

A reflexive capability pathway to commercialisation of innovations using an integrated supply chain: a case study of an innovation in the Australian residential sector

KERRY LONDON AND JESSICA SIVA

A strong innovation culture is critical to the performance of the construction industry. However, the industry has one of the lowest innovation rates of any industry in Australia. The idea of using the supply chain concept to improve industry performance has long been discussed. However there have been limited examples where this concept has had any major impact in terms of performance improvements through the delivery of innovations – or where the improvements have been monitored. The Australian Housing Supply Chain Alliance commissioned a study to investigate the pathway for highly innovative firms seeking to commercialise novel ideas in the housing industry. Eight detailed semi-structured interviews were conducted. A document analysis of organisational records and court reports was also conducted. A narrative analysis was used to map fifty-seven stories from ten key protagonists against the innovation process framework. A critique of the barriers and enablers allowed the development of a structured methodology of ‘best practice’ for innovations requiring an integrated supply chain approach. Reflexivity theory provided a method to critique the characteristics of the innovator group in how they successfully delivered the innovation to the housing industry. The mapping of the required human capital and the strategizing to develop a cluster of actors whose collective contributions will achieve the design, construction and distribution of the innovation was an important finding. The capacity to overcome barriers relied upon the cluster’s adaptability capabilities within the context of an integrated supply chain that enabled them to transform barriers into enablers through the use of human capital. The innovator group had a detailed awareness of the human capital required, its location and ways to access the resources in response to the creation, development and adaptation of the innovation. The importance of this case study is that this was an innovation of national significance. The dissemination of this case study to the housing sector as part of its cultural heritage is important to demonstrate the challenges of innovation within a largely successful innovation implementation.

Keywords: innovation, reflexivity, human capital, case study, integrated supply chain

¹ Professor Construction Management; School of Property Construction & Project Management; RMIT University; Bldg 8, Lvl 8, 360 Swanston Street, Melbourne VIC 3000 Australia; Kerry.London@rmit.edu.au

¹ PhD candidate; School of Property Construction & Project Management; RMIT University; Bldg 8, Lvl 8, 360 Swanston Street, Melbourne VIC 3000 Australia; Jessicapooisun.Siva@rmit.edu.au

1. Introduction

The housing sector has always been seen as an important part of the construction industry. The housing sector generally makes up 50% of the construction industry. In 2012 the

construction sector represented 7.7% of the GDP of an economy (ABS, 2012). In Australia in 2009 the residential sector accounted for approximately \$70b and from 2000-2009 the average was 47% of the total spend in the construction industry (ABS, 2010). There are significant problems in the supply of housing in Australia. The Australian National Housing Supply Council (2012) reported that the "housing shortfall (gap) increased by 28,000 dwellings over the year to end-June 2011, taking the cumulative shortage since 2001 to 228,000 dwellings. The Council projects that the national shortfall will increase to 370,000 dwellings by 2016, 492,000 by 2021 and 663,000 by 2031, assuming historic demographic and supply trends continue (the Council's "medium" growth scenarios for underlying demand and supply)." Noticeably, this gap is steadily increasing. The shortfall means we are faced with a crisis in our capacity to plan, design and construct to meet our nations needs unless we act immediately to improve our capacity for a more efficient, effective and innovative supply system. "Housing affordability constraints, cyclical economic factors and barriers to additional housing supply may cause underlying and market demand to diverge considerably" (NHSC, 2012). Housing research in the past has focused on policy and planning problems as the way to address supply challenges (Holmes et al, 2008). To date the housing supply debate has been largely focused on housing demand, affordability and land supply. Lack of innovation in housing supply is considered a barrier to the sector's capacity to meet market demand (NHSC, 2012) and yet very little attention has been paid to challenges experienced by those involved in the design and construction stages of supply. One of the suspected overarching key causal factors of poor housing supply is the fragmented nature of housing supply with numerous actors involved with their own objectives. A lack of coordination and integration between supply chain actors can exacerbate barriers to innovation. It is proposed that a more cohesive supply chain would prove beneficial to all housing sector stakeholders.

The aim of this research was to undertake a detailed case study analysis of successful delivery of an innovation to the Australian housing construction industry. In the 1980s an innovative concrete footing system was designed, tested, developed and constructed to address the problem of high variability in onsite materials management. The need to improve reliability in housing concrete footings was directly related to a business imperative. At the time the state manager of the largest national housing developer was exploring ways to increase revenues through developing efficient on-site materials management. He had observed much waste in materials in the onsite construction processes and vastly differing amounts of materials specified versus actuals used. It is noted that the study makes no comments on whether the innovation actually made a difference to housing affordability and this was not the intention. The genesis of the solution was the 'waffle' slab construction system which was borrowed and adapted from the use of this system for multi story car parks in another part of the country. We don't wish to delve too deeply into definitions of innovations however given that this was not a construction system used previously anywhere else in the world at the time for residential housing footings our study is predicated on the assumption that this was an innovation- ie an application of a new idea to a current problem. As the story unfolded during the study it certainly had all the attributes of being an innovation. The technical innovative aspects were well documented either during the creation and development of the innovation through various engineering technical documents and publications or subsequent to its diffusion throughout the sector. Significantly though, the most important aspect of our study was that the 'human' and 'business' story of

the creation, development and adaptation journey of the innovation had not been uncovered although the technical story was well documented.

This paper explores the innovation journey to create, develop and adapt the concrete footing system. The case study is an example of an innovation that required supply chain participants to behave differently than they had previously. Their conventional norms and practices which were focussed on outcomes and objectives specifically for an individual firm which holds a particular position within the supply chain at each tier for each firm had to be balanced with an overarching a whole of supply chain objective. This research is a first step in addressing the problems of the residential construction market through the “supply chain lens”. This paper focuses on the idea that innovative firms seeking to deliver and commercialise novel ideas are constantly responding and adapting their strategies to suit the changing requirements of the innovation process. Firms can deal with barriers and respond to change through the strategic management of human capital including social, cultural and intellectual. The paper begins by briefly outlining the theory that underpins this study which is a combination of innovation diffusion and construction supply chain theories. We fundamentally seek to begin to make contributions through this small study to construction supply chain theory. This is then followed by a brief description of the methodology undertaken for the study in terms of the data collection and analysis methods. A discussion of the innovation pathways methodology is presented in relation to the creation, development and adaptation stages of the innovation process. The interpretive framework is extended from previous work undertaken by London and Siva (2009, 2011) whereby they borrowed and adapted from Bourdieu’s reflexivity theory to consider how firms manage a changing international environment. Reflexivity has its derivation in sociological research (Giddens, 1991). It is based in a positive interpretation of change and a continual responsiveness to change by participants in the system. The key similarity is the way in which organisations manage human capital in a constantly changing environment where there are no previous patterns or rules. The findings are interpreted within the reflexivity framework established previously. Finally we suggest future research directions and conclusions specific to theory development.

2. Theoretical framework

2.1 Construction supply chain

The idea of using the supply chain concept to improve firm behaviour and thus ultimately improve sectoral performance through the development of supply chain clusters and targeted project constellations (London, 1999); targeted procurement (Shakantu et al, 2007) or integrated supply chains (McDermott, 2006) has been discussed in the academic research community since the late 1990s (London, 2008). The supply chain concept is very much concerned with firm behaviour within markets. The supply chain is the upstream and downstream contractual relationships between firms who deliver a commodity (product and/or service) related to the core business of a construction project. Subsequently the supply chain once formed creates a flow of commodities, cash and information. The creation of the supply chain is impacted by the location of the individual firm within its competitive market. These markets have unique structural and behavioural economic characteristics.

The upstream and downstream linkages are affected by the characteristics of these markets and in particular the ensuing power relationships which arise between tiers (London, 2008). This provides the central premise for this study.

A central idea of supply chain theory is that holistic supply chain integration relies upon each firm at each tier in the supply chain knowing and aiming for a common objective. Although this fundamental principle is a long standing assumption within the supply chain theorists and active practitioners; it is still one of the most basic problems in relation to developing integrated supply chains and creating holistic performance goals for supply chains. Much rhetoric states that supply chain management will solve problems, create innovations and improve productivity however, there has been little empirical research that deals with the strategic practice of supply chain management associated with creating innovations and solving commercialisation challenges in the housing sector in Australia (London and Siva, 2011). There are a range of tools and techniques that can be applied from other sectors that are 'tried and true' that have been proven to achieve more cohesive supply chains, in particular the well known theory and practices from the Toyota Production System also often referred to as Lean Production. Accompanying lean production is practice and theory to support that practice on supply chains. However, it is critical that an understanding of the sector specific challenges associated with the unique housing sector supply chain problems are considered as well. The investigation of the concept of the supply chain for innovations in the housing sector has not been undertaken in the Australian research community and for that matter in the international research community from the position of 'capital' transformation within the supply chain. It is noted however, that there is an emerging area of research on construction innovation in a more general sense.

2.2 Innovation diffusion

Rogers' theory of innovation diffusion (1962; 1995; 2003) provided an initial framework through which examination of the diffusion of an innovation through construction supply chains was examined. Rogers defines the diffusion of innovations as the process by which knowledge of an innovation is transmitted through communication channels, over time, among the members of a social system. The theory of innovation diffusion has been used in many different sectors including health, information technology and construction. London et al (2007) and Walker et al (2005) explored e-business and information technology adoption in the Australian construction sector using concepts from this theory. Within this framework diffusion is largely measured through the degree of adoption within a system. Adopters are categorised by Rogers' as innovators, early adopters, early majority or laggards. These adopter categorisations are differentiated primarily in relation to diffusion as temporal process whereby diffusion happens in time, whilst the other key elements of innovation; communication channels and social/business systems exert influence upon the temporal diffusion process depending on their specific qualities (London et al, 2007). Further to this there are two key phases in relation to the diffusion of an innovation: first is the creation of the innovation and that process by the 'innovators'; and second, the adoption by others in the industry and the process of diffusion of the innovation.

The adopter categorisation by Rogers is particularly applicable to the second phase of the innovation diffusion process whereby adopters can largely be grouped into one of the four categories of innovators, early adopters, early majority or laggards. This simplistic classification by Rogers, however, places all participants involved with the creation of an innovation into the broad “innovator” group which does not capture the specific characteristics of the different participants within this group and the process undertaken by the different participants to create the innovation. The present research sought to extend the work of Rogers to examine more specifically the characteristics of the different participants within the innovator group and the process undertaken to create an innovation in the housing sector. This research was focussed on the creation phase towards the development of a pathways methodology for the innovator group. The participants in the “innovator group” include those players who were actively engaged with the creation, development and implementation of the waffle footing system innovation process. The innovator group is differentiated from the other adopter groups in that participants are actively engaged in the creation and development of the innovation and they are not simply adopting something which has already been designed, tested, evaluated and implemented. This research aimed to go beyond the identification of factors of adoption within an organisation to explore in detail how the innovator group developed and diffused an innovation in a fragmented industry such as the housing sector through supply chain integration and to understand the characteristics of the collaborative efforts between those firms.

3. Research design

The empirical stage of this study was undertaken through three main phases: firstly; exploratory description of case study: description of the chronological history of the creation and development of the innovation including key players, events and decisions; secondly, critique of process: detailed critique of the process including the factors affecting creation, development and implementation and, finally, development of integrated supply chain innovation methodology: description of the actual process and then the critique of barriers and enablers to allow the development of a structured methodology of ‘best practice’ for innovations requiring an integrated supply chain approach. This paper reports selected findings from phases 2 and 3. Detailed reporting of the results can be found elsewhere (London and Siva, 2012).

3.1 Data collection

Through a series of interviews with key protagonists we uncovered stories which highlighted the organisational, communication and economic factors impacting on the process undertaken by the innovator group to deliver an innovation to the housing construction industry. This phase involved the conduct of eight semi-structured interviews with ten key players from seven organisations of the “innovator group” associated with the concrete footing innovation (refer to Table 1). The duration of the interviews was between 60-180 minutes. A key aim of the interviews was to enable participants to narrate stories which represented “critical moments” in their experiences of the innovation process. According to Chase (2005, p.661), while there are narrators who will tell stories whether or not researchers want to hear them, there are also others who might not take up the part of the

narrator unless they are specifically and carefully invited to do so. Chase (2005, p.661) suggests “framing the interview as a whole with a broad question about whatever story the narrator has to tell about the issue at hand” while at the same time remembering to extract specifics about the interviewees experiences. The interview questions for this study were designed to be broad and open-ended to provide participants the opportunity to express themselves in their own words without being influenced by suggestions from the researcher as well as to invite the narrators to tell their own stories (Foddy, 1993). However, whenever the response provided by the participant lacked clarity in terms of assisting the development of the proposed model and in answering the research questions, the researcher utilised extension or trigger questions to clarify and elaborate responses. The participants were asked questions relating to four key areas: their role in their organisation at the time and their specific role in relation to the waffle pod footing innovation, key events in the innovation process, barriers and enablers which hindered/drove the innovation and the key players in the process.

Table 1: Interview participants

Case study	Organisation type	Position in organisation	Role in relation to innovation	Location
C1	Large housing developer	State manager	Supply of experimental/ prototype sites Organisation of supply chain to create and implement system	Australia-wide
C2	Footing contractor	Managing director	Construction of footing system for experimental/ prototype sites	South Australia
C3	Building materials supplier	Sales representative	Promotion, distribution and selling of the system nationally	Australia-wide
C4	Plastic spacer manufacturer	Managing director	Manufacturing of key component of system ie plastic spacer	South Australia
C5	Engineering consultant firm	Managing director	Engineering design of the system Monitoring and testing of experimental/ prototype sites Obtained approval/ accreditation for system	South Australia Victoria
C6	Industry association	Regional manager	Promotion of the system in Queensland	Queensland
C7	Polystyrene supplier	Sales representative	Distribution of the system in Victoria Adaptation of the system in relation to waste management	Victoria

3.2 Data analysis

A data analysis technique referred to as the narrative inquiry approach was used in this study. The key actions and events which influenced decisions made were systematically identified to connect and map the consequences of those events over time against the creation, development and adaptation of the innovation (Riessman, 1993). The technique of story analysis was used for data analysis, which offered a way of connecting different stories

to understand the innovation process and in particular changes that took place over time (Bell, 1993). The unit of analysis was the cluster of organisations that were involved in the innovation and the collection of stories that described the various experiences of the participants. The interviews were recorded, transcribed and subjected to four stages of analysis including: Description of the stories from each participant in isolation in relation to their experiences during the creation of the innovation process; Collecting and connecting the stories and then matching to the five stages of the innovation process from all participants including agenda-setting, matching, redefining, clarification and routinising; Description of barriers and enablers to the innovation process and, Description of the pathway for the creation, development, adaptation and diffusion of this particular innovation.

3.2.1 Narrative analysis technique

The first part of analysis involved an identification of links between stories particular to each participant. Stories were identified and coded into the five stages of the innovation process including agenda-setting, matching, restructuring/redefining, clarifying and routinising. Three key steps were undertaken at this phase of analysis. Firstly, each interview was transcribed into “rough drafts” to develop narrative segments. A framework developed by Labov (1972) was used to identify the boundaries of narrative segments. According to Labov (1972) all well-formed stories are made from a common set of elements and each clause has a function, which includes: Abstract: what was this about?; Orientation: who, when, what, where?; Complicating action: then what happened?; Evaluation: so what?; and Result or resolution: what finally happened?. Secondly, the narrative segments were interpreted to identify the meaning of each story. In each story a particular feature was identified to demonstrate a certain element of a particular stage of the innovation process. Based on the participant’s decisions, activities or events described, each story was classified into categories according to the primary characteristics of the five stages of the innovation process. The third stage involved linking the stories into chronological order. The stories coded into the five stages of the innovation process were then “pasted together” to form a “metastory” to demonstrate the participant’s experiences related to the waffle pod footing innovation over time.

4. Results

Each case study organisation was analysed using narrative analysis and the stories from each participant organisation in isolation in relation to their experiences of the innovation process. The within-case analyses of each of the seven organisations were presented in terms of:

- “meta-story”: stories told by participants which have been “pasted together” chronologically. The meta-stories highlight the organisational, communication and economic factors impacting on the creation, development and adaptation of the innovation
- timeframe
- key players in the innovation process:
- inter functional supply chain relationships
- inter organizational supply chain relationships

- expertise: resources highlighted as significant to the innovation process in terms of specific knowledge domains, skills and experiences
- credibility: resources highlighted as significant to the innovation process to provide the innovation with reputation/credibility such as key milestones, events in the form of accreditations, publications, awards and credential backgrounds

Analysis and summary charts were developed for each case study. A total of fifty-seven stories were matched against the five stages of the innovation process with key themes identified in how participants experienced each stage of the innovation process. It is not the intention of this paper to discuss this part of the results, however, an example of stories coded into the first stage of the innovation process, ie “agenda-setting” is provided in the appendices (Table 2).

4.1 Transforming barriers to enablers: reflexivity and human capital

At each stage the firms experienced different problems resulting in the need for strategies to suit the changing requirements of the innovation process. Instead of simply identifying the barriers which occurred at each stage of the innovation process, a more useful approach we took was to identify common themes in how those barriers were overcome. The way that the innovator group overcame barriers can be mapped to how social, cultural or intellectual capital (or a combination of these) was used (Bourdieu, 1990). Thus the management of human capital is how barriers are transformed into enablers. To make sense of the way in which the players used social, cultural and intellectual capital we turned to a sociological theory known as Reflexivity theory (Giddens, 1991). In our interpretation a reflexive capability approach to the innovation process suggests that at any given time one would require a specific set of resources in terms of social, cultural, intellectual and financial capital. Successful innovators often seem to have awareness, whether conscious or not, of the specific capital required at various times and an understanding of where that capital resides. Furthermore it involves understanding the ways to access the various forms of capital in response to the creation, development, adaptation and diffusion of the innovation. A general theme running through the analysis is the fluid nature of the different forms of capital and their interconnectivity. The analysis has shown that the various forms of capital can be easily transformed into or leveraged into other forms of capital. A discussion of the inter-relationship between various forms of capital and how this influences the innovation process has been undertaken elsewhere (London and Siva, 2011).

In summary the individual stories from each participant was a useful starting point for identifying key barriers and enablers. The different experiences between participants were then cross-compared to identify any common themes. Table 3 (refer to appendices) provides a summary of the themes arising from the cross-coding of the participants’ stories into the five stages of the innovation process. Further to this the inter-organisational process undertaken by the innovator group participants in the creation, development, adaptation and diffusion of the footing system was examined. Finally, linking the barriers to the enablers begins to bring some clarity to an innovation process pathway (Figure 1).

5. Innovation pathways methodology

As indicated by Figure 1 in the first instance the group needs to develop a clear market analysis and business proposition for the innovation. This early stage analysis will be iterative but such questions will include: Who are the competitors of the innovative system? What financial and IP stake does each player involved in the creation of the innovative have? Who will own the innovation? What type of ownership mechanisms will be developed? It also raises questions such as: Who will be most affected by introducing this new innovation? ie Who are the competitors for this innovation and how will they try to influence the introduction of the innovation into the market place? This sort of analysis needs to be completed by each organisation involved in the creation of the innovation so that risks can be identified. Not only does the innovation group need to identify this at the organisational level but more widely across the sector as well. For example, if we introduce a new footing system who are all the stakeholders that will be impacted by the introduction of this new system? Who will lose market share? Who might gain market share?

5.1 Creation

In this phase the concept for the innovation was created and various players were identified as being significant contributors. After the creation phase where there was a reasonably clear understanding of the need for supply chain integration as the champion of the group saw that the most significant barrier in the development phase was the potential absence of particular key supply chain players. The strategy was to identify intellectual capital required to take the innovation forward and in so doing identify key knowledge domains. As the start up phase was considered to be reasonably high risk there was a careful consideration of the level of investment of resources. Therefore at this stage the group developed alliances to access the resources needed. This involved identifying typically like-minded people in the industry who were willing to take a risk and were excited about the proposition on the table. This is essentially identifying social capital that is needed in the group.

5.2 Development

After the original creation phase the group moved into the next phase of development. In this phase we saw modifications to the original design as pilot testing was completed. Importantly though another player came into the group who provided a greater capacity to distribute the system more widely to the market. This player clearly was invited into the group because of trust and mutual understanding matched with a clear business motivation.

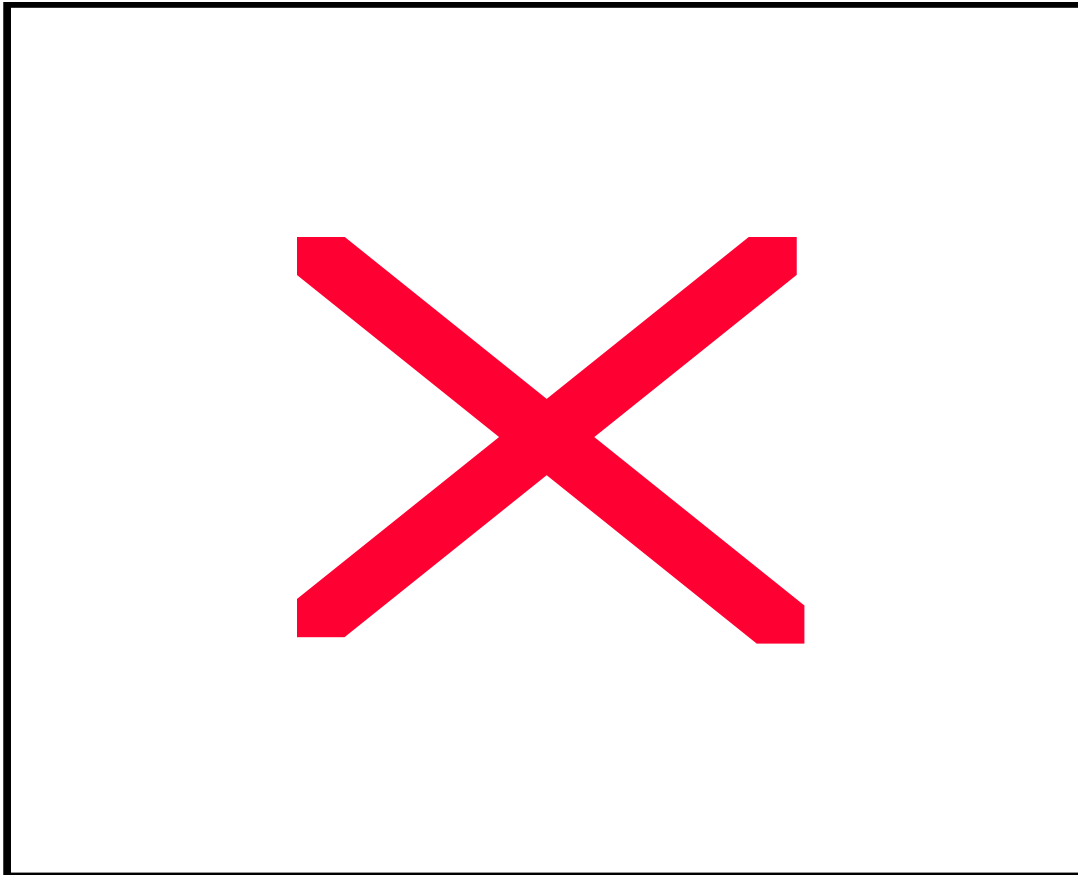


Figure 1: Innovation process pathways methodology (developed for this research)

5.3 Adaptation

The final innovation phase before the whole scale diffusion was another form of refinement of the innovation that is the some adaptations of design due to constructability requirements. In this phase we saw much more significant market penetration and competitors essentially began to sit up and take notice. Because the innovation became a much more plausible proposition and had now had testing, piloting, evaluation and approvals from regulatory authorities some significant barriers came into play. Five main barriers were identified as indicated in Figure 1. One such example was the difficulty of changing people's mindsets and perceptions that the innovation was a worthy system. The strategy in this instance was to seek various ways of demonstrating credibility through technical publications, alignment with various professional associations, awards and creating alliances with other leading players in the industry. The group took each particular barrier and developed a strategy to counter the challenges that they were facing and we have identified the particular form of capital that was used in each strategy.

6. Conclusion

We examined in a detailed manner the creation of an innovative system in the Australian housing construction industry. We can think of the innovation process as a chain of events. There is a series of steps that innovators need to go through to not only come up with a

great idea but also to then strategise to develop a cluster of actors to create, develop and drive the innovation through. There is perhaps a “creation myth” where we have come to believe that innovations revolve around the heroic acts of a single creative genius when in reality it is about pulling together resources from a chain of actors. At different times of the innovation process various relationships will be formed and reformed in response to situational needs. Once something is changed along the way there is a flow-on effect and everything downstream from that change is effected. The mapping of the location of the required human capital and then the strategizing to develop a cluster of actors whose collective contributions will achieve the design, construction and distribution of the innovation was an important finding of our research. This paper sought to develop an Innovation Pathways Methodology through a critique of the barriers and enablers experienced by the innovator group in relation to the concrete footing system. The identification of barriers and enablers achieved through this study is significant in that it allowed a critique of the unique characteristics relating to the pathway undertaken by the innovator group to create, develop, adapt and diffuse the waffle footing system innovation. This required appropriate management of functional relationships within organisations and also more importantly the inter-firm relationships in the supply chain. Barriers to the innovation process were generally considered as resulting from the lack of awareness of the resources and access to specific resources relevant to particular stages of the innovation process. Enablers were identified as the appropriate management and integration of the various resources in the form of social, cultural and intellectual capital which resided in the different firms within the supply chain at different phases of the innovation process.

The innovation process is dynamic. A critique of the barriers to innovation identified in this research highlighted that rather than dealing and coping with change in a reductionist manner the challenge of successfully delivering an innovation is to embrace its dynamic nature. The way that the innovator group overcame barriers related to the clear awareness of the inter-changeability of roles and relationships across the group of firms throughout the innovation process and the capacity to respond and adapt strategies to suit the changing requirements of the innovation process. The Innovation Pathways Methodology developed through the findings can be a useful tool for those thinking about implementing an innovation. It provides a starting point to identify where the weak links might be so that appropriate steps can be undertaken to transform barriers to enablers. The importance of this case study is that this was an innovation of national significance. The dissemination of this case study to the housing sector as part of its cultural heritage is important to demonstrate the challenges of innovation within a largely successful innovation implementation.

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APPENDICES

Table 2 Stories coded into the agenda-setting stage

Agenda-setting						
C1	C2	C3	C4	C5	C6	C7
<p>Opportunistic surveillance:</p> <p>Story 3: "had a break when I realised one day sitting in the office...I'm paid to think about things"</p> <p>Story 5: "the other thing that hit me was in multi-storey car parks I'd seen where these waffle pods had been used...I just said, cant we do that same stuff here?"</p>	<p>Opportunistic surveillance:</p> <p>Story 1: "I was in Port Lincoln 30 years ago and they came up with a crusher bull waffle pod...So I sent a mob of my guys over there to try and pour a job"</p>	<p>Opportunistic surveillance:</p> <p>Story 1: "C3 is basically a building materials supplier...they were actually looking to diversify and try something else and have another product that they could promote Australia-wide"</p>		<p>Opportunistic surveillance:</p> <p>Story 1: "So what we did was set up some internal R&D projects...so we had different streams to what we were doing"</p> <p>Story 2: "because we were involved with footing designs and having problems with movement. As a structural engineer I had designed waffle slabs for first floors...So I figured we got nowhere for support in soils or footings in soil and maybe a waffle will be a good concept"</p>	<p>Opportunistic surveillance:</p> <p>Story 1: "and we were searching for footing systems that would work on very heavy clay in South Australia"</p>	<p>Opportunistic surveillance:</p> <p>Story 1: "I guess we saw a market opportunity"</p>
<p>Performance gap:</p> <p>Story 4: "the traditional [footing system] was a brick build-up...and what that meant was you had unknown rock excavation on the strip footings...when you hit rock, you called the customers up and said you're going to have to pay us some more money so straight away you're off-side"</p> <p>Story 6: "the margins in housing are quite low, they're terrible because of the inefficient way we did things"</p>				<p>Performance gap:</p> <p>Story 3: "the idea was to get a footing system that was as near as possible to a factory-produced...and above-ground...cause once you start digging you lose control of what you're building, you get over-runs, your trenches collapse"</p>		<p>Performance gap:</p> <p>Story 1: "we had an issue with our own recycle material – extruded etc to re-sell it...it wasn't very good return"</p>

Table 3 *Cross case comparison: key themes in relation to five stages of innovation process*

Stages of innovation process		Case studies						
	Key themes	C1	C2	C3	C4	C5	C6	C7
Agenda-setting	Opportunistic surveillance	√	√	√	√	√	√	√
	Performance gap	√				√	√	√
Matching	Establishing fit between problem and innovation	√	√	√	√	√	√	√
Redefining	Changes to organisation/innovation	√	√	√	√	√		√
	Developing alliances to integrate resources	√	√	√	√	√	√	√
Clarifying	Convincing diffusion within organisation		√					
Routinising	Enablers to diffusion across organisations	√	√	√	√	√	√	√
	Barriers to diffusion across organisations		√	√	√	√	√	√
	Adaptations/re-inventions		√	√	√	√		√