sales rates and revenue.**
- **Planning policy settings need to consider the economics of development to deliver the most effective supply outcomes.**

There is much debate around new housing supply and its impact on housing affordability. While many blame the housing affordability crisis on a lack of new supply, which in turn is blamed on a restrictive planning system (House of Representatives Standing Committee on Tax and Revenue 2022), others believe the decline in affordability is due to demand side pressures, pointing to a planning system that has delivered record levels of supply in recent years (Rowley, Gurran et al. 2017). What is missing from the debate is the role of private sector developers and how they make decisions to deliver housing supply in the first place. Noting the private sector delivers over 98 per cent of new housing, which is an increase from around 80 per cent in the 1950s. It is important to understand what drives developer's decisions to progress, and how government could stimulate the sector if increasing housing supply is a policy priority.

The recent HomeBuilder stimulus was an interesting case study in how the industry is able to respond quickly to a demand side policy, and the resulting fallout. Developers were able to accelerate land release in response to increased demand driven by generous grants, and planning systems across the country were able to accommodate such an increase in subdivision and homebuilding activity. The only constrains in the system were around materials and labour in some states. Of particular interest for this research is how the government delivered additional spending power to consumers, reducing the risk for the development sector leading to this increase in activity. Understanding development risk and how to reduce this risk is important for policy makers seeking to implement policy designed to increase housing supply. While an efficient development approval process is part of development risk, there are other important drivers that policy makers need to be aware about when debating housing supply and affordability.

5.1 What drives developer decisions?

Chapter 2 discussed how developer decisions to supply housing are based on the ability to generate a level of return commensurate with the perceived risk of the development. If developers are confident a site can generate their TRR they will proceed with the development, if it cannot, they will walk away. Development is complex. There are numerous reasons for this complexity, including the structure of development companies, how developers obtain their finance, landownership, the timing of land purchases and the delivery of infrastructure, and payment of taxes. Regardless of this complexity, there are a few clearly defined elements of decision making that hold true, and policy makers must understand, if they want to assess how policy settings will impact on developer behaviour.

5.1.1 Market conditions

Strong demand, rising prices, cheap, accessible credit and high levels of consumer confidence are the perfect conditions for developers. When assessing a site for development, developers will attempt to forecast the revenue they can generate from a site. As explained in Chapter 2, this is based on current prices of similar products in the market with some allowance for how conditions will change over the development period. If demand is strong, developers have confidence they will achieve predicted prices and almost as important, rates of sale that will deliver their required return. Strong market conditions stimulate development because they reduce risk by increasing certainty of revenue. It is the opposite in a weak market. No developer will embark on a project if they do not think they can sell the end product. Policies that stimulate demand (such as consumer grants, tax breaks and low interest rates) create conditions for profitable development, assuming there is an appropriate level of consumer confidence in the first place. Unexpected price rises during a development period will result in higher than anticipated profits for a developer. Indeed, such market movements can result in very profitable development. Conversely, unanticipated price falls during a development period can lead to significant losses.

Policy settings that force a developer to deliver a type of product unsuitable for a particular market will also mean no development. Again, if the developer does not think they can sell the end product in a timely manner, they will not proceed with the site. Trying to force density in an area where there is little demand for that type of product, usually because of competing product in the established market, will be unsuccessful. Also trying to force density into an area where prevailing prices do not deliver profitable development will also mean no development. Developers, and financiers, are also conservative in nature and like to see evidence of sales for a product that may be new to a market. This requires the first developer to take that extra risk before others follow. In such cases, development by the public sector can stimulate new product in an area.

5.1.2 Risk and return

There are a number of factors that developers consider when assessing risk and the level of return required to compensate for that risk. These include market conditions and costs that a developer in unable to fully predict in their feasibility modelling. Those settings that are fixed and easy to predict, such as anything related to tax, statutory fees and the actual physical costs of construction in normal markets, do not pose a problem and can easily be considered during the modelling process. It is those factors that may vary after a developer has set the development process in motion, which is problematic. Unforeseen delays can cause an increase in costs, a decrease in revenue, and a lower than expected return. These delays may be caused by slow development approval processes, unexpected infrastructure costs, labour and supply shortages, weather events and changes to design requirements. Anything outside the developers' control is a risk factor. The greater the certainty in development, the more likely it is a site will be developed.

The development industry lobbies at length around the costs of urban regulation and taxes in their submissions to government. However, the majority of these costs and taxes are quantifiable and can therefore be factored into price paid for the land (Murray 2021). It is only when new costs are introduced, or existing costs increase, after a developer has conducted their feasibility and purchased the land that return may be affected. In this scenario, developers may attempt to push additional costs onto consumers, if market conditions allow them. The situation is complicated by land ownership issues as policies may change well after a developer has purchased the land and this can affect profitability, but in a stable policy environment the costs should be accounted for in the purchase price of the land rather than higher end prices. However, that assumes an open and transparent land purchasing process and that landowners are willing to absorb such costs.

5.1.3 Landowner expectations

The residual theory tells us that land gets what is left over after costs and profit are taken from revenue. If a developer properly accounts for all costs, and is accurate with revenue predictions, the price offered to the landowner will depend on the developer's required return. If the residual is high enough to stimulate a sale, development can proceed. Developers will offer different land prices based on their return requirements and modelling of inputs. The highest offer should prevail. Only unexpected costs added to development after land purchase, changes to end sale prices or an increased development timeframe will deviate end returns from the predicted outcome. Complexity arises through the myriad of ways that developers can purchase land and the fact this method of land pricing requires developers to maximise potential revenue otherwise they may be outbid by competitors. Given developers take prices from the established market, the whole development process is predicated around maximising the land price. This benefits the landowner, not the end consumer.

Reducing the land cost input could enable a developer to deliver a dwelling product to the market at a lower price. However the prices of new dwellings are generally set with reference to the comparable products in the local market, meaning there is little incentive for the developer to price below market other than to increase sales rates.

If policy makers really wanted to make new housing more affordable, they could impose a maximum price per hectare on development sites. In theory, this would allow a more affordable product to be delivered, as one of the main cost inputs is controlled and reduced. In practice this would probably distort housing markets, stifle housing supply and fail to benefit anyone.

In a competitive land bidding process, there is no way to deliver an end product below prevailing market prices, unless costs can be cut, simply because the price offered for the land will be too low. An expression of interest process or land advertised on the market is likely to result in the highest offer price prevailing. If a developer is able to purchase 'off-market' they have a higher chance of negotiating a land price that may be below the maximum calculated through modelling, and therefore more likely to be able to adjust end sales prices.

Landowners are well aware of prevailing market values in an area, and will often engage consultants who adopt similar feasibility modelling processes to come up with what they believe is a realistic price. Add additional costs into the development process and a developer may not be able to meet the landowners price expectations. This may prevent development on a site until the landowner lowers their expectations or a developer is somehow able to reduce costs or predict a revenue higher than competitors.

In a market where landowners are looking to secure the maximum possible price, there is little scope to deliver affordable housing options or simply any development that does not conform to the traditional expectations in which the landowner's price requirements are based. The only way for a developer to deliver a more affordable product outside negotiating a lower price is to accept a lower return, reduce direct development costs and/or shorten the development period. Alternative land ownership structures such as joint ventures between the developer and landowner and/or profit-sharing arrangements or deferred land payments, offer alternatives to the traditional maximum land price model and could deliver more affordable products. Any land that is secured 'below market' has the potential to deliver products below a revenue maximising position and still deliver the developer their required return.

This raises the issue of land value uplift taxation to deliver community benefits such as affordable housing. The current model of determining land purchase price benefits the landowner rather than the developer, although the developer may be the landowner if they have been banking a piece of land during any policy change. Introducing clear policies that require contributions from market development sites can yield significant community benefits over time (see for example Crook, Henneberry et al. 2016). The UK model of affordable housing delivery, for example, while much changed over time, still delivers affordable housing contributions with the developer factoring such contributions into the price paid for the land (Crook and Whitehead 2020). Stronger market conditions mean affordable housing contributions as land values increase. While there is considerable site by site negotiation around what level of affordable housing a site can deliver, policy clarity delivered outcomes over time as developers adjusted to the requirements. Any attempt to introduce mandatory affordable housing contributions from market sites in Australia would require very clear policy, a long lead in time to give the industry time to adjust, and a clear framework for assessing realistic site by site contributions based on a range of site-specific issues.

5.1.4 Cost certainty and price setting

If developers are certain of the direct costs of development, which includes taxes, infrastructure contributions, statutory fees and construction costs, they are confident around their feasibility modelling prediction. The final unknown is then the revenue they can generate from the end product. Unexpected cost increases post land purchase will need to either be absorbed by the developer in the form of lower profits or a higher revenue is necessary to absorb the costs. Chapter 4 calculated the type of revenue increases required to compensate for a variety of scenarios. For example, a 10 per cent increase in construction costs would require a 5-–7 per cent increase in end sales prices in order to maintain the original IRR. In some cases, developments will be profitable enough to absorb unexpected increases with a predicted IRR well above their TRR, but in a competitive development industry these are the exception rather than the norm and usually restricted to sites a developer may have purchased prior to re-zoning and/or off-market.

While the development industry often states that increased costs resulting from policy requirements will end in higher prices for the end consumer, the ability of developers to pass on these costs depends on market conditions. If consumers are prepared to pay the price set by the developer, the costs can be passed on. If not, the developer will have to sell at a price that may mean they are required to absorb some of the costs. In a market with strong local supply and weak local demand, a developer will be lucky to maintain prices predicted at the start of the development process let alone increase prices to absorb costs. In a high demand market with weak local supply, it is arguable that prices would have increased in any event driven by the market, so the decline in affordability is less about pushing costs onto consumers and more about market driven price increases.

It is too simplistic to assume that all development is profitable enough to absorb additional costs imposed by new policy, but it is also not the case that such costs will automatically result in declining affordability through higher prices. Policy makers need to understand that every site is different, and the impact of new policy settings will be determined by the characteristics and forecast profitability of the site, and also prevailing market conditions at point of sale.

5.2 Policy settings and developer decisions

The analysis in Chapter 4 examined how changes to key input variables affected return outcomes. The modelling outputs can be summarised as follows:

- Small increases or reductions in end sales prices have major implications for IRR outcomes. A 10 per cent change in revenue can mean a 50 per cent drop in the IRR. This means revenue is the biggest risk factor in the development process.
- Small increases or reductions in direct costs of construction can also have major implications for returns. A 10 per cent increase in costs can mean a 40 per cent reduction in the IRR.
- Significant reductions in the time taken from the commencement to completion of construction can have a positive impact on feasibility. Even a one or two month reduction in a 24 month build time can mean the difference a profitable and unprofitable development.
- An increase in the time taken for development approval after land purchase will have a modest, negative impact on return outcomes. The longer the delay, the greater the impact.
- Developer contributions over and above those factored into the original purchase price can have major implications for profitability. For example, doubling the per unit contribution can halve the IRR.
- Affordable housing requirements introduced prior to land purchase have major negative impacts on development returns. Such contributions cannot be factored into the price paid for the land, so they have to be absorbed by the developer. A 20 per cent affordable housing requirement can reduce an IRR by as much as 80 per cent depending on the size and type of product. Density bonuses can offset some, but not all of the reduction in revenue, again dependent on the type and scale of the product. The less subsidy required in the affordable housing contribution, the lower the impact on the IRR.
- Policy makers need to be aware of how changes to policy can affect housing supply, particularly on those sites already owned by developers. For new sites, as long as the landowner is open to negotiation and has realistic expectations, developers can adjust to new settings through the price paid for the land. So, what do policy makers need to consider when developing new policies to deliver housing supply? Rowley, Gilbert et al. (2020) discussed what government can do around site availability and urban regulation to encourage new supply. Here we discuss more broadly how policy settings can affect profitability and therefore a developer's decision to develop.

5.2.1 Stimulating the market

If governments are to use demand side grants to stimulate housing markets in the future, they must learn from HomeBuilder and the capacity and the industry's response to sharp demand increases. While local planning authorities have mostly accommodated a big surge in development activity, most new build activity has been generated through detached dwellings, usually less problematic when it comes to development approvals. Smoothing housing supply over a longer period rather than a Homebuilder-like rush would help the industry cope and avoid capacity constraints. A stimulus scheme operating across the entire industry, rather than concentrating on detached homebuilding, would also be more equitable. But what HomeBuilder has shown is that grants are an effective way of boosting housing supply in the short term and bringing forward development activity reliant on greater certainty and improved market conditions.

5.2.2 Inclusionary zoning

The introduction of affordable housing contribution requirements through inclusionary zoning can have a major impact on development feasibility. While density and height bonuses can help replace revenue, the developer needs to be able to pass costs onto the landowner and that means knowing well in advance what such requirements are likely to be. It will then be up to the landowner to determine if the resulting land price is sufficient to simulate a sale. On smaller sites, the land price could fall by as much as 50 per cent if there is no capacity to increase the number of market units. Other consequences of on-site affordable housing contributions could be felt through revenues and sale rates. Policy makers need to be conscious of the impact of such policies on development profitability and ensure they do not stifle supply. Such policies have proved to be effective in the UK, and in Australia on a smaller scale (see Gurran, Gilbert et al. 2018). Carefully designed schemes, long lead in times and flexibility around site by site negotiations are essential. Such mandatory affordable housing contributions are the most likely source of large-scale affordable housing contributions in Australia. Many sites would be able to absorb the costs of such delivery under a well-constructed and consistent policy.

5.2.3 Taxes and infrastructure

Policy makers should be aware of the impact of new costs on development and should make allowances for sites where such costs have not been factored into feasibility calculations. Government should avoid last minute developer contribution requirements and instead have a transparent developer contribution plan in place.

The costs of upgrading local infrastructure can prevent development so governments need to determine whether there is merit in funding, or at least co-funding such infrastructure or otherwise risk no development occurring. This is true of both infill and greenfield sites, and upfront investment in infrastructure can unlock sites for development where otherwise the upfront costs for developers would result in the site being unviable. A strategic approach to infrastructure investment to ensure a steady supply of developable sites is essential.

Industry bodies such as the UDIA, PCA, HIA and MBA have been calling for tax reform for a number of years. Stamp duty is widely perceived as a barrier to household mobility impeding transactions. From a developer's perspective, the upfront stamp duty on land purchases add to costs. The removal of stamp duty would likely boost demand, increasing sales rates and impacting on end sales prices. Certainly, the removal of stamp duty would have a positive impact on development industry activity by reducing end sales risk. Foreign duty surcharges also impact the development industry by making it harder to secure sales, particularly pre-sales for apartments. In some developments this will impact viability.

For governments looking to stimulate housing supply, reducing tax costs for developers would improve profitability and could stimulate supply. For example, land tax has major implications for long term projects.

There is much discussion around the potential for build-to-rent development providing a vehicle for institutional investment in the residential sector, and delivering a supply of private rental accommodation. Industry highlights land tax and Managed Investment Trust tax settings as a barrier to such development[4]. Reform to these settings could deliver a boost to the industry by improving the financial viability of such schemes. Build-to-rent schemes have existed for many years in the form of CHO-developed social rental dwellings with tax concessions, and often capital grants, essential for such schemes to be viable.

4 https://info.propertycouncil.com.au/property-australia-blog/build-to-rent-insights?utm_campaign=2020_NAT_PROPERTY%20AUSTRALIA&utm_medium=email&_hsmi=167127157&_hsenc=p2ANqtz-9c6aUhML0imzxo_8IYbxLINgIGGIdHXSyxhRqznKfxkUvCu0vjZyA2mXu789Zttut7ydxE9ELC--tW_STadDx52QX2eQ&utm_content=167127157&utm_source=hs_email

5.2.4 Urban regulation

To operate efficiently and deliver housing supply where it is most needed, the development industry needs a steady supply of sites that are financially viable to develop. This requires long term strategic thinking by all levels of government and a mechanism where investment in infrastructure is shared between government, landowners and developers. Improvements to strategic planning and investment in infrastructure was one of several areas highlighted by the UDIA in their submission to the House of Representatives Standing Committee on Tax and Revenue's inquiry into housing affordability and supply[5].

The general complexity of the regulatory system with multiple layers of plans and approvals adds to uncertainty as a development could be blocked or changes required, at any time. Timeframes can slip, which impacts on development viability. The growing complexity of the environmental approvals process state by state adds to development risk and can be a barrier to supply. Improved clarity of procedure and defined timelines can reduce risk for the developer.

The efficiency of the planning system was highlighted as a major issue by interviewees in this research and is a factor that creates uncertainty. Industry lobby groups highlight planning reform as necessary to deliver more housing supply. The planning system has proved to be responsive in times of strong demand, accommodating very strong periods of building approvals, highlighted in the last 18 months by HomeBuilder driven supply. However, there can be blockages within the numerous agencies that are part of the approval process, with infill development being the most complex. Adequate resourcing of referral agencies and defined timelines can help reduce uncertainty as highlighted by the UDIA WA State Budget submission[6].

Appropriate zoning that considers market demand is another important factor in stimulating development. Over or under zoning can prevent development; over zoning by overestimating the revenue that can be generated by a site and under zoning by not realising a site's development potential which may result in the landowner being unwilling to sell. Consideration for the economics of development within the planning framework is essential. This is also the case for any proposed inclusionary zoning policies.

Changes to national construction codes and local design guidelines can also add to costs and make certain types of development in certain local markets unviable as prices are too low to generate a profit for the minimum development cost.

Improvements to strategic planning and investment in infrastructure were areas highlighted by the UDIA and HIA in their submissions to the House of Representatives standing committee on tax and revenue's inquiry into housing affordability and supply[7]. Calls for a more streamlined planning process in addition to infrastructure investment programs designed to effectively promote new housing supply represent a common theme in many submissions (HIA 2021; UDIA 2021; Eslake 2021).

For example, the HIA submission calls for governments to maintain a rolling minimum of 15–25 year forward land supply for housing in metropolitan areas (HIA 2021). To bolster industry confidence, transparency, routine review of supply targets and regular reporting of allotments were highlighted as key areas where improvement is required.

5 https://udia.com.au/wp-content/uploads/2021/09/210913-UDIA-National-Submission-to-House-of-Representatives-Standing-Committee-on-Tax-and-Revenue.pdf
6 https://www.udiawa.com.au/wp-content/uploads/2021/07/State-Budget-Submission-2021-22.pdf
7 https://udia.com.au/wp-content/uploads/2021/09/210913-UDIA-National-Submission-to-House-of-Representatives-Standing-Committee-on-Tax-and-Revenue.pdf

The HIA submission also covered suggestions around infrastructure, planning and tax. To ensure infrastructure funding is shared more equitably across the community, HIA suggests a range of funding options that include: 'general revenue, government borrowings, issuing tax effective infrastructure bonds, public-private partnerships, general levies across the whole community, or user charges' (HIA 2021: 8). For HIA, the relationship between planning approval and building approval for residential developments on land zoned for residential purposes is in need of a review (HIA 2021). Under current conditions, constraints on land use can arise at any stage of the supply pipeline, including after land has been zoned for residential development. To address the additional risk and uncertainty this poses to developers, HIA calls for greater certainty in the application of planning controls on residential land, while also disclosing all known constraints that governments intend to apply.

In terms of tax, HIA suggest the Australian Government facilitate a dialogue through the National Cabinet process to identify and develop an appropriate approach that would support state and territory governments to either reform or remove stamp duty (HIA 2021: 16). By a similar token, Eslake calls for the abolition of negative gearing for investors, citing that the policy has distorted the allocation of capital, undermined the equity and integrity of the income tax system, and has exacerbated the mismatch between the demand for and the supply of housing (Eslake 2021: 24).

5.2.5 New construction technologies

New construction technologies and processes have the potential to reduce costs and timeframes, and this research presents some examples of these technologies. Direct reductions in costs and timeframes could improve housing affordability assuming the cost savings do not end up in a higher land price for landowners. New technologies, particularly lightweight construction, have the potential to open up sites not previously developable due to the costs of preparing the site for construction. While some lenders remain reluctant to lend on innovative construction methods due to a lack of evidence around market acceptance, the growing number of projects using alternative methods will overcome this issue. Increased use of new methods within public sector projects, demonstrating success, will accelerate the uptake of such innovations. The surge in development activity resulting from COVID-19 stimulus measures has resulted in supply shortages for material such as timber and steel frames and labour shortages such as bricklayers, in WA at least. Having a greater variety of construction methods available can help overcome such supply blockages when material shortages do arise for a particular product.

5.2.6 COVID-19

COVID-19 has affected work practices on-site and lockdowns have caused delays in construction. Both factors increase costs for the developer. In the current market environment where dwelling prices have risen sharply, these costs are largely off-set by increasing revenues, unless prices are locked in through pre-sales. However, governments should be aware of the impact of COVID-19 on current development projects. The increase in HomeBuilder stimulated building activity will feed through the system in the next 12–18 months, while the record surge in prices of the last 12 months[8] will stimulate new supply through increases in projected revenue, unless there are other market factors at play. Uncertainty remains around what will happen once Australia fully reopens its borders and populations are free to move.

What seems to be a COVID-19 driven housing demand surge has benefited the housing industry, but not without affordability implications. Record loan approvals have created some concern about an overheated market and a softening of lending standards. The cost and availability of credit is a key driver for the development industry as it fuels housing demand. The risk appetite of banks is also important when it comes to providing development finance. Policy makers needs to strike a balance between the economic benefits of a strong housing market, the affordability implications and the sustainability of the current lending environment.

Rising prices and changing patterns of housing demand driven by COVID-19 create new development opportunities and new challenges for policy makers. Ensuring adequate land supply and supporting infrastructure to cope with demand pressures in regional areas is essential to allow the development industry to respond.

8 https://www.corelogic.com.au/news/september-2021-home-value-index?utm_medium=email&utm_source=newsletter&utm_campaign=20211005_propertypulse

5.3 Final thoughts

The development industry is incredibly complex made up of hundreds of different organisations with a myriad of different structures. As such, a project such as this can only take a broad-brush approach to highlight the impact of a range of settings on traditional approaches to development. The general findings show the importance of market conditions in driving supply and how factors such as infrastructure costs, delays in development approvals and construction timelines have a negative impact on development profitability if they cannot be factored into a developer's assessment of site value. Factors that are certain to the developer, such as taxes and construction costs, can be considered in their decision to develop, it is the unknowns that developers fear. Clear and consistent policy, certainty in development timeframes and policy advice create the ideal conditions for development. The rest is dependent on market conditions.

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Appendix 1: Construction innovation case studies

This appendix presents details of six case studies using construction and process innovations. The case studies are designed to illustrate the potential for time and cost savings which, in turn, can reduce the cost side of the feasibility equation and potentially make development project more financially feasible.

Case Study 1: Skaio Apartment Building, Germany

Name	Skaio Wooden Apartment Building
Location	Heilbronn, Germany
Development	Public-Private partnership (40% subsidised by the government)
Area	5,685m^2
Project Commencement	2018
Project Completion	2019
Contract Value	€ 15.4 Million

Figure A1: Skaio Wooden Apartment Building - Germany's first and tallest wooden high-rise building as of end of 2019

Source: Archdaily 2020.

The project is developed from re-conquered timber, designed in the mode of DfMA with careful selection of sub-elements to suit. The following applies:

- Materials for the construction of the building were drawn largely from advanced (proprietary) wood technologies, re-innovated with hybrid construction methods.
- The objective of the project is to optimise climate-friendly construction, using timber as the main raw material with minimum treatment.
- Completion was 'fast', precise and of a high construction quality. 11 floors of a gross floor area of 5,685m^2, commenced and completed between 2018 and 2019.
- Prefab further assured safer off-site working conditions and advanced craftsmanship with long-standing, indispensable knowledge.
- Inclusion of wood is intended to achieve pragmatic ways of use instead of its visual presence.
- The project delivered a range of different dwellings from 1 bedroom studios to 3 bed apartments.
- Timber concrete composites were used in slabs, as prefabricated walls, and structurally as laminated timber used in building frames.

This case study provides evidence to the relationship between innovative construction technologies and positive project outcomes; in that, the DfMA approach implemented in the building allowed an efficient optimisation of project value as clients were able to inspect module units before installation. Time saved during construction implies significant saving in time-related, and sometimes method-related, components of project costs. For example, what took 40 weeks to complete in this case study could take up to 200 weeks to complete in a wet in-situ equivalent. In terms of savings, this could account for up to 80 per cent saving in site fencing costs, scaffolding costs, insurance of the works, equipment costs, supervision overhead, cost of finance, site office, amongst others. No least important, the cost saving of the 1,200 metric tons of carbon dioxide exuded in the project outweighs any immediate savings that a concrete or steel alternative may offer.

Case Study 2: The Via Verde, New York, United States of America

Name	Via Verde
Location	New York, USA
Development	Private
Area	26,942m²
Project Commencement	2010
Project Completion	2012
Contract Value	$98.8 million

Figure A2: The Via Verde, a LEED NC Gold certified project

Source: Rudy Bruner Awards, https://grimshaw.global/projects/via-verde-the-green-way/

Designed in 2006 by Grimshaw, the Via Verde won the first juried design competition for affordable housing in New York City. The design was adjudged to set new standards for the sustainable design of affordable housing and healthy living principles, with a deliberate intention to become a model for future development in the city.

- The project is a redevelopment of a brownfield site that required significant environmental remediation.
- The design is an attempt to provide sustainable design for affordable housing that supports and improves the social conditions and health of residents, by promoting physical activity.
- A housing complex is a 222-unit facility, located in the Melrose section of South Bronx. It sits on a difficult parcel and created a series of open green spaces connecting multiple residential buildings.
- The facility is mixed-use: an unusual mixture of owned and rental units comprising 71 workforce housing co-operatives, and 151 low-income rentals.
- The building consists of a 20-storey tower, a mid-rise building with duplex apartments and town-houses. The project Integrates sustainable design into affordable housing that represents both cosmopolitan community and urban context.

- To cut costs, on-site parking requirement for residents was eliminated via special mayoral approval.
- The facade targets high performance by using pre-fabricated rain screen with composite wood, cement and metal panels. Value engineering of the project noted significant loss due to use of more metal and less wood on the exterior panels.
- Cost per dwelling unit was higher (5 per cent) but it was justified by the virtue of its value as a model and demonstration project.
- The project targets reduced construction and operating costs by eliminating all on-site parking and delivering energy-efficient design.
- While high-rise residential towers employed conventional cast-in-place concrete construction, low and mid-rise components of the building used a block-and-plank structural system.
- The building's prefabricated screen system hybridised insulation. In addition, moisture proofing and windows along with the cladding were delivered to site in modular sections.
    a. The windows created an open façade which redefined aesthetics for public housing.
    b. The exterior rain screen that enveloped the entire building innovated a new appearance for affordable housing.
    c. Subtle colour variations on metal cladding and wood accents on the brick-concrete base gave a modern and reflective appearance.

Innovation is emphatic in the design, the construction and use of the facility. Modular construction ensured development timelines were efficient. To complete 222 multi-rise dwellings within 2 years is evidence in this. The facility harvests its energy from the sun: the design vernacular of the facility defines the true cost and the true sense of affordability as opposed to dollar value; in that, the cost outlay was for the present and the future, in which innovation is combined to co-produce some facility outcomes that define efficiency and value throughout the project's lifecycle, rather than short-term immediate savings in construction costs.

Case study 3: Puukuokka Housing Project, Jyväskylä, Finland

Name	Puukuokka Housing Block
Location	Jyväskylä, Finland
Development	Private
Area	18,650m²
Project Commissioning	2011
Project Completion	2015 (Phase 1 comprising 54 flats); 2016 (Phase 2 & 3; 96 flats).
Contract Value	€2,400/m² (area of dwellings only)

Figure A3: Housing Block, Jyväskylä; Finland's first cross laminated timber (CLT) constructions

Source: https://oopeaa.com/wp-content/uploads/2014/05/Puukuokka_portfolio_long_A3_161122_.pdf

Puukuokka project supports social sustainability through lease-to-own financing strategy by providing affordable products. Its functional space is attractive to users through its unique architectonic expression and sustainability credentials. Puukuokka project is the first cross laminated timber (CTL) project of 6-8 storeys in Finland, made into single-family dwellings and a semi-public character of its shared spaces

The following are the specific characters of the project:

- The entire load bearing structure and frame is made of prefabricated volumetric CLT modules of 150 flats and 4,650m² shared spaces.
- Its wooden facade elements are prefabricated and assembled on-site. The insulating qualities of massive wood allow for controlling the temperature of individual apartments independently from the hallway.
- Prefabricated modules were fully prepared and finished in controlled indoor conditions in consideration of on-site adjustments.
- This site and construction-ready modules only required a simple plugged-in-like assembly system similar to Lego construction.

- Easily programmable as per the progress of the installation of modular elements; the prefabricated façade with finishes were installed on-site in phases.
- This coordination among parallel processes achieved a higher quality in the end result as opposed to traditional construction process.
- The central hallway being the only on-site construction, the construction time was cut down to six months, a major advantage in the Scandinavian region.
- Double merits of combined modularisation and prefabrication assured uniform, a high standard of quality and minimized delays (including weather-related issues on-site).
- The modular cubical elements made of cross-laminated timber are dry, adaptable, lightweight and ready to install. The safety and medical advantage of this is significant.
- Modular construction reduced the installation flaws as the components were more dimensionally stable under fluctuating moisture conditions.
- Stakeholders were able to drive project value by participating in the design and modular constructions, effectuating valuable changes and outturn conditions until they have achieved satisfaction with the ready-to-install product.
- To accommodate the needs of the project, the town plan was amended and thus considered only a part of the shared spaces in calculating permitted building area.
- The building complex is built on a concrete foundation with indoor parking spaces offered on the basement level.
- Piloted through a low-cost, low-risk financing model for homebuyers, the state guaranteed a bank loan on a modest down payment.

In summary, CLT technology provided the bases for the design and construction with engineered timber. Project outcomes were such that stakeholders were able to drive specific objectives of sustainability with finance, quality, attraction, safety value and minimal environmental impact of both the construction and the use footprint of the project. The modular construction method used did not only cut the construction period by six months (which has a significant on-cost value), there were additional benefits in the projects as clients were able to drive their own value by being sure of their outcome before on-site installation. The project turned out a cost-friendly outcome that the public could support as well as a national legacy of reputation in terms of technology (CTL), processes (modular, fast construction) and satisfaction (limited environmental footprint, pre-installation certainty and opportunities for co-production).

Case study 4: Tynte Street Apartments, Australia

Name	Tynte Street Apartments, Australia
Location	North Adelaide
Development	Private
Project Commissioning	November 2018
Project Completion	December 2020
Contract Value	Final Budget - $37,000,000

Figure A4: Tynte Street Apartments, Australia

Source: https://majesticmsuites.com.au/photo-gallery/#gallery-2

This is a new development project from the original Channel 9 site in North Adelaide. In this project, the precast construction method and structural steel combined with bondek has been widely used. This has saved time and cost extensively.

- Foundations – All footings was Piled from ground level before bulk earthworks commenced. Bases/Pilecaps was done after basement was excavated.
- Retaining walls – The Northern and Eastern Boundaries was done with retaining piles from ground level before excavations commenced. This provide the lateral support for the neighbouring properties as well as the vertical loadbearing capacity for the structure. The balance of the retaining walls was done by conventional strip footings with Pre-Cast Retaining walls placed on them.
- Basement Structure – The Basement structure was a conventional concrete columns and frame with Precast Cores and Precast perimeter walls to provide lateral stability.
- Above Ground Structure – This was a conventional steel column and beam construction with bondek formwork to slabs. The concrete floor was bonded to the steel structure with the use of Shear Studs to allow the structure to work together. Lateral stability was achieved through the use of concrete precast core areas and specifically located shear walls through every floor.

- Roof – The Roof was structural steel – The stair and lift shaft precast runs through the roof and provides the required lateral support for the structure
- The use of the bondek and steel reduced the over all weight of a conventional concrete frame structure, therefore reducing the cost of the weight bearing footings and piles. The use of steel columns, beams and precast makes the erection of the structure quicker as all of the components can be manufactured off site which allows production in a controlled environment, better production and quality control would be applied and then only erecting required on-site. It allows these components to be manufactured and stored until it is required on-site.

When it comes to material selection it becomes important to consider the initial capital cost and ongoing cost that might influence the ongoing cost for holding the building. – Examples are precast – the contractor could use normal precast and then paint it or the contractor could use Coloured precast. The contractor got the initial saving on the normal precast but will have budget to repaint the building in 10 years' time – if the contractor use coloured precast it would cost more initially, but the contractor would not have to paint the walls.

Case study 5: Lewisham Exchange, UK

Name	Lewisham Exchange
Location	London
Development	Private – affordable housing and student housing
Project Commissioning	2019
Project Completion	Estimated August 2021
Contract Value	£118 million

Figure A5: Lewisham Exchange, UK

Source: Courtesy of Tim Witt.

This is a student apartment developed by Vita Lewisham 2 Ltd (Vita Group). Contractor on-site is Tide Construction, Modular Contractor is Vision Modular and Architect is JTP. It is the highest modular student accommodation building in Europe. This is 1 x 35 storey tower containing student accommodation and 1 x 20 storey tower containing affordable housing and student accommodation. This was a large, modular construction utilising such construction methods to reduce risk of delays. As the modules start in the factory so much earlier than are require on-site any factory delays are not on the critical path unless there are huge factory delays. Other advantages:

- On-site program risk is reduced as internal fit out and windows are completed off-site. On-site weather risk is reduced with modular build.
- Earlier return on investment for the developer.
- More security on cost budgets.
- Reduced finance costs for the developer due to reduced construction program.
- Improved quality assurance processes as most works are installed in a controlled factory type environment.

- Less site labour as approximately 60 per cent less required on-site and 80 per cent fewer site vehicles.
- Generally greener and less pollution with modular built items.
- Safer working environment in the factory.
- Fire detailing installed in a more controlled environment.
- Lower construction waste by approximately 80 per cent.
- 97 per cent of materials are recycled.
- CO_2 emission saving of approximately 50 per cent.

There were also challenged associated with the development:

- Getting risk adverse funders on board with the modular process.
- Advanced payments required for works completed in factory.
- COVID-19 pandemic labour issues. This was very challenging and the modules in the factory went from being four months ahead to getting completed just in time.
- COVID-19 pandemic material supply issues.
- Council imposed district heating network system and the associated legal processes.

Case study 6: Hotel Indigo, Australia

Name	Hotel Indigo
Location	Adelaide
Development	Private
Project Commissioning	January 2019
Project Completion	December 2020
Contract Value	$80 million

Figure A6: Hotel Indigo, Adelaide

Source: Courtesy of Daniel Oteng.

The development used a bubble deck approach which is a floor system throughout the structure, and it was used on twelve of the sixteen stories. It helps to reduce the weight in each floor slab, it uses less concrete and can reduce the whole building weight which obviously helps reduce footing and compiling cost and can build taller with it. Bubble deck was recommended for cost savings

Wherever elements are fabricated offsite it helps with needing less labour on-site and manufacturing is more streamlined. The furnishing and joinery came onsite pre-assembled, and the contractor just had to fix it in place. When the contractor manufactures something offsite it reduces construction waste, and it is easier to recycle it. The services were coordinated using BIM for the design.

The site location meant the contractor didn't really have any lay down area and the luxury to store materials onsite which caused logistical issues.

The building has got quite a complex Building Management System (BMS) and all the vin cards the one that the hotels guest scans his card in, all of the electronic smarts for the whole room and the lights, tv's, air-conditions, all run on this one control panel in there and that is all linked into the guest's card that is the key cards so that when the swipe in, the aircon and the lights turns on and when they leave the room a sensor within fifteen minutes scans the room to make sure there is no one left in the room and then it will shut itself down. That would have been a big upfront cost to the hotel, but they will see it as a huge money saver in terms of cost savings.

Appendix 2: Case study site feasibility outcomes

Land Subdivision – 200 mixed lots	AUD
Revenues	
Gross Sales Revenue	64,845,594
Residential	64,845,594
Less Selling Costs	(4,601,861)
NET SALES REVENUE	60,243,732
TOTAL REVENUE (before GST paid)	60,243,732
Less GST paid on all Revenue	(5,895,054)
TOTAL REVENUE (after GST paid)	**54,348,678**
Costs	
Land Purchase Cost	11,000,000
Land Acquisition Costs	820,490
Construction Costs (inc. Contingency)	23,339,726
Townhouse	10,452,306
Houses	9,342,607
Larger	2,865,015
Contingency	679,798
Professional Fees	2,075,556
Statutory Fees	5,493,167
Infrastructure surcharges	466,795
Project Contingency (Reserve)	931,345
Land Holding Costs	475,210
Finance Charges (inc. Fees)	368,333
Interest Expense	976,844
TOTAL COSTS (before GST reclaimed)	45,947,466
Less GST reclaimed	(3,872,276)
TOTAL COSTS (after GST reclaimed)	**42,075,190**

Land Subdivision – 200 mixed lots	AUD
Net Development Profit	12,273,489
Development Margin (Profit/Risk Margin)	**26.29%**
Residual Land Value	12,269,381
Net Present Value	**701,376**
Project Internal Rate of Return (IRR)	**21.64%**
Residual Land Value	10,695,840
Equity IRR	24.99%
Equity Contribution	11,820,490
Peak Debt Exposure	17,579,215
Equity to Debt Ratio	60.71%
Weighted Average Cost of Capital (WACC)	6.89%
Breakeven Date for Cumulative Cash Flow	Nov-2022

House and Land – 20 units	AUD
Revenues	
Gross Sales Revenue	13,606,233
Residential	13,606,233
Less Selling Costs	(791,049)
NET SALES REVENUE	12,815,185
TOTAL REVENUE (before GST paid)	12,815,185
Less GST paid on all Revenue	(1,236,930)
TOTAL REVENUE (after GST paid)	**11,578,254**
Costs	
Land Purchase Cost	3,000,000
Land Acquisition Costs	198,000
Construction Costs (inc. Contingency)	6,035,140
Residential Construction	5,916,804
Contingency	118,336
Professional Fees	370,641
Statutory Fees	20,099
Project Contingency (Reserve)	254,280
Land Holding Costs	275,000
Pre-Sale Commissions	-
Finance Charges (inc. Fees)	235,416
Interest Expense	297,282
TOTAL COSTS (before GST reclaimed)	10,685,858
Less GST reclaimed	(705,301)
TOTAL COSTS (after GST reclaimed)	**9,980,557**
Net Development Profit	1,597,697
Development Margin (Profit/Risk Margin)	**14.83%**
Residual Land Value	2,580,000
Net Present Value	**410,814**
Benefit Cost Ratio	1.0467
Project Internal Rate of Return (IRR)	**20.12%**
Residual Land Value	3,398,183
Equity IRR	41.26%
Equity Contribution	1,796,689
Peak Debt Exposure	8,508,232
Equity to Debt Ratio	21.70%
Weighted Average Cost of Capital (WACC)	7.67%
Breakeven Date for Cumulative Cash Flow	May-2023

Apartments – 54 units of various sizes	AUD
Revenues	
Gross Sales Revenue	31,600,000
Residential	31,600,000
Less Selling Costs	(1,658,297)
NET SALES REVENUE	29,941,703
TOTAL REVENUE (before GST paid)	29,941,703
Less GST paid on all Revenue	(2,872,727)
TOTAL REVENUE (after GST paid)	**27,068,976**
Costs	
Land Purchase Cost	3,401,000
Land Acquisition Costs	206,478
Construction Costs (inc. Contingency)	17,807,708
Residential Construction	15,895,620
General Construction	1,562,918
Contingency	349,171
Professional Fees	1,215,135
Statutory Fees	51,500
Project Contingency (Reserve)	766,199
Land Holding Costs	83,066
Pre-Sale Commissions	280,720
Finance Charges (inc. Fees)	633,334
Interest Expense	750,067
TOTAL COSTS (before GST reclaimed)	25,195,207
Less GST reclaimed	(1,986,043)
TOTAL COSTS (after GST reclaimed)	**23,209,163**
Net Development Profit	3,859,812
Development Margin (Profit/Risk Margin)	**15.52%**
Residual Land Value	1,624,419
Net Present Value	**(469,167)**
Benefit Cost Ratio	0.9721
Project Internal Rate of Return (IRR)	**15.72%**
Residual Land Value	2,941,826
Equity IRR	24.19%
Equity Contribution	3,668,059
Peak Debt Exposure	20,102,331
Equity to Debt Ratio	17.67%
Weighted Average Cost of Capital (WACC)	8.75%
Breakeven Date for Cumulative Cash Flow	Sep-2024

Townhouses – 10 units	AUD
Revenues	
Gross Sales Revenue	7,200,000
Residential	7,200,000
Less Selling Costs	(487,535)
NET SALES REVENUE	6,712,465
TOTAL REVENUE (before GST paid)	6,712,465
Less GST paid on all Revenue	(654,545)
TOTAL REVENUE (after GST paid)	**6,057,920**
Costs	
Land Purchase Cost	1,000,000
Land Acquisition Costs	56,415
Construction Costs (inc. Contingency)	3,817,030
Residential Construction	3,742,186
Contingency	74,844
Professional Fees	195,077
Statutory Fees	20,099
Project Contingency (Reserve)	161,625
Land Holding Costs	35,200
Pre-Sale Commissions	50,820
Finance Charges (inc. Fees)	231,250
Interest Expense	121,055
TOTAL COSTS (before GST reclaimed)	5,688,570
Less GST reclaimed	(432,498)
TOTAL COSTS (after GST reclaimed)	**5,256,072**
Net Development Profit	801,848
Development Margin (Profit/Risk Margin)	**13.96%**
Residual Land Value	522,088
Net Present Value	**6,551**
Benefit Cost Ratio	1.0015
Project Internal Rate of Return (IRR)	**20.18%**
Residual Land Value	1,006,438
Equity IRR	32.50%
Equity Contribution	1,099,724
Peak Debt Exposure	4,432,628
Equity to Debt Ratio	25.56%
Weighted Average Cost of Capital (WACC)	10.09%
Breakeven Date for Cumulative Cash Flow	Jun-2023

Mixed residential development	AUD
Revenues	
Gross Sales Revenue	58,955,577
Residential	58,955,577
Less Selling Costs	(3,643,702)
NET SALES REVENUE	55,311,874
TOTAL REVENUE (before GST paid)	55,311,874
Less GST paid on all Revenue	(5,359,598)
TOTAL REVENUE (after GST paid)	**49,952,276**
Costs	
Land Purchase Cost	5,360,300
Land Acquisition Costs	369,314
Construction Costs (inc. Contingency)	29,676,911
Lots	7,359,164
Townhouses	5,749,347
Apartments	13,134,837
Other	2,569,187
Contingency	864,376
Professional Fees	3,041,214
Statutory Fees	1,955,056
Project Contingency (Reserve)	1,029,400
Land Holding Costs	1,041,324
Pre-Sale Commissions	6,760
Finance Charges (inc. Fees)	376,666
Interest Expense	923,543
TOTAL COSTS (before GST reclaimed)	43,780,487
Less GST reclaimed	(3,912,177)
TOTAL COSTS (after GST reclaimed)	**39,868,310**
Net Development Profit	10,083,966
Development Margin (Profit/Risk Margin)	**23.18%**
Residual Land Value	5,945,032
Net Present Value	**1,183,300**
Benefit Cost Ratio	1.0442
Project Internal Rate of Return (IRR)	**23.97%**
Residual Land Value	6,058,880
Equity IRR	31.15%
Equity Contribution	5,729,614
Peak Debt Exposure	15,663,907
Equity to Debt Ratio	36.28%
Weighted Average Cost of Capital (WACC)	6.33%
Breakeven Date for Cumulative Cash Flow	Oct-2024

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