

Social Enterprise Housing Supply Chains for Resource-Constrained Communities: A Complexity Lens Approach

Abstract

Purpose: Delivering housing to resource-constrained communities is a complex process beset with difficulties. This study employs a complexity lens to examine the approach taken by a social enterprise in Australia to develop and manage a housebuilding supply chain for resource-constrained communities.

Design/methodology/approach: The research team employed a longitudinal case study approach from 2017 – 2022, which utilised mixed methods to understand the phenomenon and gain an in-depth understanding of the complex issues and problem-solving undertaken by a social enterprise start-up.

Findings: Balancing mission logic with commercial viability is challenging for a social enterprise. The supply chain solution that evolved accommodated the particulars of geography and the needs of many stakeholders, including the end-user community and government sponsors. Extensive and time-consuming socialisation and customisation led to a successful technical design and sustainable supply chain operation.

Originality: This longitudinal case study contributes to knowledge by providing rich insights into the roles of social enterprises and how they develop and operate supply chains to fit with the needs of resource-constrained communities. Adding a contextual response dimension to an established complexity framework helped to explain how hybrid organisations balance commercial viability demands with social mission logic by amending traditional supply chain and governance practices. The case provides insights into supply chain configuration, needed changes, and potential impacts when a social enterprise as a focal actor inserts into a traditional for-profit construction supply chain.

Practical implications: Analysing supply chain intricacies via a complexity framework is valuable for scholars and practitioners, assisting in designing and developing supply chain configurations and understanding their dynamics. Meeting the housing construction needs of resource-constrained communities requires the social enterprise to place societal focus at the centre of the supply chain rather than merely being a system output. The developed business model complements the engineering solution to empower a community-led housing construction supply chain.

Keywords

Supply chain complexity, construction, construction supply chain, social enterprise, resource-constrained communities

1. Introduction

Housing/shelter is a basic human need. However, researchers have highlighted how Australia has insufficient and inadequate housing stock to meet community demand, resulting in substantial overcrowding in resource-constrained communities (RCCs) (Gounder, 2020; Memmott *et al.*, 2022). Standards of housing and living conditions deteriorate with remoteness, with 36% of dwellings in RCCs reported to have major structural problems and 28% problems with household facilities that assist in washing people and clothes, safe removal of waste and safe storage and cooking of food (NATSISS, 2016). Over 18% of people aged 15 or over in RCCs live in overcrowded conditions. (Fien and Charlesworth, 2012). Recognition that RCCs are not homogenous and require a tailored approach to address the needs of different cultures, geographical remoteness and climatically inhospitable environments renders a one-size-fits-all governmental approach ineffective (Gounder, 2020). However, focusing on individual dwellings deters meaningful engagement with RCCs and the development of vital community infrastructure (Fien and Charlesworth, 2012).

Many RCCs are in geographically-remote, tropical and subtropical regions where the climatic conditions require special construction provisions for floods and cyclones, extreme temperature variations, and local topographical challenges (Habibis *et al.*, 2019). Transport and labour are costly due to the distances and local skills shortages (Fien and Charlesworth, 2012). The design, operation and coordination of homebuilding activities for geographically remote RCCs also add considerably to the costs, encouraging construction companies to prioritise efficiency and standardisation over effectiveness and customisation (Makinde, 2014). As a result, housing provision to remote communities in Australia is delivered mainly by the larger fly-in and fly-out contractors with limited engagement with the RCCs that they are serving.

Following a visit to Australia in 2017, the United Nations Special Rapporteur indicated to the Human Rights Council that while the Government had adopted numerous policies to address the socioeconomic disadvantages of people living in RCCs, the policies did not duly respect the rights to self-determination or full and effective participation. The Human Rights Council argued that the Government could achieve significant progress if it consulted, financially supported and worked hand-in-hand with RCC organisations (UN Human Rights Council 2017, p. 18). The Special Rapporteur also recommended that responsibility for local programme implementation be transferred to community-led organisations to build capacity and the ability to exercise self-determination, identifying low-cost construction alternatives, and developing new finance models that do not rely solely on government funding for housing (UN Human Rights Council, 2017)

Although the failure of public and private organisations to address complex social housing issues provides an opportunity for social innovation (Mair and Sharma, 2012), the operational challenges of overseeing and supporting remote community-based staff limit the opportunities for local engagements and design input (Habibis *et al.*, 2019), in part due to occupational, health, and safety considerations. Failure to consult and consider the cultural and geographic needs of RCCs leads them to feel a loss of control and lack of transparency, together with a poorly constructed housing stock (Dannatt, 2015). Consequently, the Australian government is encouraging social enterprises (SEs) to deliver housing into the sector due to their innovative practices and social entrepreneurial acumen. However, the problems associated with construction supply chain complexity multiply when a construction supply chain is also required to embrace cultural considerations (Dannatt, 2015).

Our study explores the societal and theoretical issues of construction supply chains by addressing the following research question:

How do social enterprise supply chains address the needs of resource-constrained communities to deliver housing?

Because this question has attracted only limited studies to date (Yawar and Seuring, 2017), our research explores the role of an SE in addressing the shortfalls of traditional construction supply chains that have failed to address the specific needs of RCCs. Here, we define an RCC as "socioeconomically disadvantaged or marginalised" (Amrose *et al.*, 2020, p.196).

The research examines the fit between an SE organisation's approach to delivering commercial viability and philanthropic elements within a challenging task environment (Defourny *et al.*, 2021; Drazin and van de Ven, 1985). The study highlights the challenges the SE faces over five years of operation as it seeks to align various contextual contingencies while delivering prefabricated housing flexibly and responsively. As deployed in numerous fields, including healthcare, new product development, construction, and manufacturing supply chains (Aitken *et al.*, 2021; Baxter and Turner, 2021; Boehme *et al.*, 2021; Cecchi *et al.*, 2022; Turner *et al.*, 2018), we apply a well-established complexity framework by Maylor and Turner (2017) to assess the fit between the SE supply chain and RCC housing needs.

This research contributes to a subject area that is growing in importance as researchers examine SEs as focal actors in the supply chain that can achieve societal goals while remaining financially viable (Pullman *et al.*, 2018). Its main contributions are twofold. Firstly, an operations management complexity lens examines the fit between a socioeconomically-disadvantaged community's housing needs and the SE's approach to delivering value via novel supply chain practices. Highlighting the importance of social innovation and adaptation when SEs begin to operate in traditional for-profit supply chains, this contribution adds to the literature regarding the intersection of social challenges, supply chain management and performance outcomes (Yawar and Seuring, 2017). Secondly, this research illustrates how a hybrid organisation can balance commercial viability demands with social mission logic by amending its supply chain practices and governance. In a counterintuitive approach to traditional construction supply chain methods, relinquishing control of its customer-facing elements enabled the SE to deliver increased value. These two contributions are essential as public and private organisations fail to solve complex societal problems (Mair and Sharma, 2012).

The structure of this paper is as follows. A review of the SE literature describes their role and purpose in meeting the demands of communities before discussing how supply chains support housing construction. Next is the complexity framework that assesses the fit between the RCC's housing needs and the processes developed by the SE to deliver value. Following the methodology and the findings, the paper concludes with a discussion of theoretical contributions, managerial implications, and research opportunities.

2. Literature Review

This section begins by elaborating the characteristics of SEs and the process of social value creation followed by a brief description of the human-centred design approach the case study organisation used to develop its housing solution. The following section outlines the limitations of traditional construction supply chains, in which a focal firm (usually the main contractor) maintains top-down control, before exploring the potential of SE hybrid organisations. The last section describes the application of a complexity lens to understand the challenges SEs face when trying to attain fit between their structure and processes and RCC needs, while seeking to combine a commercial orientation with a social mission.

2.1 Social Enterprises

An SE is a private organisation that adopts a business strategy to achieve socially oriented purposes (Dacin *et al.*, 2011); hence it is defined by its combination of social objectives and commercial orientation (Doherty *et al.*, 2014). The prime aim is to tackle social or environmental issues, with profit as an enabling factor. In this regard, SEs are hybrid organisations that reconcile incompatible

prescriptions between social and commercial logics (Defourny *et al.*, 2021; Doherty *et al.*, 2014). Organisational structures can range from non-profit to for-profit with an incorporated social mission (Defourny and Nyssens, 2017), a focus that makes them different to other social ventures.

The literature identifies four types of SEs: *mutuals*, established to support the needs of a particular group through activities, such as trading cooperatives; *trading charities*, organised to raise funds to support a primary mission or for charity through commercial activity; *public-sector SEs*, including marketisation of public services and spin-offs, from government-funded organisations such as universities; and, *social-business models*, set up by social entrepreneurs to meet a social mission through commercial activities (Defourny *et al.*, 2021; Spear *et al.*, 2009).

Lyon and Owen (2019) point out that SEs obtain a large proportion of their revenue from selling products or services in the market. Hence, these types of organisations distance themselves from purely philanthropic sources of income. Arguably, SEs are emerging with the scope to solve complex community problems via trading activities and innovative practices. SEs and social entrepreneurs have the benefits of being autonomous, proactive, aggressive against competitors, risk-bearing, and innovative (Martens *et al.*, 2016).

Researchers highlight the importance of social innovation as it is the foundation of modern SEs (Meqdadi *et al.*, 2020). When innovative activities and services are explicitly motivated by meeting a social need and are predominantly developed and diffused through organisations whose primary purposes are social, these are social innovation practices (Latour, 2005; Mulgan, 2012). Latour (2005) used the term 'social innovative initiatives', which focus on addressing social problems and are activated by a social concern followed by the aim of making money through value creation.

The process of social value creation, which addresses the needs and concerns of sections of society (Kummitha, 2017), often occurs in consultation with the community. Products or services developed in continuous consultation with communities can achieve increased momentum among the target groups (Brown and Wyatt, 2010; Kummitha and Crutzen, 2017). One type of continuous consultation framework deployed by SEs is Human Centred Design (HCD), which Burns (2018, p.208) defines as "a design framework that aims to develop solutions to problems by involving the human perspectives in all steps of the process, via observing the problem within context, brainstorming, conceptualising, developing, and implementing the solution." Central to HCD are the lives and desires of the people for whom the design activities are focused (Burns, 2018; Maguire, 2001). HCD aligns with SEs' mission-centric approach of seeking to perform economic activities that deliver blended value by balancing economic and social objectives.

Because designs should match the social needs and contexts of the people impacted, the design process should focus on finding a solution for a real-life problem experienced by real people. HCD is an iterative process of design and redesign (Burns, 2018), meaning that, at each stage, the design is reconsidered and receives feedback from the users before progressing further (Burns, 2018; Kummitha, 2018). Consequently, the HCD process must keep users and other stakeholders engaged through requirements definition, early feedback, evaluation, and field testing (Burns, 2018; ISO, 2010). Burns (2018) and Maguire (2001) point out that the cycles of iteration between the design and testing phases, which underpin HCD methods, are critical to ensure the design calibrates with user needs. Determining these needs supports the construction supply chain in responding and adapting its processes to deliver value.

2.2 Construction sector supply chains and social enterprises

The construction industry faces accusations of lacking customer focus and end-user involvement and being short-term, adversarial, opportunistic, parochial, and disjointed (e.g., Costa *et al.*, 2019; Fearne and Fowler, 2006). Poor control and development of technical specifications, scope creep, lack of customisation for local requirements and logistics problems are common issues with construction

projects (Rudolf and Spinler, 2018). The traditional approach, in which a focal firm (the main contractor) has top-down control, challenges the sector's ability to drive down costs and increase value. On the other hand, contemporary supply chain management practices could offer significant improvements in delivering stakeholder value and cost reductions by minimising waste within the construction sector (Behera *et al.*, 2015). In contrast with traditional (fragmented) construction supply chains, efficient and effective processes that produce customer value via collaboration-based governance can offer mutual advantages for actors by improving synchronisation, information flow and decision-making (Dolci *et al.*, 2017). In practice, this is likely to be challenging as developing supply chain governance that delivers value necessitates innovation and changing social norms in the supply chain to "create a vested interest in maintaining group values" (Richey *et al.*, 2010, p.239).

While construction researchers have recognised the crucial role of innovation in delivering excellent value, such studies have generally focused on economic, technological, and environmental innovations with little consideration of the social dimension (Loosemore *et al.*, 2021; Xue *et al.*, 2018). The challenges involved in serving the needs of isolated communities mean that developing community-based housing solutions that support and engage RCCs is an ongoing issue for many nations (Habibis *et al.*, 2019). Australia's government has encouraged social entrepreneurs to develop potential resolutions to the inherent problems (Loosemore *et al.*, 2020). Researchers have highlighted social entrepreneurs' altruistic practices and innovative methods to question the status quo (Defourny and Nyssens, 2017; Kummita, 2017; Mulgan, 2012). For example, social entrepreneurs can ultimately trigger change (Mair and Sharma, 2012) by adopting HCD processes. Construction innovations that deliver social improvement offer an opportunity to create hybrid organisations across public, private, and SE sectors (Loosemore, 2015). Consequently, the role of co-creating social value to improve the opportunities for people in RCCs through cross-sector collaboration between the government, SEs, and the construction industry, has begun to see positive change (Barraket and Loosemore, 2018).

Developing a hybrid organisation is challenging. While SEs can link end-users with construction businesses and the government, the actors use divergent logic. Research suggests that managing the tensions between social value creation versus commercial gain requires persuasion, conflict resolution, and joint value creation approaches (Alinaghian and Razmdoost, 2021). SEs are hybrid organisations that combine profit-making and delivering value to society by pairing commercial orientation with a social mission (Defourny and Nyssens, 2017; Doherty *et al.*, 2014). Construction supply chains driven by cost efficiency are already complicated and complex on many levels (Turner *et al.*, 2018) and require a range of activities, relationships, organisations, knowledge, and skills to achieve a particular outcome across their lifecycles (Gosling *et al.*, 2015). Overlaying the complexities onto a hybrid organisation magnifies the issues as each phase requires input from different companies within the construction supply network, increasing network complexity and potential loss of value. Additional socio-political and structural dimensions and emerging complexity issues can further hinder the opportunity for hybrid SE organisations to deliver value to RCCs (Pullman *et al.*, 2018).

2.3 Analysing Fit through Supply Chain Complexity

Understanding the fit between RCCs' housing needs and the SE processes to deliver value is pivotal in solving the construction supply chain issues. The SE organisational response and the RCCs contextual contingencies should align to improve effectiveness and performance (Drazin and van de Ven, 1985; Romero-Silva *et al.*, 2018). OM research suggests that production practices and processes should reflect the contextual contingencies imposed on the organisation by its environment (Ketokivi and Schroeder, 2004). The most effective organisational design is one in which the organisational structure and processes fit the contingencies (Donaldson, 2001). Comprehending the issues that can hinder or enable fit between the SE's housing supply chain delivery business model and the RCC's cultural and geographical context in the construction of dwellings is vital and calls for a 'lived experience' approach to understanding participants' challenges (Cecchi *et al.*, 2022; Cicmil *et al.*, 2009; Maylor and Turner, 2017; Williams, 2005).

The role of complexity in understanding the challenges of operating construction projects and supply chains in delivering value has been the subject of much recent research (Aitken et al, 2021; Ateş et al., 2022; Boehme et al., 2021; Turner et al., 2018). Maylor et al. (2013) built on the complexity review of Geraldi et al. (2011) from the project domain as their Complexity Assessment Tool (CAT) foundation, which categorised managers' key challenges when managing projects. Later work explored this further when Maylor and Turner (2017, p.1080) defined three specific categories of complexity that potentially apply to the housing construction sector:

- *Structural complexity*: increases with the number of people involved, financial scale, number of interdependencies within and without, variety of work performed, pace, breadth of scope, number of specialist disciplines involved, number of locations and time zones. Structural complexity can be identified in the technical requirement of new construction demands ('detail complexity' in the terminology of Bozarth et al., 2009) and in the novel configuration of participants that need coordination (Chetty et al., 2018; Dedehayir, 2018).
- *Socio-political complexity*: increases with the divergence of people involved, level of politics or power-play to which the project is subjected, lack of stakeholder/sponsor commitment, degree of resistance to work undertaken, lack of shared understanding of the project goals, lack of fit with strategic goals, hidden agendas, conflicting priorities of stakeholders.
- *Emergent complexity*: increases with project novelty, lack of technological and commercial maturity, lack of clarity of vision/goals, lack of clear success criteria/ benefits, lack of previous experience, failure to disclose information, rising to prominence of previously unidentified stakeholders, any changes imposed on or by the project.

In addition to identifying three forms of complexity, Maylor and Turner (2017) suggested three forms of response: *planning and control*, *relationship development*, and *flexibility*. These ideas follow well-established supply chain principles (Turner et al., 2018, p.1450), including sales and operational planning (Ivert and Jonsson, 2014), effective relationship management with suppliers and clients (Christopher, 2016), product proliferation reduction (Gottfredson and Aspinall, 2005), use of third-party agents (Masson et al., 2007), IT system implementation, and slack resource utilisation (Aitken et al., 2016). When taken together, the factors led to a three-by-three framework (Maylor and Turner, 2017, p. 1086) that offers a lens to guide reflective practices and data analysis of the three forms of complexity and the three identified responses. All nine elements can be populated, and other work has established the practical utility of the analysis (e.g., Baxter and Turner, 2021; Boehme et al., 2021; Cecchi et al., 2022). Consequently, the complexity model provides a lens to evaluate the fit between an SE's housing delivery model and the RCC's cultural and geographic needs as the project requirements evolve.

2.4 Operationalisation of Performance

Through a supply chain complexity lens, this study assesses the fit between RCC contextual measures and SE supply chain activities, to provide an understanding of how the SE materialised a performance that successfully delivered a housing solution to match the needs of an RCC. Performance here is taken as being a function of the match between SE organisational elements, including structure, processes and technology, to the RCC context (Chen et al, 2015). The supply chain complexity lens illuminates the match. For example, socio-political complexity captures evidence related to housing designs that reflect the culture of people living in RCCs.

The performance of the fit between the SE supply chain approach and RCC contextual factors was operationalised through UN Human Rights Council (2017) housing solution metrics. The UN identified specific factors important in meeting the housing needs of Australian RCCs. The proposed holistic approach included both perceptual and objective factors (Boyd et al, 1993) in matching the housing

needs of RCCs. The factors were identified as (i) RCCs taking control over their own destiny, (ii) collaborative working between the community and qualified professionals, (iii) developing short- and long-term strategic plans, (iv) building special purpose housing organisations at a regional level to work in partnership with local communities and (v) identification of low-cost alternatives. These factors were deployed by the SE to develop an innovative business model which had the potential to provide a solution to social problems and trigger systemic change in the construction sector's approach to RCC housing delivery (Mair et al., 2012). Assessing progress against each UN factor was used to gauge the performance of the supply chain in matching the contextual requirements of the RCC.

The SE's five-year journey documented in this case illustrates the adaptations of the SE's approach to matching the contextual factors of the RCC. The performance of the innovative SE approach reflects the (dynamic) fit between RCC housing needs and the SE supply chain. Adapting the model of Morton and Hu (2008), to reflect a more dynamic and longitudinal perspective, Figure 1 depicts the framework deployed to examine the performance of the SE's approach in delivering housing to RCCs. The feedback loops representing changes of the SE approach due to misfit or a shift in agency from the RCC as they provide greater clarity on their needs. Figure 1 provides a more holistic view of the interaction of context and organisational design over a five year-period avoiding the pitfalls of static interpretations (van den Ven et al, 2013).

We distinguish here between the *output* of the work, the physical construction of houses as identified in UN factor V, and the *outcome*, the longer-term social impact in RCCs (UN factors I-IV). An extensive body of literature shows that evaluation of these is far from straightforward. Output performance is often measured against the original plan (e.g. Anbari, 2003; Kagioglou *et al.*, 2001), yet this is a very limiting view. Longer-term benefits accrue over time, and their evaluation can vary not just over time but also between stakeholders (Cooke-Davies, 2002; Davis, 2018; Ika and Pinto, 2022). Indeed, there may be tension between delivering outputs against outcomes. In our case, the construction of housing is a vehicle for wider change, so the erection of dwellings could likely be achieved more rapidly (in the classical sense of 'efficiency'), yet this misses the wider purpose of the SE's work. Pavlov and Micheli (2023) argue that performance is an emergent property of complex systems, and propose that in such environments, alignment (or fit) requires "increasingly frequent loops of learning and adaptation" (p.907). 'Fit' as shown in Figure 1 can therefore be dynamic in nature, potentially incorporating correctable 'misfit' as knowledge evolves, and feedback paths are developed.

Maylor et al. (2023) highlighting the practical, dynamic, nature of performance evaluation over time with multiple stakeholders. Drawing on service quality literature, they show that 'conformance to plan' is insufficient as a metric, especially in an evolving context where success is subjective and is determined by stakeholders' evaluation. We incorporate this view, using the complexity perspective to understand better how participants navigate their unfolding challenges over time, negotiating the processes and incorporating the learnings over the duration of the case.

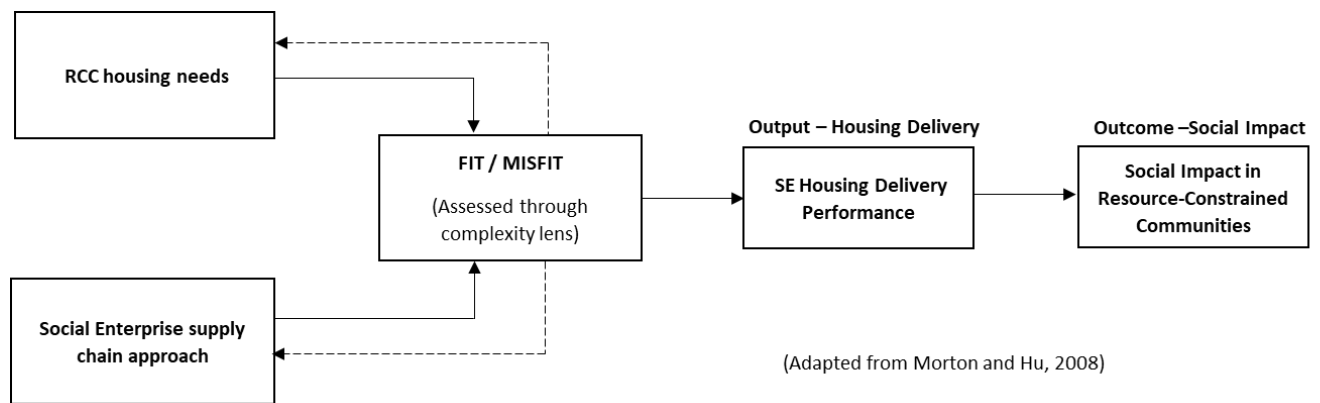


Figure 1: Framework for assessing fit in the delivery of housing

3. Methodology – Longitudinal Case Study

3.1 Case Study

This study examines how SEs address supply chain complexities while delivering housing to RCCs. According to Yin (2014, p.16), case studies allow for in-depth investigation of a "contemporary phenomenon... within its real-world context". Researchers can immerse themselves in the case and explore the causality of identified phenomena and the environment, for example, rather than just the results (McCutcheon and Meredith, 1993). BuildCo (a pseudonym) was a suitable case organisation due to its willingness to consider alternative supply chain approaches and as a family-owned business in Australia with a mission to tackle the global housing crisis through local community engagement.

BuildCo uses a modular building solution invented by a father and son duo. Co-inventor 1 and his four sons established the business in Australia to commercialise their patent-protected collapsible modular housing system. Co-Inventor 1 was a residential and commercial builder with 35 years of experience when he began developing a housing system to help solve housing crises in RCC communities. The skills of the four sons vary; two had worked in the construction industry (including Co-inventor 2) before joining the family business, one in a managerial capacity, and another joined the firm from academia with a PhD in chemistry. Expansion of the core team has occurred gradually by adding employees and sub-contractors.

BuildCo's novel supply chain approach incorporates the viewpoints of the RCC community and tenants. Pre-certified, pre-engineered modular parts can be manufactured locally by engaging members of the RCC community, regional suppliers, fabricators and contractors, supporting the sustainable development of local construction supply chains and stimulating the local economy. The house framing system patent considered various factors, including available transport and materials, constructability, cost, and environmental and cultural issues.

3.2 Research Design

This research deploys a complexity lens to assess the fit between the SE's responses, supply chain processes, and RCC contextual needs, and builds on a lived experience approach to understanding participants' challenges (Cecchi *et al.*, 2022; Cicmil *et al.*, 2009; Maylor and Turner, 2017; Williams, 2005). A longitudinal case study was appropriate, given the need to monitor an unfolding process. The study spanned five years (2017 – 2022) and aimed to gain detailed insights into the complexity of the addressed housing problem rather than just a broad view of the relationships between different actors. This is in line with previous work which uses a longitudinal study to understand the nature of 'fit'. (Siggelkow, 2002). In this case, the SE's approach as it adapts to different RCC contextual factors

is examined to comprehend how the “combination of a number of contextual factors can make a practice a better fit” (Romero-Silva et al, 2018, p.1344).

The lead researcher engaged with the SE weekly to become deeply familiar with construction practices and develop insights through observations and reflection as part of a learning cycle. The other research team members engaged with the lead researcher to develop abstract concepts and generalisations based on the observations and reflections (Kolb *et al.*, 1984). Such sessions occurred when major commercialisation milestones were reached by the SE; on average twice a year. The research team's practice of scrutinising and reflecting on the field data enabled it to develop the narrative for the investigation.

3.2 Data Collection

Data were collected from various sources which allowed for data triangulation. Table I provides an overview of the data collection and learning cycles. Ethics approval for an organisational-level investigation meant that the data sources included observations, interviews, e-mail correspondence, and such archival data as patents, consulting reports, and publicly available policy documents.

Table I: Data Collection Overview

Time	Action Cycle Activity	Time and Resources	Data Extraction
2017 – 2019	Problem definition, solution, ideation and prototyping	LR: Weekly engagement, on average RT: 2 workshops (following solution development and prototype testing)	<ul style="list-style-type: none"> • Interviews <ul style="list-style-type: none"> ○ Co-founder 1 ○ Co-founder 2 • Supply chain and process mapping • Cost analysis • E-mail correspondence • Observations (office) • Archival data
2020 – 2022	Proof of technology Proof of business model	LR: Weekly engagement, on average RT: 1 workshop (following construction completion)	<ul style="list-style-type: none"> • Interviews <ul style="list-style-type: none"> ○ Co-founders ○ Engineer ○ Marketing ○ Finance • Observations (office and factory) • Supply chain/process mapping refinement • E-mail correspondence • Archival data
LR: Lead Researcher; RT: Research Team			

To become a construction component supplier that empowers communities globally, eight people support the SE, fulfilling various roles from marketing and accounting to building and construction, engineering and management. These individuals were all interviewed to garner their different perspectives. Interviews followed a semi-structured interview guide ranging from approximately two hours at the beginning of the study to around 30 minutes in the closing stages. Individual and group interviews conducted on-site and by phone captured the data and helped verify the findings. Observation of operations in the firm's prototyping facility enabled the researchers to create flow charts, gain in-depth knowledge about the system, and develop supply chain maps.

3.3 Data Analysis

A multi-method analysis approach using multiple data sources allowed for method triangulation. Moreover, utilising different data collection techniques and field researchers enhanced research rigour via data and investigator triangulation (Boehme *et al.*, 2012), thereby allowing the researchers to establish a greater holistic understanding of the social entrepreneurship journey and the approach to product/business model design to solve a complex societal problem in resource-constrained environments.

The complexity framework provided the analytical backbone for the data analysis. It allowed the research team to conduct a thematic analysis based on the three-by-three conceptual research framework (Turner *et al.*, 2018) and hence a reduction, summarisation, classification, and interpretation of the field data (Miles and Huberman, 1994). Such an application of conceptual frameworks for data analysis is common in supply chain management research (e.g. Boehme *et al.*, 2021; Gosling *et al.*, 2015). The methodological approach allowed the research team to document the progress of the SE as it navigated a myriad of complexities from initial concept design and business model development/supply chain solution to prototyping of the first co-design and co-build housing delivery. The complexities covered both the output and outcome (Figure 1), and the challenges of their interplay. Our focus was on the UN housing solution metrics (in Section 2.4), but not to the exclusion of other identified issues.

4. Findings

4.1 Stage 1: Problem definition, Solution ideation and Prototyping (2017 – 2019)

According to the last Australian census (Census, 2016), the RCC in New South Wales (NSW) is a diverse community of 322 people with equal proportions of males and females. 12.2% are unemployed, and 48.9% work full-time. The median weekly personal income for people aged 15 years and over is A\$477, compared with the average of A\$664 for NSW. The SE, BuildCo, identified socioeconomic problems such as limited access to employment, education and income and set out to develop potential solutions to the complexity of issues.

Table II outlines the main issues that faced the remote settlement and the SE's response to them. Social problems and limited access to health services and education accompany a lack of employment opportunities. Like many RCCs in remote settlements, the population is highly mobile (a circulating population) due to seasonality and cultural and family events, making funding and housing procurement processes complex and dynamic. The cost of housing is also higher than that of urban environments, partly due to the shortage of tradespeople. Consultation between the community, designers and housing providers is sparse or confined to descriptions of house type, leading to a lack of cross-cultural discussions. Housing delivery has followed a government-push approach with little to no engagement with the affected stakeholders. While commercial outcomes for the community were deemed desirable, they were not specified explicitly within a traditional tendering process designed to identify cost-effective bids. The construction industry and the government perceive prefabricated housing as a viable, cost-effective, solution to improve housing safety, quantity, and quality, but many of the existing socioeconomic problems remain unresolved. Standard housing designs delivered by expensive fly-in and fly-out workforces are the norm.

Table II Main issues facing the RCC and the SE's responses

RCC Issues	Identified issues (based on observation)	SE response (based on interviews)
Design alignment with the culture	<ul style="list-style-type: none"> • Intergenerational living is not supported • Restrictions on sharing toilet facilities • Different use of space during seasons • High mobility of people living in RCCs due to seasonality, cultural events and family events • Clear sightlines from and to the dwelling • Government pushes for house typology standardisation • Not enough storage 	<ul style="list-style-type: none"> • Modular components allow for co-design with tenants from the RCC
Cost related to remoteness	<ul style="list-style-type: none"> • High cost of fly-in and fly-out labour • Lack of local skills to build homes • High logistics and transportation costs to and from RCC • Lack of competition to deliver housing in RCC 	<ul style="list-style-type: none"> • The involvement of the RCC in assembling the prototype structural frame allows the use of local materials for final fit-outs. • A structural frame modelled on the limitations of a 20ft container • Pre-certified structure removes structural liability and allows using unskilled labour
Consultation process	<ul style="list-style-type: none"> • Consultation between communities and housing designers and builders is not extensive enough to clarify the needs of RCC people • Cost and time constraints drive standardised housing and planning processes • Limited recognition of the broader social and environmental needs of RCC 	<ul style="list-style-type: none"> • Consultation with RCCs during the problem definition and ideation stages to obtain deeper insights. • RCC co-design of houses with the architect using modular components
Supply chain control	<ul style="list-style-type: none"> • Technically driven supply chain to meet commercial viability • Lack of trust between RCC, government and external contractors • Lack of transparency regarding existing RCC housing stock and capability/capacity within the community 	<ul style="list-style-type: none"> • Change from a main contractor to a service provider • RCC-pull instead of a construction company/ government-push

A systemic change called for a different approach from the government, the main construction supply chain entities, and the community to achieve buy-in. The BuildCo business owners consulted with local not-for-profit organisations and the representatives of various RCCs during the problem definition and ideation stages to obtain deeper insights into the problem. BuildCo's co-Founder 2 commented that:

"There are plenty of people in the community that have completed the theoretical part of their trade's apprenticeship but were not allowed to complete the hours so they can get their licence."

Figure 2 illustrates BuildCo's product development pathway and supply chain implementation timeline, which used an HCD approach to develop design alternatives and potential solutions.

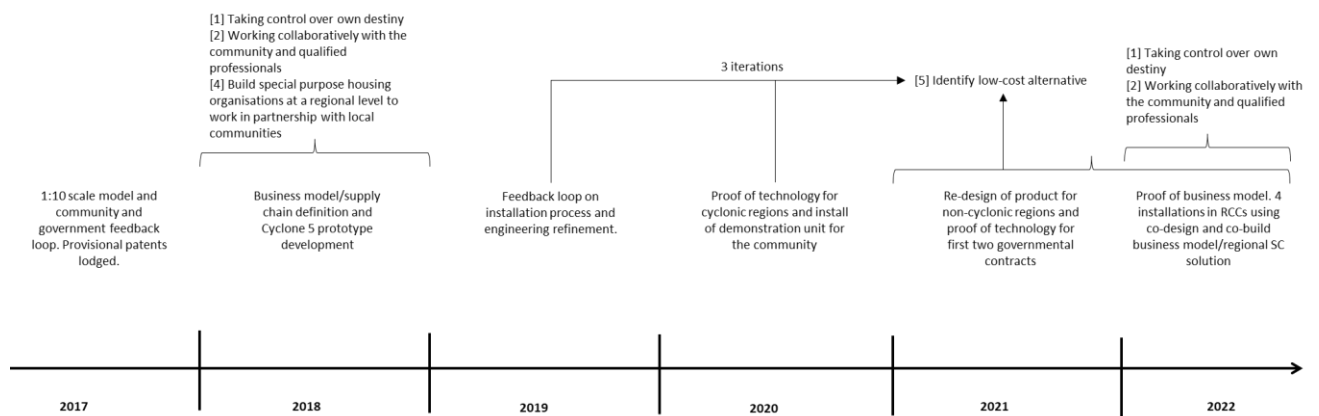


Figure 2: BuildCo's Start-Up Timeline addressing UN goals Addressing UN goals [1], [2], [4], and [5]

In 2017, the inventors of the housing construction technology developed a 1:10 scale model of their original standardised structural steel frame idea to obtain feedback from RCCs and government agencies as the primary funding providers. Time spent with civic representatives enabled the company to understand the community's problems. Co-Founder 1 at BuildCo, stated:

"It was only after we started to develop our stakeholder network and build relationships with local not-for-profit organisations and cultural consultants up in the top end [Northern Australia] that we started to understand the needs and refine the product to suit those needs."

Before building the first Cyclone 5-rated prototype at scale in 2018, the patent-protected, pre-certified and pre-engineered structural steel housing system shown in Figure 3 required two iterations. Cyclone 5 means that the structural components are certified to wind speeds up to 252 km/h. The components fit onto a 20ft container for easy transportation and to comply with national and international construction codes.



Figure 3: BuildCo's Structural Steel Housing System

The end-user community assisted in assembling the prototype, which helped to iron out the remaining engineering shortcomings and difficulties with assembly. Feedback on the concept's suitability and the interest, support and buy-in of community and government stakeholders also resulted. The community representatives informed the BuildCo founders of their housing issues and community circumstances, including the government's failure to provide culturally appropriate housing. Lack of trust and alignment between the RCC, government representatives and the construction supply chain approach of using fly-in and fly-out workforces was evident.

Simultaneous refinement of the business model and supply chain solution via an iterative HCD approach, building on feedback from the RCC, positioned BuildCo at arm's length to the community, taking on a service provider role through the licensing of Intellectual Property (patents). The revised business model established a community-representative NGO as a licensee of the structural frame solution so that its revised mission statement read:

"Our mission is to enable resource-constrained communities globally to design, manufacture and construct their own affordable, high-quality, pre-certified, pre-engineered and sustainable house. We achieve this by establishing local capabilities to stimulate the local economy and the quality of life of our consumers, one house at a time."

UN goals 1, 2 and 4 ([1] Taking control over own destiny; [2] Working collaboratively with the community and qualified professionals; [4] Build special purpose housing organisations at a regional level to work in partnership with local communities) influenced the business model and supply chain solution. The licencing of IP business model enables self-determination in housing delivery and can lead to special purpose housing organisations. The collaborative approach is a vehicle to upskilling individuals within the community. Goal number 5 ([5] Identify low cost alternative) influenced the technology development. The refinement of the pre-engineered and pre-certified components led to higher levels of standardisation as well as a considerable reduction in steel required for structural framing. In part, the business model was a response to pushback from the construction and building industry, which was less than supportive of the new technology. The Australian construction industry is highly conservative, with a traditional mindset (Boehme *et al.*, 2018).

BuildCo initially identified several community-led not-for-profit NGOs as potential licensees and signed memoranda of understanding with them. Licensees take on the regional supply chain coordination role and identify suitable sub-contractors and labourers from the community to become involved in the construction and maintenance processes. Co-Founder 2 stated:

"Our trip was a real success. The only reason why these companies are still talking to us is that we do not try to sell them a product. They love the idea of fabricating and running the supply chain."

Obtaining buy-in from the community and government stakeholders and fine-tuning the technology and business model/supply chain solution consumed much of 2019. The adaption of the SE's processes and technology overcame earlier misfits between the SE's approach and RCC needs. The standardised structural components have been certified by a third party to have a lifespan of 100 years, whereas the expected lifespan of a house in Australia is 60 years. The system components shown in Figure 3 are interchangeable, meaning a mass customisation approach and a semi-modular solution that offers choices to the end user.

4.2 Stage 2: Proof of Technology and Proof of Business Model (2020 – 2022)

Massive environmental challenges, such as the NSW bushfires followed by floods and the Covid-19 pandemic, dominated company activities during 2020 – 2022. At that time, the SE's headquarters were in NSW, a non-cyclonic region; however, every environmental disaster impacted the local, regional-based RCCs. Consequently, BuildCo focused on local efforts, which required a technology redesign for social housing delivery in lower wind speed regions and conformance to industry standards and the

government's legislative framework. The pre-engineered and pre-certified structural steel frame system must also align with existing construction fit-out materials, components, and standard sizes. In the event, reducing the amount of steel created a non-cyclonic version at a lower cost.

The Marketing Manager commented:

"We really had a disaster relief product. But who wants to live in a box? This redesign was necessary in order to deliver homes instead of shelters."

A considerable amount of time was needed to identify a for-profit construction partner willing to take on the risk of building with new technology while simultaneously being endorsed by the community and approved by the government's funding body. BuildCo tendered successfully for two government social housing contracts in partnership with a community-endorsed construction company. Both projects were tackled with a local architectural firm to demonstrate the benefits and constraints of mass customisation for community housing. Convincing an architect to get involved in a novel project was not difficult as they do not have a strong presence in the Australian detached residential housing market due to the dominance of the project home building industry with its high levels of standardisation. As the Marketing Manager pointed out:

"Architects 'got' our product straight away. It invites them back into the residential housing market. It is buy-in from the commercial builders we are struggling with."

The commercial projects focused on the technology rather than the business model, with houses designed using governmental buy-in rather than tenant buy-in. Although the construction company delivered the houses, there were no particular community outcomes. More positively, a government housing provider subsequently took possession of the fully compliant homes.

Further demonstration of the technology was in close collaboration with an RCC that environmental disasters had heavily impacted. BuildCo decided to move its main office closer to the impacted community and invested more than six months in a co-design process utilising a local architect, learning and becoming familiar with local customs and being accepted gradually by the community. The tenant-level co-design process with a local architect created a real 'buzz'. The SE gradually adapted its approach to fit with the needs of the RCC delivering both outputs and outcomes.

Two houses, each comprising a main house and a granny flat, allowed for intergenerational living, which is a critical component for raising the community's children and delivering societal outcomes. Moreover, the flexible layout can adjust to tenants' circumstances over the house's lifespan. For example, one of the master bedrooms, being over 27 m², can be converted into a second living room should a family member suffer a severe illness. The community-endorsed builder who delivered the houses hired three untrained local labourers, two of whom were future tenants.

Table III maps and summarises the patterns of supply chain complexity and response identified during the early stages of the HCD process (modified from Maylor and Turner, 2017). Socio-political complexities offered a particular difficulty in this case. The participants varied considerably in their backgrounds and organising logic, risking a lack of shared understanding (Daghar *et al.*, 2022; Nahapiet and Ghoshal, 1998) and hampering effective organisation and coordination. Product development projects rely heavily on social relationships for their effectiveness (Baxter and Turner, 2021), with informal social mechanisms held to be practical for complex project work where reliance on 'rational' management systems can be inadequate (Hobday and Brady, 1998). Emergent complexity also played a significant part in this case. The uncertainty at the outset was central, with multiple unknowns regarding the requirements and the routes to completion. Coordinating a practical supply chain and developing the required ecosystem presented new and dynamic challenges (Adner, 2017; Bozarth *et al.*, 2009).

Table III: Patterns of complexity identified during the initial phases

	Structural Complexity	Socio-political Complexity	Emergent Complexity
Planning and Control Response	Develop novel cyclone-proof, pre-certified, pre-engineered structural steel frame system/solution for housing in RCC. Develop standardised components that allow for mass customisation and hence for customisable low-cost alternatives	Coordinate between government, families, representation bodies, and supply chain partners during the HCD process. Incorporate feedback from various stakeholders underpinning collaborative working between RCC and wider stakeholders including qualified professionals	Work with local cross-cultural consultants to identify skills gaps and gain transparency in local human and infrastructure capability and capacity. Collaborative approach expected to underpin long-term plans of RCC run supply chain
Relational Response	Build trust and relationships to get everyone in the supply network onto the same page and aligned with a shared conviction for the social vision. Achieve collaborative and mutually supportive supply network participants	Invest time in relationship development with RCCs, businesses and government. Refine SE approach to address the complex societal problems	Liaise with supply chain partners to overcome a traditional, conservative mindset in the building industry that is reluctant to work differently. Address misfit between historical ‘fly-in and fly-out’ approach and RCC needs
Flexibility Response	Engineering is fixed, rigid and standardised, while the business model forms around patents and community empowerment. Structural outputs linked to development of housing organisations that can work with RCC’s outcomes	Several iterations of technical and business/ supply chain solutions based on RCC stakeholder feedback	Deep-rooted community problems that require arms-length relationships and a community-led approach to housing provision. Adapt SE approach to empower RCC

We note the complexities identified cover both the output and outcome demands (Figure 1), and that effective responses needed to satisfy both the more immediate construction requirements and also the longer-terms social impact aims. ‘Fit’ under these conditions therefore necessitated working with the two timeframes important to the RCC. The iteration of technical housing solution development was evident. There were few ‘quick’ answers, as the co-development of solutions was a social process not amenable to being rushed. The SE incorporated the voice of people living in RCCs to establish a supply chain that delivered outcomes as well as outputs. The pre-engineered, prefabricated and pre-certified patent protected components paired with an innovative SE business model has the potential to provide a solution to social problems and trigger catalytic or systemic change (Mair et al., 2012). The proof of business model in 2022 demonstrated how UN goals 1 and 2 can be achieved through engineering innovation delivered by an SE.

5. Discussion

This five-year longitudinal case study arose from the lack of knowledge about SEs as focal supply chain actors and their management of relationships to achieve social goals (Longoni *et al.*, 2019; Pullman *et al.*, 2018). The study describes the challenges of balancing commercial viability with social mission imperatives as the SE organisation positions itself at the nexus of government, NGO and RCC housing construction. Delivering housing to RCCs required the SE to accommodate technical and community

needs within a financially viable business model and offer a product portfolio that encourages local capabilities and capacity utilisation.

The SE has addressed several recommendations by the United Nations, which has endorsed that governments take measures in consultation with communities and community organisations to develop housing strategies and increase and improve the availability of remote, regional, and urban housing (UN Human Rights Council, 2017, p.20). Offering pre-certified and pre-engineered structural components for specific environmental contexts and enabling end-user (self-help) customisation of dwellings at the final fit-out stage (O'Rourke and Nash, 2019) reflect the SE's desire to accommodate cultural practices and community-led design while delivering a durable, flexible product. The SE solution also overcame the limitations of other prefabricated housing approaches (MacAskill *et al.*, 2021) by offering a flexible, affordable, mass-customisable housing solution that maximised local material content and labour (Wu *et al.*, 2019). This approach parallels Toyota's, which advocates customisation, localisation, and inventiveness to break free from established routines (Takeuchi *et al.*, 2008).

By comprehending the sociocultural factors of the communities it serves, the SE repositioned the locus of supply chain control to the RCC, resulting in a demand 'pull' approach to housing construction that contrasts starkly with traditional 'push' approaches where the focal firm controls the flow of information and materials to achieve cost efficiencies and deliver standardised products. The role of the SE became one of generating income by operating at arm's length to provide engineering support and structural certification.

In short, the SE realigned its supply chain response with the task environment to deliver houses that meet community needs, demonstrating the SE's ability to combine profit and social motivations (Defourny and Nyssens, 2017; Doherty *et al.*, 2014). A pre-certified structural steel technology solution with an IP-based licensing business model empowered community councils to assume dominant roles in deciding housing designs, delivery and local skills development, encouraging the program's acceptance (Pardasani, 2006). The ability to change the designs of buildings highlights the importance of understanding a feasible level of customisation and degree of prefabrication possible in the production system. Comprehending possible mismatches is an important subject for future research (Jonsson & Rudberg, 2015).

Pluralistic governance approaches for achieving a common goal are often successful in supply chains (Blome *et al.*, 2013; Um and Oh, 2020; Yadlapalli *et al.*, 2018). The new governance structure blended formal contracts (patents) with informal trust-based relational governance through extensive socialisation. In contrast with the formal contracts that dominate traditional construction contexts due to their adversarial and opportunistic behaviour (Costa *et al.*, 2019), the cultural dimensions of RCCs in Australia necessitate governance based on informal structural arrangements "designed to influence the behaviour of organisation members based on social control and trust rather than bureaucratic structures" (Ryciuk, 2020, p.153). Recognising the misfit between standard construction sector approaches and RCC needs was important for the SE to develop a model, underpinned by a simple IP mechanism, that meets RCC requirements. Balancing conflicting demands involved the SE refining the technology and the business model using an HCD approach. Today, the SE incorporates the voice of those who live in remote RCCs in Australia to offer pre-engineered, pre-certified and patent-protected structural housing components. Pairing this technology with an innovative SE business model offers a solution to social housing problems that 'traditional' construction and supply chain approaches have struggled to achieve.

Skills development, local employment, and long-term prosperity were all factors that catalysed positive systemic change (Mair and Sharma, 2012) since the enablers of change were local partnering and sourcing (Matopoulos *et al.*, 2014). Local actors can have a much better understanding and knowledge of the culture and value system and deeper connections with crucial authorities and

communities (McLachlin & Larson, 2011). By involving the end-user community as a critical business model requirement, the SE specifically addressed the challenging technical and legislative aspects of the new building design and the societal dimensions of problem-solving to enable acceptance and buy-in. Thus, reengineering the labour and material resource flows from an expensive fly-in and fly-out process to localised sourcing, local engagement, and training of local RCC actors was a critical aspect of the SE's social mission that delivered mutual benefits (Um and Oh, 2020). Similarly, designing the dwellings using modelling and prototyping facilitated knowledge transfer that supported the local RCC installation teams and materials sourcing. Creating local employment opportunities and developing the needed skills also encouraged the NGOs representing the needs and values of RCCs to invest effort into sourcing modular components and ongoing maintenance of the houses.

The initial observations, interviews and analyses provided a solid foundation for a process of identifying patterns and regularities that have led to a novel supply chain approach by the SE that incorporates the voice of the RCC when constructing prefabricated housing components (Eisenhardt and Graebner, 2007). The case study highlights the broad range of challenges experienced by SEs as they traverse organisational, supply chain and institutional levels when delivering objectives (Azadegan and Dooley, 2021). Understanding how SEs navigate the complexities is essential. This study utilised the supply chain complexity framework by Turner *et al.* (2018), which was invaluable for detailing the activities. The high-level approaches include technical issues with the product, stakeholder engagements over a multi-year period to build effective relationships, and problem-solving. Also noted was that it could be difficult for the model to capture the broader contextual challenges of the case situation.

Consequently, rather than 'force' the data into the framework of Table III, the model is extended to acknowledge the broader contextual aspects of the case. Adding 'Contextual Response' aspects to Table IV makes it easier for researchers to articulate those aspects of a study which may be of specific contextual significance. We believe this is a valuable methodological contribution that extends earlier findings (Geraldi *et al.*, 2011; Maylor and Turner, 2017; Turner *et al.*, 2018) by allowing researchers (and practitioners) greater clarity when analysing novel case settings. It extends the 'language' of complexity terminology, allowing discussion of the tensions that arise in supply chain configurations.

Table IV: Patterns of complexity identified in the later phases

	Structural Complexity	Socio-political Complexity	Emergent Complexity	Contextual Complexity
Planning and Control Response	The structural frame requirement to comply with standard construction products informed redesign for more straightforward implementation. Ensure the product works with a short supply chain and government specifications	Support skills development that provides jobs in the community and contributes to its prosperity	Redesigning the product for a lower-wind environment necessitated a significant redesign	Develop and use local knowledge in a co-design process to accommodate the RCC situational constraints
Relational Response	Identify a local community-endorsed construction partner to build using the new technology	Work in cultural partnership, positioning the business as a service provider. Position the technology to	Identify a social enterprise housing construction company willing to risk using the new technology.	Extensive socialisation to learn 'what works' in the local area and the local needs and businesses. Trust development

		enable a community-led supply chain	Convince an architect to work with the constraints of technical elements	and a willingness to learn about the local community culture
Flexibility Response	Develop a revised mass-customisable, non-cyclonic product version for co-design in a specific locality	Work to balance the needs of the community, government, legislation, architect and builder to 'translate' the needs of all stakeholders	The start-up team needed to change their ways of working. Moved company headquarters and revised internal work processes to accommodate Covid by working predominantly online	Use a <i>learn-do</i> pathway and <i>observe one, share one, lead one</i> approach to knowledge transfer when constructing houses with new technology
Contextual Response	A design optimised for local geography, business environment and culture	The extensive efforts to understand local needs and facilitate/broker agreements between the players	Iteration of concepts and working arrangements to ensure community acceptability and accommodate business realities	Rethink the design process for the geography, local capability, capacity, and materials

Tables III and IV supports our understanding of 'fit' as shown in Figure 1. Over the period of five years the patterns of complexity identified altered as the SE developed solutions to enable both the desired outputs and outcomes. The initial complexities shown in Table III highlighted the challenges the SE experienced at the outset which were addressed and refined to overcome earlier misfits of their approach. Misfits arose from two sources, technological and societal, reflecting the performance outputs and outcomes of the UN factors. Technology created misfits are not uncommon when introducing new products (Siggelkow, 2002). The second misfit reflected the traditional construction methodologies, of striving to keep costs low through standardisation, clashing with the desire to customise to deliver RCC societal needs. With the second phase of development (Table IV), the contextual complexity lens highlights the importance of recognising, articulating, and socialising what works for specific communities to overcome misfits and deliver both outputs and outcomes. The changing complexities identified over the five years demonstrates the evolving, dynamic and challenging nature of realising and maintaining fit between an organisation's strategy, structure and systems, and contextual factors.

Although requiring further study, we consider this a potentially valuable tool for assisting the design, development and understanding of supply chain configurations and dynamics, especially when linked to design thinking approaches. For example, one key finding is that the SE did not succeed by imposing top-down control as a main contractor but by ceding significant control to the local community and encouraging local knowledge, judgement and labour to come to the fore; factors that strengthened commitment to the concept and buy-in from the end-user community.

The expanded framework also revealed patterns not evident in the original three-by-three model. Firstly, *socialisation* with the main community actors to build trust and understand needs took significantly longer than expected. The HCD approach was critical in achieving end-user acceptance because it allowed design *customisation* in line with individual occupants' needs. An interesting paradox is how supporting these interventions required a 'hands-off' approach to encourage community members to develop the solutions that most suited them. Working with stakeholders to craft a solution benefited every party, as the SE alone could not achieve a design consensus despite

owning the rights to the patented technology. The iterative nature of the project also highlights the need for SEs to bend their business model and timeline to accommodate the pace and acceptance of change of the RCC.

A final issue is how the case offers a different perspective when considering the design process. Creating a design and implementation solution when a central concern is stakeholders' capability and capacity calls for engineering approaches that include a holistic understanding of the context and an appreciation of disparate stakeholders' needs. For the SE, this included the Australian government's willingness to plug funding gaps in communities to help make them self-sufficient, independent, and resilient. The case highlights the deficiency of merely offering a one-size-fits-all business model and technical solution when seeking to maximise the cultural and socioeconomic benefits.

6. Conclusion

During the five-year investigation, the SE developed a supply chain operation to meet the societal needs of RCCs by adopting an innovative business model and approach to housebuilding that delivers homes for a specific context rather than just meeting a standard. The challenging nature of developing a model that meets with the ambition of the SE and the community it serves is illustrated through the patterns of complexities that were identified. Delivering the outputs and outcomes shown in Figure 1, through matching the SE approach and RCC needs, necessitates comprehending and addressing the complexity issues that arise over time. The SE approach to adjusting its approach involved creating a supply chain capable of altering internal and external construction designs that support the traditions critical to RCCs (O'Rourke and Nash, 2019).

Our research question was, *How do social enterprise supply chains address the needs of resource-constrained communities to deliver housing?* Our longitudinal case study identified that balancing the SE's mission with commercial viability requirements is challenging (Pullman *et al.*, 2018). The case organisation's solution addressed geographical demands and the needs of many stakeholders, including government sponsors and the end-user community. Although this approach was more time-consuming than a 'standard' top-down construction process, socialisation and customisation formed key development elements that led to a successful technical design and a viable supply chain implementation. The dynamic role of the SE actors regarding supply chain design and management was critical to unlocking the potential of the technology and latent resources of the RCC. By changing the governance of the supply chain from SE-led to RCC-driven, the SE relinquished direct control and instituted a pluralistic governance approach (Blome *et al.*, 2013). Understanding how governance can be fine-tuned within the SE, across the supply chain and extending to the broader socio-political levels is an important area for research to comprehend the role of SEs holistically (Wieland, 2021).

In this study, we extended Maylor and Turner's (2017) complexity framework to encompass the importance of 'context', which provides the opportunity for a richer analysis of complexities and institutional responses. Given the relatively unusual nature of the case, this was a valuable addition to the established model and enabled the capture of data that may have remained uncategorised. We believe this to be a valuable methodological addition which may prove beneficial to other researchers investigating 'non-standard' cases.

Balancing the SE's mission with commercial viability requirements is similar to the challenges commercial organisations face when balancing the competing demands of profit and sustainability. The case study organisation was required to incorporate the RCC's social, geographical, and technical needs into their operation, which called for socialisation, customisation and governance changes. In short, delivering social and commercial value requires that the supply chain revolves around the needs of the RCC, thereby shifting the societal focus from a system output to the centre of the system.

As with any research, there are limitations to this study. It is a single longitudinal case study, which makes the applicability of the findings to other contexts uncertain. Our data collection was limited to

selected participants because ethical approval did not extend to collecting data from Indigenous community members. Similar research should use data from a more comprehensive set of stakeholders.

Note: Due to the nature of this research, the participants did not agree for their data to be shared publicly, and supporting data are unavailable.

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