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Deconstructing Dynamic Capabilities: The Role of Cognitive and Organisational Routines in the Innovation Process

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Deconstructing Dynamic Capabilities: The Role of Cognitive and Organisational Routines in the Innovation Process

Abstract

A better understanding of innovation processes might lead to productivity improvements. By focusing on a specific, economically relevant sector (construction) and type of firm (small to medium-sized enterprises [SMEs]), this article seeks to extend the dynamic capabilities framework by clarifying the roles of cognitive and organisational routines in organisational innovation processes. Insights generated from an in-depth case study of a medium-sized construction firm reveal that dynamic capabilities might diminish the relevance of an explicit innovation focus, because such capabilities have the potential to trigger emergent, incremental innovations. Accordingly, for construction SMEs, a development, rather than research, mode of innovation appears relatively more critical, as manifested in conscious cognitive routines and functional/integrative organisational routines.

Key words: Dynamic capabilities, cognitive routines, organisational routines, innovation

INTRODUCTION

To enhance firm productivity, a key route is developing a clearer understanding of their innovation processes. With a greater understanding of the processes, firms can improve their innovation management and leverage more appropriate, context-specific capabilities (Hartmann, 2006; Sexton and Barrett, 2003), such as research and development (R&D) and new product development capabilities, as well as organisational resources that facilitate modifications to firm processes, structures and business models. In certain sectors, such innovation capabilities are particularly important (Egan, 1998; Fairclough, 2002); in this study, we consider the innovation potential of construction firms and the resulting effects on their competitiveness. The construction industry contributes approximately one-tenth of the world's gross domestic product and employs approximately 7% of the total global work force (Economy Watch, 2010).

Furthermore, small to medium-sized enterprises (SMEs) are particularly prominent in the construction industry (Australian Bureau of Statistics, 2012; Australian Government, 2011), so we consider which capabilities facilitate innovations by SMEs in the construction sector. Such firms are interesting because of not only their contributions to national economies but also their great sensitivity to shifting business cycles, changes in the general economy and seasonal shifts (Kapliński, 2008; Giang and Pheng, 2011; Ruddock and Lopes, 2006), leading to their disproportionately high failure rates (Chan et al., 2003; Collins, 2012). When construction SMEs instead respond effectively to environmental challenges and opportunities (Jones, 2011), they can strengthen their economic positions and expand their market presence. In this context, sufficient resources, adequate cash flow management and good financial controls certainly help SMEs survive, but they cannot entirely explain why some SMEs outperform others (DeSarbo et al., 2007). We propose that effective

strategic management offers another central distinction between SMEs that survive and those that fail (Barrett et al., 2008; McAdam et al., 2010).

To explicate this effect, we turn to prior research that suggests that innovation management in SMEs draws on both cognitive and organisational routines (Sexton and Barrett, 2003), which enable the firms to evaluate and implement innovations. According to the dynamic capabilities (DC) view (Teece, 2007; Teece and Pisano, 1994), firms also require strategic elements that enable them to realign their resources and operational capabilities to match changes in the environment (Zahra et al., 2006) and thereby sustain their competitive advantages over time (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000; Teece, 2007). We seek to combine these complementary perspectives and thereby extend the DC framework by clarifying the influence of its constituent cognitive and organisational routines on innovation, in the context of construction SMEs. To emphasise these influences, we undertake an in-depth case study of a medium-sized construction firm in Australia.

The remainder of this article is organised as follows: First, we describe the innovation process of SMEs and discuss the organisational capabilities—with an emphasis on operational and dynamic capabilities—and routines—with a focus on cognitive and organisational ones—that are most pertinent in this context. Second, we outline how the role of cognitive and organisational routines might be conceptualised within a DC framework. Third, we apply this conceptual approach in an in-depth case study setting. Fourth, after summarising the extended DC framework, we note some implications for research and practice and outline the limitations of our study, as well as opportunities for further research.

BACKGROUND: INNOVATION IN CONSTRUCTION SMEs

In Australia, SMEs (which employ up to 199 people) account for 98% of all construction firms and contributed about 77% of the industry's value in 2009–2010, in terms of gross domestic product (Australian Government, 2011). Most SMEs feature independent ownership and operations, including close control and centralised decision making by owners/managers (State of Tasmania, 2012). In addition, similar to most SMEs, construction sector SMEs often lack sophisticated decision support systems (Heyden et al., 2013). Instead, a central decision maker, such as the founder, CEO or managing director, usually is responsible for initiating innovations or organisational changes. Such senior managers exert disproportionate influences on firm decisions and participate in a fluid mix of strategic, tactical and operational choices (Powell et al., 2011). In turn, decisions by senior managers tend to permeate the organisational processes of SMEs (e.g., Boone et al., 1996; Simsek et al., 2010).

Another common trait of SMEs is their agility and flexibility (Dainty et al., 2001), yet this strategic advantage also creates a significant challenge, in that the firm must constantly scan its external environment (Reichstein et al., 2005), respond to changes in that environment with appropriate strategic responses (Love and Irani, 2004; Packham et al., 2005), ensure constant technological renewal (Jones et al., 2011) and conduct R&D—all with limited financial and human resources. These traits strongly impede SMEs' capability to innovate (Cobbenhagen, 2000). Yet to remain competitive, SMEs generally need to develop innovation capabilities (Gann, 2000; Sexton and Barrett, 2003). Accordingly, SMEs seek 'renewal with respect to products, markets and production process' (Cobbenhagen, 2000, p. 26; see also Buija, 1984), which requires them to emphasise innovation processes within their organisational systems.

Operational Capabilities and Innovation in SMEs

Innovation requires capabilities that enable modifications to the firm and its strategies; these capabilities entail ‘the comprehensive set of characteristics of an organisation that facilitate and support innovation strategies’ (Burgelman et al., 1996, p. 8). Sexton and Barrett (2003) suggest that both external and internal capabilities (and challenges) affect innovation and that these influences can be understood according to the market-based view (Hurley and Hult, 1998; Slater and Narver, 1994; Zhou et al., 2005) and the resource-based view (Barney, 2001; Eisenhardt and Schoonhoven, 1996), respectively. According to the market-based view, firms must exploit market conditions (Dosi, 1988) by choosing appropriate innovations, implementing them effectively and supporting them with adequate resources, such as financial capital. The resource-based view (RBV) (Barney, 1991; Wernerfelt, 1984, 1995) instead explains performance differences among firms by their access to resources and suggests that the availability and access to particular resources also affects the extent to which firms can realise innovations.

The RBV goes further to indicate that a sustainable competitive advantage requires firms to possess bundles of static, valuable resources that are heterogeneous and relatively immobile (Peteraf, 1993; Wernerfelt, 1984). Then operational capabilities serve to leverage these resources in the production and delivery of products and services, enabling the firm to generate revenues (Helfat and Winter, 2011; Winter, 2003). One such operational capability is new product development; in this case, firms draw on their capabilities to produce new and possibly innovative products or services to leverage their resource base. Therefore, the extent to which a construction SME operates and competes successfully, such that it generates quasi-rents,¹ depends on its effective set of operational capabilities.

¹ Quasi- (or Ricardian) rents derive from the scarcity and value of resources and capabilities that are unique and cannot readily be replicated (Klein et al. 1978; Penrose, 1959).

In some cases though, innovations by construction SMEs actually refer to modifications to operational capabilities, such as new production and delivery capabilities or novel new product development capabilities, which enable the SMEs to operate more effectively in dynamic markets. Accordingly, we need to determine how operational capabilities change, from initial development, through integration with complementary or new procedures, to deployment and ultimately to their expiration. The RBV largely ignores change processes within the firm, but another theoretical rationale, the dynamic capabilities view (DCV), offers an interesting complement.

Dynamic Capabilities and Innovation in SMEs

Dynamic capabilities help firms capture Schumpeterian rents,² because with DC, firms can realign their resource base and embedded operational capabilities with any changes in the environment (Zahra et al., 2006) and thereby sustain their competitive advantages (Ambrosini and Bowman, 2009; Teece, 2007). Eisenhardt and Martin (2000, p. 1106) define DCs as ‘specific strategic and organisational processes ..., and strategic decision making that create value for firms within dynamic markets by manipulating resources into new value-creating strategies.’ The DCV thus extends the RBV by providing insights into a firm’s evolving resource stock and associated processes, which develop in response to changing business environments (Makadok, 2001; Teece and Pisano, 1994).

Teece’s (2007) description of DCs specifies three distinct processes that they embody: sensing and shaping opportunities, seizing opportunities and reconfiguring the resource base. *Sensing* involves scanning the environment for opportunities and threats, across markets and technologies (Teece, 2007). For a construction SME to develop a sensing capability, it likely must sustain effective relationships with suppliers, contractors

² Schumpeterian rents accrue from risky initiatives and entrepreneurial insights that lead to innovations, rendered by (new) combinations of resources and capabilities (Amit and Zott, 2001)

and R&D partners; follow best practices; and recognise advances in the industry and related sectors. *Seizing* implies determining and implementing the opportunities and investments that appear most likely to succeed (O'Reilly and Tushman, 2008; Teece, 2007). Finally, *reconfiguring the resource base* suggests that the firm can adjust its internal and external resources and operating capabilities, as needed (Teece, 2007).

Accordingly, DCs allow for modifications to both internal and boundary (e.g., sub-contractors that might be appropriated by the firm; Grant, 1996; Gudergan et al. 2012) resources (Helfat et al. 2007). Through their DCs, firms create and leverage new operational skills and resource configurations—which also represent organisation process innovations—that might contribute to their competitive positioning (Acs and Audretsch, 1990; Olsen et al., 2006; Ellonena et al. 2009). The DC concept continues to undergo refinements and empirical examinations (Green et al., 2008), yet it also provides an interesting potential lens through which to view innovation processes within construction SMEs (Verona and Ravasi, 2003). In particular, Kao et al. (2009) argue that construction firms must undergo continuous readjustments in response to their volatile and changing environments. Such continuous adjustments of a firm's capabilities and resource base constitute the core focus of the DCV.

Assessing Cognitive and Organisational Routines within DCs

Sexton and Barrett (2003) suggest that firm capabilities consist of two main categories: cognitive (or thought) routines (Louis and Sutton, 1991) and organisational (or action) routines (Verona, 1999). Distinct combinations of these two types of routines in turn affect various types of innovations (e.g., project, service, market; Olsen et al., 2006; Rogers, 1995; Sundbo, 1997).

Cognitive routines comprise both automatic, steady-state activities and conscious, active problem solving and innovation. A competitive firm must be able to switch from one

cognitive mode to the other, which implies it also possesses an ability to sense a need for change or stability. Firms likely operate in automatic mode until they sense a crisis point, which prompts them to switch to conscious mode and begin innovating actively. This switch usually requires effective attention management, which can be difficult for firms that have grown complacent within an operating environment. Innovation-conscious leadership thus facilitates the identification of a need to switch from one cognitive mode to another (Sexton and Barrett, 2003).

Organisational routines can be functional or integrative, but they all enable the transformation of cognitive intent into organisational action (Verona, 1999). Sexton and Barrett (2003) suggest that functional routines encourage the firm to deepen its knowledge base, through internal learning and appropriate deployments that enhance the firm's functioning. Integrative capabilities instead broaden the knowledge base, through the capture, blending and dissemination of otherwise disparate knowledge. That is, these latter capabilities refer to absorbing critical knowledge from external sources (e.g., boundary resources) and integrating it into a reconfigured recourse base (Verona, 1999) that then enhances the firm's operations.

Although cognitive and organisational routines thus affect organisational innovation processes differently (Sexton and Barrett, 2003), we find no delineations of these unique roles in existing assessments of the DCV. To address this gap, we suggest an extended conceptualisation of the DCV that integrates Sexton and Barrett's (2003) logic and thus might clarify innovation processes, in the context of construction SMEs.

EXTENDED DYNAMIC CAPABILITIES FRAMEWORK OF ORGANISATIONAL INNOVATION

In Figure 1, we illustrate our proposal for extending the theoretical framework in which firms absorb functional knowledge, using external integration routines (Kenney and

Gudergan, 2006), and consciously take a competitive position in an uncertain, complex environment. They also embed and transform their capabilities within their internal environment, which includes both organisational structures and culture (Ambrosini and Bowman, 2009; Wilden et al. 2013; Verona, 1999). In our extended framework, when the firm's environment changes, accessible recourses get re-bundled and reintegrated, through sensing, seizing and reconfiguring processes. We also differentiate the roles of cognitive (conscious and automatic) and organisational (functional and integrative) routines across these three processes.

Insert Figure 1 about here

Applying Teece's (2007) classification, we posit that firms *sense* opportunities through their differential access to existing information, which results from entrepreneurial endogenous leadership (Lockett, 2005) or opportunities created through the re-synthesis of existing and new information (exogenous or endogenous) (Schumpeter, 1934). Sensing, as an overarching process, includes automatic, cognitive routines that include continuously scanning for opportunities. The sensing process also may be complemented by conscious, cognitive routines that help the firm identify issues with its existing scanning processes and develop better approaches. This improvement involves refining scanning mechanisms, through various uses of endogenous and exogenous resources (Nelson and Winter, 1982).

In the next step, firms *seize* opportunities by specifying and assessing potential business models to leverage a sensed opportunity, using endogenous knowledge and exogenous networking. Similar to sensing processes, the overarching seizing process proceeds through automatic, cognitive routines, such that the firm systematically embraces identified opportunities and activates them through its re-configured operational capability and resource base, using steady-state routines. Again similar to the sensing process,

conscious, cognitive routines also come into play, supporting a reconfiguration of the seizing process to facilitate a particular type of organisational change.

We predict a parallel development for the *reconfiguring (resources)* process, which involves the continuous alignment and realignment of specific, tangible and intangible assets (Teece, 2007) to deliver outcomes from a seized opportunity. We also note that once an opportunity has been sensed, seized and reconfigured, the overall process may move into automatic, cognitive routines until such time as another novel opportunity is sensed.

Furthermore, all three processes receive support from functional and integrative organisational routines that lead to institutionalisation and facilitate the implementation of the cognitive routines at the firm level. For example, integrative organisational routines that mobilise managers to engage with their external environment likely increase exogenous resources, such as knowledge about how to seize opportunities and new product or service developments (Clark and Fujimoto, 1991). Integrative organisational routines also reflect the firm's ability to delineate boundaries for effective communication and control its tangible and intangible assets (Teece, 2007). By developing and defining alliances and partnerships, integrative organisational routines introduce new resources into the firm, which likely improve its scanning, seizing and reconfiguring processes. Furthermore, DCs also pertain to the release of irrelevant or out-of-date resources, so well-established routines for abandoning resource combinations that prove inadequate also are critical (Eisenhardt and Martin, 2000).

Our preliminary, illustrative integration of cognitive and organisational routines as elements of the sensing, seizing and reconfiguring processes suggests the need for an empirical investigation of how this framework can best be conceptualised and operationalised. We undertake such an investigation in the context of construction SMEs in

an attempt to clarify the intricacies of both routines, explain their roles in external and internal environments and predict their impact on innovation processes.

RESEARCH METHODOLOGY

Despite increased attention to the DCV, the conceptualisation of DCs remains somewhat abstract, and the ensuing operationalisations are not straightforward (Danneels, 2008). Empirical investigations also are methodologically challenging (Ambrosini and Bowman, 2009; Newbert, 2007, largely because of the difficulties associated with observing and measuring DCs (Kraatz and Zajac, 2001). Therefore, context-specific assessments of DC-related processes often rely on exploratory, qualitative research (Easterby-Smith et al. 2009; Godfrey and Hill, 1995; Lockett and Thompson, 2001; Rouse and Daellenbach, 1999). Accordingly, we adopt a case study approach, which is suitable for exploring context-specific parameters (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). In this study specifically, the exploratory case study approach supports assessments of the roles of both cognitive and organisational routines with respect to the three DC processes, within a unique organisational context (Eisenhardt and Martin, 2000).

We use a single case (Yin, 2009), which we consider appropriate, according to Siggelkow's (2007) precepts for persuasive case studies. First, the novelty of the case is clear, in that the focal firm has a reputation for innovation. Second, its characteristics would not be expected to exist to the same extent in other average firms in its sector, so the case study firm is atypical. Third, the potential for insights is high, in that the results reveal endogenous, theoretical traits, illustrating firm characteristics that might otherwise remain unseen (Siggelkow, 2007). Furthermore, our method is congruent with a clinical approach to developing a forensic, holistic understanding of the firm and its behaviour (Ekstein, 2000), which we use to extend a theoretical framework through a deductive investigation (Eisenhardt and Graebner, 2007).

The firm we study is a specialist, 'façade' engineering firm that has persisted through several economic cycles and established international operations in various geographical regions. The medium-sized enterprise consists of about 70 employees. As a private company, it does not make its financial performance data publicly accessible, but our interview data suggested that the firm engaged in projects amounting to more than AU\$14 million. Even as firm revenues have grown over time, it has reduced the number of employees, to ensure its survival.

This firm services its clients mainly from its Australian office (operating since 1990) and a sister company in the United Arab Emirates (operating since 2006). It has been involved in high-profile infrastructure and building projects around the world, including airports, railway stations, galleries, high-rise residential buildings and commercial buildings in Australia, Hong Kong, Singapore, New Zealand and the United Kingdom; it more recently added some high-profile projects in the Middle East. This evident expansion makes this firm an appropriate setting to study continuous innovation generation and the underlying processes and routines.

Senior managers represent the main informants for this research, because they participate in strategic processes and routines and understand the difficult-to-observe innovation outcomes that we seek to investigate (Chen et al., 1993). A key informant approach is suitable for researching processes and routines, despite the acknowledged potential for bias and random error that results from this approach, because little archival data exists to describe such organisation-level concepts (Kumar et al., 1993). As Kumar et al. (1993, p. 1634) recommend, 'do not select informants to be representative of the members of a studied organization.... Rather, they are chosen because they are supposedly knowledgeable about the issues being researched and able and willing to communicate about them.' Accordingly, we conducted five in-depth interviews with key senior managers:

the managing director (MD), general manager–Australasian operations (GM/A), general manager–UAE operations (GM/U), design manager (DM) and contracts manager (CM).

The interview guide followed a semi-structured format, and the interviewees could speak freely about their views of how events and conditions developed within the firm's operations. Each of the interviews, which lasted from 50 to 80 minutes, was recorded, transcribed and coded (Strauss and Corbin, 1998), using NVivo to aid the process. We also collected and analysed secondary data from the company's website and relevant news clippings. Although the preliminary theoretical framework guided the data analysis, we sought to avoid constraining any broader interpretations by our preliminary theoretical conceptualisation. The analyses produced deep descriptions of the processes contained in the framework and uncovered several complex influences of DC processes and cognitive or organisational routines on innovation.

CASE STUDY ANALYSIS

We organise our presentation of the case study analysis and our interpretations around our preliminary framework (Figure 1). To begin, we describe the external and internal environments and each of the three DC processes. With Table 1, we illustrate how the sensing, seizing and reconfiguration processes get performed through cognitive and organisational routines and highlight the switches in cognitive processes between automatic and conscious modes.

Insert Table 1 about here

External Environment

This firm faces three key interrelated challenges arising from its international, external business environment: technological change, market volatility and complexity. Technological advancements affect the firm's products (i.e., façade systems) and production processes (i.e., for designing and fabricating façades). Although the firm's products have

not changed in nature, gradual, significant, incremental developments had altered them, including a shift in the design philosophy from static/rigid systems to more complex ‘living’ systems. In addition, developments in clamping, cabling and glass technology, both in isolation and together, have provided myriad innovative design and fabrication alternatives. From a process perspective, significant innovations in technology machining tools have enabled innovations in the design, engineering and manufacturing processes associated with individual components of façade systems.

Volatility in domestic and international markets also has contributed to two forms of business uncertainty: responding to erratic product demand patterns and managing fluctuating demand for production resources. Structural adjustments in the Australian manufacturing sector, due to changes in national and international factor markets, also have introduced new layers of complexity and uncertainty into resource procurement. Furthermore, the firm has faced complex processes in international markets related to financial (e.g., currency locations, banking regulations, tax processes), legal (e.g., contract forms, payment terms, industrial relations) and cross-cultural (e.g., employees’ cultural backgrounds, interpretation of client requirements) specifications. Thus, the external environment, in which niche clients demand unique façades systems, constantly challenges the adequacy of the firm’s existing capabilities.

Internal Environment and Operational Capabilities

The managing director (MD) has strongly influenced this firm’s initiatives and direction. In particular, the MD does not believe in growing the firm simply for the sake of being big; he remains constantly mindful of the size of the firm and its ability to offer flexibility and scalability in response to opportunities and threats. Senior managers also agree that the firm’s core business depends on their own tacit knowledge. Thus, they assert that

undertaking unique projects and engaging in endogenous and exogenous relationships enables them to deepen and extend their knowledge base.

The firm has developed distinct capabilities to deliver innovative engineering façade systems by exploiting innovations in other areas, such as material science, software systems, global logistics and communication. The MD also claims that the firm has developed skills in breathing façade systems that its competitors lack. The MD's deep internal knowledge base in manufacturing and mechanical engineering, integrated with the firm's procurement skills, enables the firm to design and offer high quality but cost competitive façade systems.

With its organic structure, the firm also facilitates resource sharing across units, which enables it to respond to changes in demand that arise from urgent requests from clients, variations in work priorities or unexpected volatility in the external market or internal resources. The firm culture promotes the idea of providing value to clients through high-quality work and pushing boundaries. These cultural values help the firm in both its non-adversarial and adversarial business and project environments. Its key strength lies in its aggressive management of its employees and supply chain members, requiring them to deliver quality and performance:

We're a quirky company ... it either works well for you in [our firm] or it doesn't work at all. We're quite hard on ourselves from the point of view of performance and quality. We don't really pretend to put up a nice, mothering, nurturing approach with our sub-contractors. Most of our long-term suppliers obviously found [the need to] have this lifetime value approach to their client. Some of the guys have been here for 15 years. We're still in business. We've come through a number of construction industry crises and survived. So culturally, although people might say that

we're lacking, as anyone can, the cliché, the harder we work and the smarter we are, the luckier we get. (MD)

In addition, the firm's process for managing relationships is context specific and targeted (i.e., opportunity based). Responsible managers foster constructive relationships among employees within the firm. In interactions with host country units, they also consciously contextualise their home country practices to acknowledge local work cultures and practices:

I think we have 13 nationalities in our [UAE] office. We've [found] that [in Dubai] different nationalities are recognised [to do certain tasks].
(GM/U)

DC: Sensing Opportunities and Threats

The case study data suggest that the sensing process features steady activities, such that the firm performs certain automatic, routine activities constantly (see Table 1). The sensing process leads to key outcomes, such as an ability to identify the changing needs of the client base, fluctuating local/international market conditions or the shifting technological landscape. However, other parts of the sensing process are performed consciously, with a view to identifying specific threats and opportunities for innovation. The following quote highlights the firm's overall approach to sensing opportunities and pursuing them through cognitive (e.g., 'thinking') and organisational (e.g., 'longer term') routines.

... well in fact, those innovative relationships and the way in which they get to be made, don't necessarily come just from someone saying, well this is an alliance project. It comes from people thinking, as they go into a project, and how they choose to make relationships work over the longer term. Then of course we started reviewing what we'd already done with

you all those years ago and thinking, I wonder if we could find something useful from that other angle. (MD)

In particular, the firm performs its sensing process using automatic routines in established niche markets, but managers apply conscious routines to scan emerging sectors (e.g., public or private sector clients requiring high end façade systems) or peripheral niche markets that might value the firm's capabilities (e.g., glazed roofing).

We stayed away from most commercial developments [in Dubai]. We cater to a certain niche ... primarily on government projects because the level of quality required and the experience required. ... Therefore we have addressed the threats from low-end low margin competition (GM/U)

These conscious cognitive routines then link with organisational routines to enable the firm to explore developing and new technologies that might affect the business. Managers consciously explore opportunities with their supply chain partners through integrative organisational routines, such as exploring how new technologies offered by supply chain partners (e.g., facade engineers, glass suppliers, fixture manufacturers) might lead to new business opportunities. Senior managers travel intensively to identify value-creating suppliers with which they can build relationships to create new opportunities:

What's the lifetime value of an iPhone customer on a particular plan? That becomes the value of the goodwill on a balance sheet. So what's our value to glass [and other] suppliers?... We relate to [our suppliers and customers and our suppliers relate to us through] that concept. (MD)

In addition, the ability to secure business through client recommendations is a testament to the firm's ability to use conscious cognitive routines, supplemented with functional and integrative routines, to sense and respond to changing customer needs in different niche markets. For example, its sensing process enabled the firm to identify a new

(peripheral) market opportunity for double-glazed window units in Australia. According to the CM, not many suppliers had detected the significance of this market, which was driven largely by the green energy push. But through conscious sensing processes driven by cognitive routines, the focal firm perceived this potential opportunity. These findings thus suggest that the firm aptly identifies opportunities and potential threats through meticulous cognitive and organisational routines, then acts on them.

DC: Seizing Opportunities

Evidence of the firm's past vigilance demonstrates its use of seizing processes, involving both conscious and automatic cognitive routines. In addition, the case study data show that the firm can switch from automatic to conscious routines, after it senses a problem that challenges its steady operational state. The primary example is the firm's decision to switch from acting as a solely Australian-based operation to expand into international operations and thereby respond to the external threat associated with demand volatility in the Australian market. The firm entered new host countries (e.g., Singapore, Hong Kong) using conscious cognitive routines, backed up by functional and integrative organisational routines. After it had begun exploiting these opportunities, the firm stabilised its seizing process, switching back to automatic cognitive routines.

In addition, opportunities offered by new information technologies or product development ideas undergo careful evaluations, prior to their potential adoption. The MD purchased a 3D printer, which he thought would add value by enabling the firm to make prototypes to display for clients. However, a popular, high-end, software technology tool (i.e., Building Information Modeling [BIM]) was rejected for its limited value to the core business:

A lot of the architects are using Revit [BIM], but [we] can't do [the level of] detailing in Revit [current version]. (DM)

The opportunities that the firm seizes largely contribute to process improvements, such as innovations in the manufacturing and transportation sectors (as in the previously discussed example of the double-glazed window units). It combines conscious cognitive routines with functional organisational routines to select appropriate clients, with which it can develop loyalty and commitment. Lessons learned from dealing with difficult clients in the past have become embedded in top management's tacit knowledge base, informing the functional organisational routines of the firm, to avoid such clients in the future. This tacit knowledge base consistently informs the firm's decisions, which suggests path dependency in its decisions about new technology adoption and new market penetration.

The service provided to long-term, high lifetime value clients generally reflects automatic organisational routines, which have enabled the firm to build and maintain its reputation and create the potential for repeat business and referrals. However, any changes to existing client or supplier relationships are consciously sensed and addressed in a timely manner. That is, conscious cognitive routines are critical for seizing an appropriate client and supplier network. In turn, the firm develops relationships in a context-specific manner, using the lifetime value concept driven by functional routines (i.e., based on the firm's internal knowledge about the value of suppliers or customers). Specifically, the firm determines each supplier's or customer's value to it, then engages with valuable ones by developing long-term partnerships, but adopts short-term, arm's-length approaches to others. When the firm senses competition among suppliers of non-critical supplies, it takes advantage of the situation to use price-driven procurement methods.

Furthermore, managers are conscious of the need to recognise and seize opportunities that do not relate directly to economic outcomes, such as developing trust-based relationships and engaging with the community. The firm offers internships and scholarships for students; it engages with educational institutions in an advisory role.

Through such activities, the firm consciously develops partnership routines that can introduce new exogenous resources. The seizing process for such non-economic factors thus reflects integrative routines.

Through their diligent seizing processes, the managers claimed they could deliver projects that their competitors could not. The DM specified the firm's ability to mobilise its functional (i.e., deep knowledge within the firm, collectively developed by designers, project managers and procurement specialists) and integrative (i.e., knowledge gathered from boundary resources, such as consultants and suppliers) routines to push the boundaries of its offerings. The firm's organisational routines and resources grew gradually, through constant work on unique façade systems, and its partnering approaches allowed it to exploit new external boundary resources (e.g., glass suppliers, design consultants), to its advantage.

Finally, exit routines describe explicitly how the firm abandons existing, inadequate resource combinations. For example, evaluating and dismissing consultants or suppliers that fail to perform up to expectations is an automatic cognitive routine, undertaken through both functional and integrative organisational routines.

Some of [consultants/suppliers] are better than others and we've had bad ones and we've had reasonable ones.... [We will] not use the not good ones again. It's really based on performance. (GM/A)

DC: Reconfiguring Resources

The firm has continuously aligned and realigned its specific tangible and intangible resources to sustain and improve its operations. Its key endogenous resources are its employees and its knowledge base (both codified and tacit); exogenous (boundary) resources include consultants and suppliers. The firm deploys functional organisational routines to re-bundle these resources, with a view to reducing the extent of outsourcing:

We're good at shuffling things around and trying to come up with a better way, a better price to do it, because everybody else just puts their mark-ups on it. (DM)

For example, the firm has developed the capacity to design and fabricate unique breathing façade systems by re-bundling its operational production capabilities for static façade systems with boundary resources. In addition, the firm reconfigured its existing business capabilities to take advantage of logistic opportunities to expand its business internationally. The firm also re-bundled resources associated with façade systems to seize the opportunity to develop double-glazed windows, as we noted previously. In reconfiguring boundary resources, the firm was able to take advantage of its suppliers' quality standard certifications. To address delays by a supplier in China, it relied on a consultant with whom it previously had developed a relationship.

Its most recent initiative sought to introduce an innovation that it tested successfully in Dubai into the Australian market. Specifically, the firm observed that the inadequate experience with onsite fabrication among drafting suppliers led to poorly detailed drawings. To address this issue, the firm placed a draftsman on site for an extended period, to allow the supplier to learn about fabrication processes. The knowledge that the draftsman gained by observing onsite fabrication enhanced the detail of the resulting drawings and ultimately improved operations. This example also highlights the firm's ability to share skills and replicate resource generation in various locations and situations.

By consciously integrating its key resources with context-specific client requirements, the firm can design façade systems in accordance with its predetermined cost estimates. The MD's manufacturing sector experience (functional routines), integrated with the skills of consultants and suppliers (integrative routines), and the subsequent deployment of prudent procurement approaches enabled the firm to arrive at practical alternative façade

designs with suitable pricing and support design-cost evaluations. This competitive advantage of the firm is rare, in that few competitors can price their designs with reasonable accuracy. Instead, competitors must wait for manufacturers and suppliers to clarify whether an element can be produced and at what cost.

Learning and reflection on its success and failures constitute the firm's conscious cognitive routines, which strengthen both functional and integrative routines. Learning accumulated through sensing, seizing and reconfiguration processes gets captured in functional routines, to deepen the firm's knowledge base. In most cases, this knowledge is neither codified nor shared; rather, it remains tacit and resides in the minds of the MD and senior managers, which they regard as a form of intellectual property rights protection:

The realm of patent [provides] protection [but] costs a lot of money. What we do requires ingenuity and intellectual property that really resides in the minds. (MD)

Finally, its façade systems design process seeks to reduce the need for highly skilled labour during site fabrication. Thus it can compete more effectively on quality and price in less developed nations, where access to highly skilled labour often is limited. The re-allocation of drafting duties between the UAE and Australian offices, using simple processes, illustrates the firm's capacity to reconfigure its resources as necessary:

We'll draw [in Australia] and [send it to UAE for them to] draw overnight and then we'll have it back in the morning.... If you work it properly, you could have a 24-hour drafting cycle. (GM/A)

DCs and Innovation Processes

The case study data indicate three temporal dimensions, describing how the firm's resources have changed over time. First, the firm developed a capability to deal with volatile markets. After some years of operation in Australia, it expanded into Asian markets, using an export

mode. Since 2006, its Middle East operations have been performed by a sister company, which operates in a foreign direct investment mode. This progression exemplifies a distinct capability development. Second, the firm developed technical capabilities to design, engineer and fabricate breathing façade systems over time by re-bundling its existing resources. Third, it has devised more flexible process and managerial systems. Thus the firm has not remained a rigid set of systems and processes but instead proved to be more flexible and elastic in adapting to changes in the external environment.

In turn, it has produced a range of innovations, including product and service (e.g., breathing façade system), process (e.g., deployment of cutting-edge software to reduce design times), market-based (e.g., designing products for specific markets, such as high-end clients; focusing on government clients in international markets), supplier-based (e.g., long-term relationships with key suppliers; ensuring quality, price and delivery standards), organisational (e.g., boundary-spanning roles such as an onsite draftsman, shared routine duties between Australia and Dubai) and business model (e.g., mix of lifetime value and arm's-length approaches) innovations. That is, firm's DCs feature innovation processes that have helped it produce modification to products, markets and processes.

DISCUSSION

This case study indicates the relevance of the extended dynamic capabilities framework that we propose (Figure 1), as a means to explicate influences on innovation in the context of construction SMEs. The case analysis suggests that this context tends to be moderately dynamic; that is, it changed frequently but also was reasonably predictable and maintained a relatively stable industry structure (Eisenhardt and Martin, 2000). The firm engaged in detailed routines that operated automatically, drawing mainly on its tacit knowledge. Its sensing, seizing and reconfiguration processes were the primary automatic organisational DC processes that fostered innovation. Simultaneously though, the firm displayed complex

organisational routines that were functional and integrative in nature, and it shifted between automatic and conscious cognitive routines with agility. This finding resonates with both Eisenhardt and Martin (2000) and Helfat (1997), who suggest that routines that use existing knowledge are most appropriate for operating in dynamic markets.

As is true of many firms, the most substantial resource base for our case firm was intangible, in the form of knowledge residing with the workforce. High-level, conscious organisational routines drive implicit learning within the firm, tacitly generating organisational knowledge through higher-order learning (Ambrosini and Bowman, 2009). For our case firm, this capability strongly contributed to its competitive positioning through innovation. Other intangible resources included the collective practices of the organisation (e.g., planning, coordinating, developing supply chain relationships) and customer loyalty. Experience gained from dealing with previous small, frequent changes in the environment strengthened the firm's capacity to deal with present and future changes (Haleblian and Finkelstein, 1999). Ultimately intangible assets generated successful, valuable innovations.

Extending the boundaries of a firm by including various members of the supply chain or effectively managing trade relationships represented a key reconfiguring routine that facilitated innovation generation (Eisenhardt and Martin, 2000); it might even compensate for a lack of internal resources, if the SME can source them from boundary suppliers. Our case study firm possessed a clearly defined set of strategic, upstream supply chain relationships; the findings thus contest the view that firms cannot integrate boundary resources of sufficient breadth or depth to foster innovation opportunities (Grant, 1996). The focal firm's ability to integrate intangible boundary resources to respond to opportunities arising from dynamic markets and devise novel, difficult-to-imitate outputs reflected its capacity to change and improve its performance, through innovations (Eisenhardt and Martin, 2000; Teece, 2007).

According to Wright et al. (2005), hostility in the external environment prompts innovativeness; accordingly, our case study firm operated in a competitive market, in which mistakes would be both public and damaging. Thus it developed a strong zero-defect culture, which in turn fostered incremental design and supply chain innovations. Functional organisational routines were regularly tailored to this end; for example, it embedded staff in suppliers' firms for quality assurance purposes and sent designers to work sites to experience the consequences of their design decisions (Yap et al., 2005).

However, we found no formally organised innovation program or specific R&D; innovation occurred largely spontaneously or just emerged, mostly due to the technological leadership provided by the MD (Nam and Tatum, 1997). The firm's ability to innovate without a conscious innovation agenda contrast with the conventional wisdom that innovation-conscious leadership is necessary (Sexton and Barrett, 2003). However, this finding resonates with Susman et al.'s (2006) assertion that SMEs do not invest in direct research but rather engage actively in continuous developments and improvements that lead to innovations. They argue that capturing meaningful R&D investments by SMEs is problematic, because they focus less on research and more on development. In our case firm, development activities (e.g., design and engineering processes, prototype development, resilience testing) were partly or wholly funded by clients, through the project budgets.

Furthermore, many of the incremental innovations achieved by this firm resulted primarily from development processes that relied on conscious cognitive routines coupled with functional and integrative organisational routines. If SMEs truly do not need to make explicit investments in research, they could enjoy at least three advantages: (1) They would not need to tie up their capital in R&D to maintain their innovative capabilities and competitiveness, (2) they could avoid the pressures and associated costs of protecting their intellectual property rights and (3) the unique capability mix they derive from a

development approach would be difficult for competitors to copy. Thus, competitive-conscious leadership seemingly can enable the firm to maintain its sustained competitive advantage (see Somaya and Teece, 2007) by driving incremental innovations (Nooteboom, 1994; OECD and Eurostat, 2005), as the following examples from the case study reveal:

- *Product and service innovation:* After more than 20 years of development, cable-stayed glass façade systems helped reduce material use and increase customer value.
- *Design and process innovation:* Fewer skills were required for onsite assembly, due to innovative designs, information transfer and manufacturing.
- *Market-based innovation:* To avoid low margins, the firm constantly adjusted to the markets in which it operated.
- *Supply-based innovation:* The firm incrementally developed an excellent supply network, including short-term, arm's-length relationships and long-term, strategic partnerships.
- *Organisational innovation:* Through flexible organisational structures and practices, the firm could share resources across its international offices, with the support of its strong staff development practices.
- *Business model innovation:* The customer lifetime value approach to both upstream and downstream supply chain relationships relied on the firm's reputation and referrals, eschewing competitive tendering.

Overall, the strategic approach of this firm embodies Susman et al.'s (2006, p. 10) recommendations that 'SMEs need to pursue innovation strategies that do not rely on scale of production or marketing, but on product customisation and customer intimacy' and that 'scale should be sought by geographical expansion to similar ("narrow but deep") product markets, not by product-line diversification.'

Our focal firm possessed the capability to assimilate opportunities offered by the external environment (market-based view) with capabilities in its internal environment to foster different, cohesive innovation trajectories (Sexton and Barrett, 2003). Moreover, its use of both cognitive and organisational routines enabled this firm to develop incremental innovations. Its DCs fostered innovation, though with uncertain outcomes. In turn, the firm could offer unique value and avoid a low margin existence, which Teece (2007) considers a key outcome of a firm's possession of DCs.

This innovative, medium-sized enterprise in the construction sector offers some notable insights, and the case study findings support our extended dynamic capabilities framework. However, these findings cannot provide a sufficient basis for generalisation. Rather, we offer a detailed assessment of the application of the proposed framework in a particular case, which generally supports its suitability for deductive research (Eisenhardt and Graebner, 2007). We caution that these findings should not be generalised beyond this particular case (Siggelkow, 2007), nor be considered conclusive empirical evidence.

CONCLUSIONS

We propose using the DCV to contextualise innovation in construction SMEs. The processes of sensing, seizing and re-configuring are essential to this framework, and we have sought to unpack them further by exploring the roles of cognitive (conscious and automatic) and organisational (functional and integrative) routines. Then to assess our proposed extended DC framework, we drew on in-depth data obtained from a single case study. The findings indicate that the case study firm maintained automatic, cognitive (i.e., steady state) organisational routines that enabled its sensing, seizing and reconfiguring processes. Furthermore, the routines underlying the sensing process, usually performed through conscious cognitive routines, could switch between automatic and conscious cognitive modes as necessary.

The findings also indicated that the firm had the capacity to reconfigure its key resources through functional and integrative organisational routines. Valuable resources—mostly intangible knowledge vested in the firm’s workforce—available both within the firm’s operations (endogenous resources) and through its networks (exogenous boundary resources) could be reconfigured swiftly to respond to changes in the environment that its automatic routines sensed and seized. Furthermore, the accumulation of resources and strengthening of its operational capabilities (e.g., technical knowledge, information transfer) over time suggested that the firm had achieved modifications of its operational capabilities and thereby created a sustainable competitive advantage.

This analysis of the firm’s DCs clearly revealed that their influence led to many unconscious, or unplanned, innovations in different parts the firm. The firm’s incremental innovations applied to its products, service offerings and processes, all of which contributed to its persistent competitive advantage. Intangible innovations related to its market positioning, supplier relationships, internal structure and business model also made key contributions to its competitive position.

In conclusion, this study offers three main contributions. First, we establish that a close consideration of the differential roles of cognitive and organisational routines can provide an insightful means to evaluate innovation in firms. Second, this research highlights the significance of pursuing the development part of R&D, especially when conscious cognitive routines, combined with functional and integrative organisational routines, indicate an opportunity for an incremental innovation. Third, for medium-sized firms in the construction industry, the possession of dynamic capabilities apparently can lessen the need for a conscious innovation agenda, because the capabilities themselves foster unconscious, incremental innovation.

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Figure 1: An Extended Dynamic Capability Framework

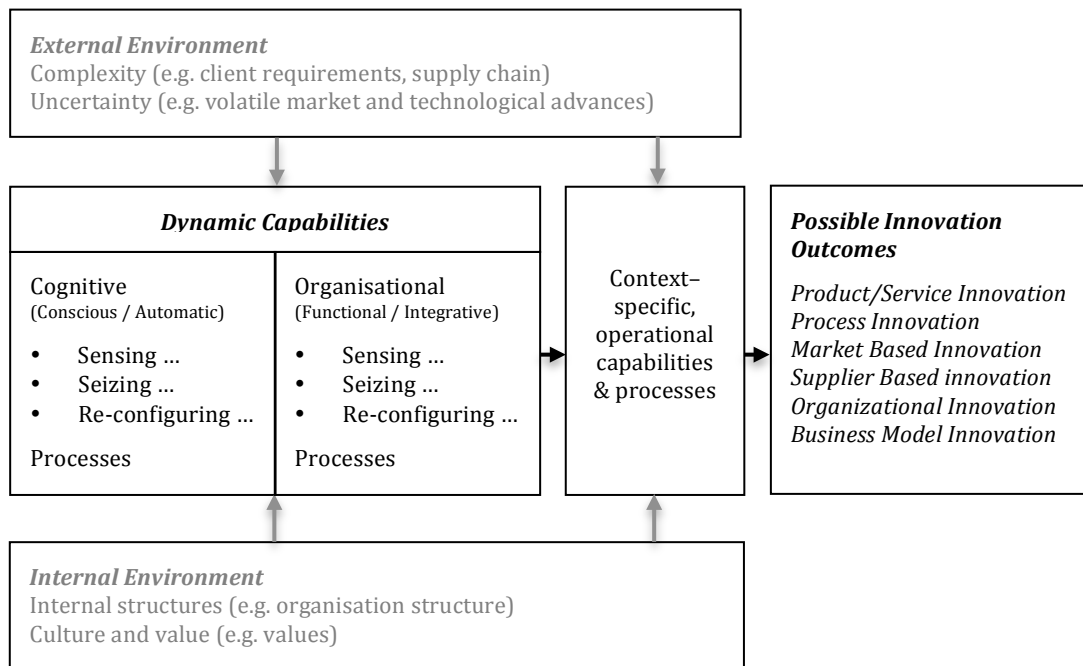










Table 1: Mapping the DC identified in the case study firm

Processes/Routines	Cognitive (or thought) Routines		Organisational (or action) Routines	
	Conscious, active problem-solving routines	Automatic, steady-state routines	Functional routines & deepened knowledge application	Integrative routines & broadened knowledge application
Sensing: Differential access to existing information by entrepreneurs or re-synthesizing information and new knowledge	Sensing includes steady-state activities, but most elements of the sensing process involve conscious routines.		Sensing is a process organized (or put into action) by both functional and integrative routines.	
(a) Engage in internal initiatives to identify or develop new technologies	√	X	√	√
(b) Explore and adopt technological developments exogenous to the firm	√	X	√	√
(c) Explore innovations by suppliers for adoption	√	X	√	√
(d) Identify changing customer needs and niche markets.	√	X	√	√
Seizing: Specifications of opportunities that can result in productive product/service development	Seizing includes both conscious and automatic cognitive routines. Firms might switch between them.		Seizing is a process organized (or put into action) by both functional and integrative routines.	
(a) Cautious adoption of technologies and product development ideas.	√		√	√
(b) Appropriate client/customer selection and building up loyalty and commitment	√		√	√
(c) Recognize non-economic factors	√		√	√
(d) Developing alliance and acquisition routines to bring new resources into the firm from external sources	√		√	√
(e) Establishing exit routines for abandoning resource combinations that are inadequate to offer competitive advantage	√		√	√
Reconfiguring: Continuous alignment and realignment of specific tangible and intangible assets	Reconfiguring includes conscious and automatic cognitive routines. Firms often switch between them.		Reconfiguring is a process organized by both functional and integrative routines.	
(a) Leveraging resources by replication or deploying them in a new domain	√		√	√
(b) Tasks performed more effectively and efficiently as an outcome of learning through reflecting on failure and success.	√		√	√
(c) Creative integration by integrating assets and resources, resulting in a new resource configuration.	√		√	√