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In addition to the above conditions, authors give their consent for the digital copy of their work to be used subject to the conditions specified on the Library Thesis Consent Form and Deposit Licence.
Implications of Openness: An assessment of the dynamics of open innovation engagement to the intrinsic characteristics of innovative small and medium enterprises

_Fern M Evitt_

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Management
The University of Auckland, 2014
Abstract

Promoters of open innovation highlight advantages in overcoming knowledge and other resource shortages to realise innovation objectives. Consequently, indications are that adoption of such collaborative practices would be beneficial to address the well-recognised innovative SME characteristic of resource shortages that impede innovation. However, open innovation research generally centres on large firms and focuses on the advantages of engagement, with less known of the disadvantages (Dahlander & Gann, 2010). The literature continues to be scarce regarding whether open innovation is predominately contributory or detrimental to SMEs (Huizingh, 2011).

This study investigates engagement in open innovation to determine the implications to innovative SMEs’ characteristics. From a systematic review of the literature on open innovation and the domain of the innovative SME, a framework is derived to guide the empirical research. The research method employed two stages; firstly, a questionnaire to 25 New Zealand engineering SMEs established the presence of open innovation. Six of these firms then participated as case studies for the second stage of research. This study finds:

1. Open innovation affords access to critical innovation-required resources for SMEs, however engagement presents serious detriments, primarily relating to personnel.
2. Decisive challenges for practitioners include steep demands on management, time issues, and internal resistance.
3. Whereas the majority of effects span open innovation engagement, certain practices incur specific effects.
4. As open innovation is contingent upon interaction with external entities, effective management of the relationship dimension and relational competence are determinates of success.
5. To optimise engagement benefits, SMEs implement a range of organisational practices.

This study contributes to the existing literature on open innovation and SMEs by developing understanding of the effects of engagement. Results indicate that while detriments are significant, the importance of the benefits surpasses the detriments, with case firms employing practices to manage the effects of engagement. Moreover, open innovation enhances organisational learning, in turn developing the organisational practices to optimise the return on open innovation endeavours in an interrelated cyclical process. The final model integrates this cyclical process to illustrate the dynamics of open innovation engagement by innovative SMEs and provides a framework for further research.
Dedication

To Michael: you are a constant source of inspiration, encouragement, and unfailing love. Thank you for being so magnificent, for supporting me throughout my PhD, for always being there, sharing the highs and the lows. Here is to the next exciting stage of our journey together.

I dedicate this thesis to you.
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List of Abbreviations:

BAU: Business as usual
CRIs: Crown Research Institutes
CRM: Customer relationship management
HERA: Heavy Engineering Research Association
ICT: Information and communication technologies
IP: Intellectual property
JIT: Just in time (manufacturing)
NIH: Not invented here
NDA: Non-Disclosure Agreement
NSH: Not sold here
NPD: New product development
OECD: Organisation for Economic Co-operation and Development
OEM: Original Equipment Manufacture
OUH: Only used here
R&D: Research and Development
SME: Small and Medium Enterprise
UN: United Nations

Position descriptions of case firm participants:

CEO: Chief Executive Officer
CM: Commercial Manager
FM: Factory Manager
GM: General Manager
OD: Operations Director
QAM: Quality Assurance Manager
R&DD: Research and Development Director
SM: Sales Manager
SMM: Sales and Marketing Manager
Chapter One

OVERVIEW OF THIS STUDY

1.1 Introduction

Innovative SMEs are characterised by resource deficits. Claims that open innovation can rectify such deficits disregard the consequences of practice adoption. This is unsurprising as little is known about the negative effects of open innovation engagement (Dahlander & Gann, 2010; Knudsen, 2007; Luoma, Paasi, & Valkokari, 2010b; West & Bogers, 2013). The literature, although light on the subject, suggests that for SMEs, the costs of engagement threaten the viability of adopting the practice. However, practices supportive of innovative SMEs’ realisation of innovation are critical for business sustainability and to manage an environment typified by intensifying competition under globalisation.

Notwithstanding the imperative for SMEs to innovate as a determinant of firm survival, the reality is that efforts regularly fail (Baum, Calabrese, & Silverman, 2000; Cefis & Marsili, 2006). The literature abounds with examples of impediments stemming from the acknowledged negative characteristics of innovative SMEs (e.g., Freel, 2004; Rothwell, 1983; Rothwell & Dodgson, 1994; Vossen, 1998b). Rothwell’s (1983) seminal article on the innovation advantages and disadvantages relative to firm size refers to the “characteristics of small innovative companies” (p. 19). He identifies the behavioural characteristics of the small firm as offering innovation advantages while lack of resources hinders innovation.

Innovation is particularly arduous for the innovative SME as their characteristic lack of resources precludes the realisation of innovation objectives. The average SME struggles with limited financial and human resources, and often representative of skill deficiencies mean few have adequate capacity to manage the entire innovation process; instead, SMEs rely on their networks to compensate for resource deficiencies (S. Lee, Park, Yoon, & Park, 2010; van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Therefore, to achieve the vitality which innovation represents, adopting practices such as those associated with open innovation appear ideal. However, such practices are often characterised by high complexity.

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1 This study employs the term characteristics of innovative SMEs, or innovative SMEs’ characteristics in reference to the advantages and disadvantages of the innovative small firm as per Rothwell, 1983, Rothwell & Dodgson, 1994 and others (see Chapter 4).

2 Innovation defined herein as “the implementation of a new or significantly improved product (goods or services), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD, 2005b, p. 46).
and risk (Chesbrough, 2010; van de Vrande et al., 2009). Moreover, unknown are the consequences of practice engagement to innovative SMEs and their intrinsic characteristics, the extent of the consequences likely to dictate the effectiveness of open innovation endeavours.

While open innovation presents SMEs with alternative innovation strategies to traditional activities, the internal effects may negate the value of engagement. Huizingh (2011) points out under-researched areas of open innovation exist in respect of application effectiveness and the firm’s internal environment. Similarly, our understanding of the managerial implications of open innovation and the negatives of engagement continues to lag (Dahlander & Gann, 2010; U. Lichtenthaler, 2010b; Wynarczyk, Piperopoulos, & McAdam, 2013). Spithoven, Vanhaverbeke and Roijakkers (2013) emphasise the deficit of open innovation studies in SMEs, highlighting the innovative SMEs' characteristic shortage of resources to accentuate the difference between SMEs and larger firms. According to the authors, resource differences is one of the areas making large firm open innovation research unsuitable for appreciation of open innovation in the SME. Indeed, Vanhaverbeke, Vermeersch and De Zutter (2012) go so far as to state that the demands of the contemporary business environment demonstrate an “urgent need to study open innovation in small firms” (p. 9). While there are indications of research increasingly directing towards open innovation in SMEs, a more systematic and critical view of how open innovation practices impinge on innovative SMEs is still lacking.

It is appreciated that open innovation offers advantages in the realisation of otherwise unachievable innovation objectives (Hoffman, Parejo, Bessant, & Perren, 1998). However, van de Vrande, de Jong, Vanhaverbeke, and de Rochemont’s (2009) study of SMEs and open innovation suggests there may be a variety of organisational and managerial challenges. Their results indicate that the application of open innovation is rife with intricacies requiring further research on the dynamics of open innovation in the innovative SME. These deficits in knowledge of open innovation have arisen due to open innovation research typically focuses on large and high technology firms, and tend to favour the benefits to engagement (Chesbrough & Appleyard, 2007; Dahlander & Gann, 2010; Knudsen, 2007; Miotti & Sachwald, 2003). Therefore, this study aims to advance understanding of open innovation and the SME by examining whether the implications of practice adoption primarily benefits or negates SME engagement.

This study ignores Lichtenthaler’s retracted articles (12 as at September 2013). Although there is risk of further retractions, the cautious retention of some of his articles herein relates to their significant contribution to open innovation in this study.
In pursuit of investigating the implications of open innovation engagement in SMEs, the following sections of Chapter 1 establish the intentions of this study; introduce key constructs, and set out the theoretical positioning of the research. Section 1.2 briefly explores the domain of the study: the open innovation phenomenon, the characteristics of innovative SMEs, and the need for alternative options in pursuit of innovation. Section 1.3 explains the purpose of this study to attend to the gaps in the literature. Section 1.4 articulates the research question; section 1.5 describes the research design and context of the study. Next, section 1.6 gives the definitions employed with section 1.7 summarising the chapter. Lastly, section 1.8 provides the outline structure of the thesis.

1.2 The domain of this study

Specifically, this study considers SMEs' application of open innovation, the consequences experienced from engagement, and the management of these consequences. The approach is from the perspective of the firm to develop understanding of open innovation in the context of the innovative SME, the implications of engagement to the intrinsic characteristics associated with their innovative nature.

This study is positioned within the innovation literature across two conversations: open innovation and that of the innovative SME. While this is not a new juncture for the two, SMEs continue to be under-represented in open innovation research (West, Salter, Vanhaverbeke, & Chesbrough, 2014). Recognised as an important oversight, there is a growing presence of studies on open innovation in SMEs with mounting interest of in situ application (e.g., S. Lee et al., 2010; Rahman & Ramos, 2010; van de Vrande et al., 2009; Vanhaverbeke, 2011; Vanhaverbeke et al., 2012; Wynarczyk, 2013). For instance, Vanhaverbeke’s case study (2011) of open innovation in a Danish SME emphasises the advantages of open innovation to address SME business threats caused by resource inadequacies. The findings of his research indicate the importance of open innovation to SMEs. However, his study does not delve into the consequences to SMEs of their open innovation engagement.

1.2.1 Open and Closed Innovation

Until recently, innovation was considered the province of the single firm and occurring solely within firm boundaries (Chesbrough, 2003a, 2003b; S. Lee et al., 2010). Conversely, open innovation practices are externalised, permeating organisational boundaries to intentionally explore all sources of innovation opportunities wherever they may be (Elmquist, Fredberg, & Ollila, 2009; Porter & Stern, 2001; van de Vrande et al., 2009). Since
Chesbrough (2003) first summarised the various external innovation practices under the term *open innovation*, interest and research in this area has grown rapidly (Knudsen & Mortensen, 2010; Ollila & Elmquist, 2011; West & Bogers, 2013). Attracting attention from academics and practitioners alike, open innovation is a young research field which continues to garner much empirical consideration (Gassmann, Enkel, & Chesbrough, 2010; Ollila & Elmquist, 2011). However, in reviewing the literature on innovation, van de Vrande et al. (2010) campaigned against debating the novelty of open innovation. Instead, they suggest that the focus should direct towards how implementation contributes to improve innovation.

### 1.2.2 Why open up

Advocates of open innovation advise adoption positively influences firms’ innovation endeavours and improves innovation realisation, offering up open innovation as a new innovation management paradigm (Chesbrough, 2010; Freel, 2007; Gassmann et al., 2010; West et al., 2014). Studies investigating open innovation point to the value of firm engagement. For example Cosh and Zhang (2011) found that implementation of open innovation increases firms’ innovation competencies. Similarly, Laursen and Salter (2006) reference the superior innovation performance resulting from firms implementing open innovation.

Organisations are encouraged to shift their innovation activities from firm-centric to adopt an external focus incorporating innovation practices that span firm boundaries (Freel, 2007; Gassmann, 2006). An open innovation focus examines the external environment to realise innovation through a variety of sources and mechanisms (Huang & Rice, 2009; U. Lichtenthaler & Ernst, 2006; Porter & Stern, 2001). Consequently, there is no longer an expectation that firms should remain isolated when innovating (OECD, 2008), instead firms to source and acquire resources regardless of organisational boundaries, access complementary expertise, technologies, and especially knowledge, in order to facilitate innovation (Hagedoorn, 1993; U. Lichtenthaler & Ernst, 2007). Chesbrough (2003a, 2003b) argues that open innovation supplements and in some cases replaces *closed innovation*\(^4\). The preoccupation with fully internalised innovation becoming redundant as no longer representative of the sole innovation practice (Belderbos, Carree, & Lokshin, 2004).

In the closed model, innovation is the domain of the single self-reliant firm, and considered as facilitating the modern corporation (Chandler, 1977; Freeman, 1982; S. Lee et al., 2010; U. Lichtenthaler, 2008). However, firms of all sizes are increasingly traversing

---

\(^4\) Chesbrough’s (2003a, 2003b, 2003c) term to describe the containment of the innovation process solely within a firm’s boundaries.
organisational borders to generate, capture, and deploy innovative knowledge and other resources through interactive engagement with other organisations (Belderbos, Carree, & Lokshin, 2004; Chesbrough, 2010; Edwards, Delbridge, & Munday, 2005; Gassmann et al., 2010; P. Powell, Koput, & Smith-Doerr, 1996; West & Gallagher, 2006).

Firms seek additional methods to realise innovation in response to a range of factors too great for any one firm to manage (Chesbrough, 2003a; Chesbrough, Vanhaverbeke, & West, 2006). Representative of the contemporary business landscape is the mobility of workers, technological progress and sophistication, shortened technology life cycles, and the increasing dispersion of knowledge (Chesbrough, 2003a, 2003b; Chesbrough et al., 2006; Gassmann, 2006; Vanhaverbeke, Cloodt, & Van de Vrande, 2007). The mobility of well-qualified individuals contributes strongly to the dispersion of knowledge, firm development, and innovation performance (Howells, 2000a). However, the transience of workers also undermines the certainty of firms to continuously access necessary talent (Chesbrough, 2003a): firms therefore compelled to access talented individuals regardless of their location (Gassmann, 2006). Consequently, open innovation facilitates the ability to address physical constraints, organisational hindrances, internal knowledge limitations, and other resource deficits hampering innovation (Gassmann et al., 2010).

1.2.3 The innovation conundrum

In an increasingly dynamic business environment, innovation is vital if firms are to adapt, renew, and flourish (e.g., Cefis & Marsili, 2005; Fagerberg & Verspagen, 2009; Gopalakrishnan & Damanpour, 1997; Nohria & Gulati, 1996; Shavinina, 2003). Schumpeter’s (1942) foundational innovation and entrepreneurship theories highlight the importance of innovation for wealth creation at a societal and firm level. He states that innovation is unavoidable for firms; innovation promotes the development of new technologies, commodities, sources of supply, and “strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives” (p. 84). Proven as a mechanism for firm growth (C. M. Christensen, 1997; J. R. Cooper, 1998; Hamel & Prahalad, 1994; Kaplan & Norton, 2005), Cefis and Marsili (2005) argue that innovation is “a matter of life and death” (p. 1167) for firms. They advise that for practitioner firms their improved rates of survival point to the advantages gained from innovation. The need to innovate is made further apparent by virtue of the fact that innovating firms frequently outperforming non-innovators (Geroski & Machin, 1992). Indeed, the crux of the matter is not whether to innovate, rather how to do so effectively (Bessant, 2003).
Although innovation therefore seems non-negotiable for firms to grow and remain competitive, there appears no guarantee of efforts translating to success (G. J. Pisano & Teece, 2007). The uncertainty of outcome appears consistent with the difficulties and risks of innovation: innovation demands that the firm commit resources - staff, equipment and expertise - to achieve the desired outcome (Bessant, 2003). The organisation itself presents innovation challenges. Firms often underestimate internal stresses, miscalculating the link between innovation performance and people management (S. Barnes & Watts, undated). Other difficulties include:

- The inability to manage innovation and process inadequacies (Amabile, 1998; Bean & Radford, 2002)
- A lack of internal capability in acquisition and application of necessary knowledge (Caloghirou, Kastelli, & Tsakanikas, 2004; Hadjimanolis, 2003; Hult, Hurley, & Knight, 2004)
- A mismatch with firms’ current business model (Chesbrough, 2006c, 2009)
- Resource issues: ranging from financial restrictions hampering firms’ investment in innovation, to knowledge and personnel scarcities that constrain innovation activities (e.g. Bakar & Ahmad, 2010; M. Battisti & Peter, 2011; Hadjimanolis, 2000; Jauhari, 2001; Katila & Shane, 2005; Sharma, 1999).

Indeed, Fagerberg (2006) observes that the complexity and diversity of innovation compels firms to interact with their environment in order to realise innovation through external sources. In particular, the resource-poor SME which wishes to innovate is often obliged to cooperate externally to innovate, in order to compensate for innovation inadequacies (Combs & Ketchen, 1999; Edwards et al., 2005).

### 1.2.4 Innovative SMEs

Even though innovation is instrumental to growth, innovative SMEs have no assurance of realising the rewards of their innovation endeavours (O'Regan, Ghobadian, & Sims, 2006). Enterprising SMEs desiring growth through innovation often face numerous barriers not experienced by larger firms (Hadjimanolis, 1999, 2003). The lack of resources is frequently referred to as the greatest impediment to innovation faced by SMEs and a key difference between small and large firms (K. S. Lee, Lim, & Tan, 1999; Rothwell, 1989). The literature regularly highlights resource deficits as hindering the ability of SMEs to innovate and to grasp the benefits of doing so (Acs & Audretsch, 1988; Damanpour, 1992; de Jong & Marsili, 2006; Foxall & Johnston, 1987; Rothwell, 1989; Rothwell & Zegveld, 1982).
Moreover, SME resources are not only scarce, a multiplicity of demands vie for their use (van de Vrande et al., 2009). The innovative SME experiences challenges due to staffing deficiencies, inadequate knowledge and lack of knowledge diversity, skill shortages, time restraints, competing management priorities, risk-aversion and regulatory requirements (Barber, Metcalfe, & Porteous, 1989; Barth, 2004; British Chamber of Commerce, 2008; McAdam, Keogh, Reid, & Mitchell, 2007).

However, studies by Rothwell (1983) and Vossen (1998b) reassure us that innovative SMEs have some advantages in terms of behavioural attributes including flexibility, a lack of bureaucracy, and willingness to learn. SMEs respond faster to opportunities than larger firms, more readily adoptive of change, and have better internal communication (Rothwell, 1983; Rothwell & Dodgson, 1994; Rothwell & Zegveld, 1982). Consequently, the opportunity to compensate for innovation resource shortcomings through collaboration with external organisations - open innovation - appears to be ideal for the innovative SMEs to achieve innovation objectives.

1.2.5 Does open innovation serve SMEs

Through open innovation, SMEs therefore can compensate for their inherent innovation barriers (Cosh & Zhang, 2011; S. Lee et al., 2010; van de Vrande et al., 2009). The proponents of open innovation highlight engagement for SMEs to supplement or complement their existing innovation activities (Chesbrough, 2010), address the problem of limited resources (S. Lee et al., 2010), and to overcome the liability of smallness (Gassmann et al., 2010). Both time-poor and financially restrained innovative SMEs often search externally for complementary organisations in order to acquire resources for innovation (van de Vrande et al., 2009). Furthermore, searching and acquiring ideas and knowledge external to the firm enhances the innovativeness of each party, and is particularly beneficial for the SME in overcoming innovation restrictions (Fagerberg, 2003).

Certainly, firms who experience greater innovation impediments than their counterparts will adopt open innovation to compensate accordingly (Keupp & Gassmann, 2009). Adopting open innovation reduces liabilities otherwise hampering SMEs innovation activities to achieve better innovation outcomes, more so than would otherwise be possible (Gassmann et al., 2010; S. Lee et al., 2010). Lee et al. (2010) caution that while open innovation addresses SME innovation-resource limitations, the internal effects of SME adoption remain under-explored, a sentiment shared by others (e.g., Bianchi, Campodall'Orto, Frattini, & Vercesi, 2010; Huizingh, 2011).
Empirical and theoretical works point to open innovation engagement as carrying commensurate risks and imposing resource hardships (e.g., Hadjimanolis, 1999; Major & Cordey-Hayes, 2003; van de Vrande et al., 2009). Lichtenthaler’s (2010b) list of potential risks include the detrimental impact on internal innovation activities, dependency on firms’ networks to compensate for innovation inadequacies, and the inability to control a partner’s actions. Van de Vrande et al. (2009) suggest a similar set of issues primarily relating to SMEs’ managerial and organisational resources. Furthermore, SMEs may experience relationship difficulties when collaborating, thereby adding to their woes (Hofer & Adametz, 2007).

Consequently, although open innovation studies point to the value of engagement, it appears that appreciation of the effects has been asymmetrical as favouring beneficial outcomes. The question arises as to whether open innovation represents a viable and sustainable strategy for SMEs to realise innovation objectives. The answer depends on developing the awareness of the range of effects incurred from engagement. Investigation by this study into the influence of open innovation activities on innovative SMEs’ characteristics will consider whether open innovation is the panacea it is purported to be or whether engagement is ultimately unfavourable. This study therefore addresses several areas of neglect in the literature concerning SMEs and open innovation in application.

1.3 Purpose of this study

Briefly indicated by the above and further explored in Chapters 2 and 3, well acknowledged in the literature and from extensive experience of the author of this study, innovative SMEs have certain characteristics that dictate their realisation of innovation. In particular, the SME characteristic of perennial resource shortages, considered often impeding SMEs’ realisation of innovation. However, the shortages are somewhat compensated by SMEs’ beneficial behaviours such as flexibility, agility, fast decision-making, and rapid responsiveness. Rothwell et al. (1983) term these the ‘characteristics of innovative small firms’ (p. 19). While open innovation is advocated as suitable for innovative SMEs to compensate for their resource shortages, the concern herein is that adopting open innovation may have further benefits; more importantly, unappreciated detrimental effects.

This leads to the purposes of this study, which are two-fold. Firstly, it considers open innovation in the context of the SME practitioner and the effects resulting from engagement, an area neglected in open innovation literature (Brunswicker & Van de Vrande, Publishing October 2014; Huizingh, 2011; Spithoven et al., 2013; van de Vrande et al., 2009). The
literature to date has favoured the large firm with less attention on SMEs; yet, as Wynarckz et al. (2013) argue, “the rationale for adoption of open innovation practices by SMEs differs from those of large firms... due to factors acutely associated with size” (p. 5). This thesis contends that SMEs that adopt open innovation do so at a cost, which requires organisational efforts to manage.

This then is the second purpose: to identify the organisational practices adopted by SMEs to manage the effects and optimise engagement. This purpose therefore responds to requests for a better understanding of SMEs’ managerial practices associated with open innovation (Bianchi et al., 2010; Brunswicker & Vanhaverbeke, 2014; Dahlander & Gann, 2010; Hewitt-Dundas, 2006; Huizingh, 2011; S. Lee et al., 2010; Spithoven et al., 2013; West & Bogers, 2013; West et al., 2014). The study therefore addresses criticisms in the literature regarding the lack of effort directed towards examining the negative aspects of open innovation engagement, particularly in the SME.

Open innovation may not be the panacea sought by SMEs to realise innovation objectives and overcome constraints. Further investigation is required to determine how organisational factors assist or hinder SMEs' open innovation engagement (Spithoven et al., 2013). Furthermore, according to Spithoven et al. (2013) there is an absence of understanding regarding the role of managerial practices and firms' open innovation efforts to realise the benefits. The expectation is that SMEs will benefit from greater awareness of the effects of engagement, permitting them to better manage open innovation and ensure the benefits exceed the detriments.

The literature highlights the need to investigate open innovation in practice (Chesbrough et al., 2006; Dahlander & Gann, 2010; Lazzarotti & Manzini, 2009; G. P. Pisano & Verganti, 2008). Moreover, Kilduff (2006) recommends that drawing from the real world generates better theory: “the route to good theory leads not through gaps in the literature but through an engagement with problems in the world” (p. 252). Accordingly, practitioners’ experiences are central to, and form the basis of, the empirical research for this study. The understanding gained thereby should enrich the knowledge of the consequences of SME engagement, an area sorely lacking in the literature (Bianchi et al., 2010). Furthermore attend to gaps in understanding how SMEs manage open innovation (Rahman & Ramos, 2010).
1.4 Research question and objectives

Given that support is gaining among academics and the business world alike for open innovation improving SMEs innovation activity, what lacks is appreciation of the adoption ramifications (Vanhaverbeke & Cloodt, 2006; Vanhaverbeke et al., 2012). This study sets out to contribute to this important area of knowledge by identifying the effects that result from open innovation practice adoption. The research question then encapsulates the focus, underpins the conceptual framework, and drives the empirical research:

*How does engagement in open innovation influence the characteristics of innovative SMEs?*

The research question meets Kerlinger’s (1986) criteria for a sound research problem: Firstly, it expresses a relationship between variables; secondly, it directly poses a question; lastly, the problem suggests a requirement for empirical research. Therefore, the research question encapsulates the focus of this study to meet both the realms of academic interest and that of real-world conditions, with the intention of improving both the theoretical appreciation and the practical understanding of open innovation. The premise is that some facets of open innovation have beneficial implications to SMEs while others have adverse effects on the characteristics of innovative SMEs. Three objectives arise from the question:

- Determine what beneficial effects to innovative SMEs’ characteristics accrue from open innovation engagement.
- Determine what detrimental effects to innovative SMEs’ characteristics result from engagement.
- Determine how SMEs manage these effects.

This study anticipates four outcomes: First, an expansion on current knowledge of the effects will contribute to the academic debate on the benefits of open innovation to SMEs. Second, increased awareness of the detrimental effects of open innovation; third, the organisational practices undertaken by SMEs to manage the effects and optimise open innovation. Fourth, an integrated model to contribute to academic and practitioner understanding based on a conceptual framework derived from the literature and refined by the empirical research.

1.5 Research Design

Identifying the effects and how they influence the characteristics of innovative SMEs is pivotal to this thesis. An extensive and systematic analysis of the literature results in a conceptual framework to structure this study. The collection of empirical data adopts a two-stage research method to weave data and theory:
1. A pilot study: the application of a questionnaire in a series of face-to-face interviews. The pilot study provided evidence of open innovation in the sample industry. It also identified suitable open innovation-active firms for Stage 2, from responses based on Laursen and Salter’s (2005) depth-and-breadth metric.

2. Qualitative case studies of six firms demonstrating active engagement in open innovation, drawn from the New Zealand engineering industry. The case study SMEs range in size from >10 through to 100 employees and these six firms provide the majority of data. Case studies are widely applied in open innovation research to develop understanding of this nascent innovation paradigm (e.g., Dodgson, Gann, & Salter, 2006; Hienerth, 2006; Lettl, Herstatt, & Gemuenden, 2006; Torkkeli, Kock, & Salmi, 2009; van der Meer, 2007). Yin (2003a) recommends the case study approach is appropriate for obtaining insights into real-life dynamics, hence the suitability of this approach to the investigation of the effects of open innovation.

1.5.1 Why focus on SMEs?

The requirement to support innovative SMEs to thrive and survive is in recognition of their contribution to the innovation landscape and to economies worldwide (Bianchi et al., 2010; Hoffman et al., 1998; Radas & Bozic, 2009). Many acknowledge the significant role of SMEs in economic growth, often considering the smaller enterprise to be the lifeblood of economies (e.g., Bianchi et al., 2010; Enright & Ffowcs-Williams, 2001; Ghobadian & Gallear, 1996; Hausman, 2005; Oke, Burke, & Myers, 2007; Radas & Bozic, 2009; D. Storey, 1994). Although small in size, SMEs account disproportionally for a larger share of new jobs, yet fewer than half of new small firms survive beyond five years (OECD, undated). “Small business has to save us” (Wennekers & Thurik, 1999, p. 26) is a rejoinder of European politicians who point to SMEs as the salvation for failing economies through the provision of innovative developments, products, and services. Recognising the importance of innovation by SMEs to economies, governments worldwide support initiatives to improve SMEs’ growth through innovation (Bougrain & Haudeville, 2002; Hoffman et al., 1998; P. J. Robson & Bennett, 2000).

Efforts to enhance SME competitiveness are often considered essential (Drihlon & Estime, 1993). SMEs are not immune to the increasing pressures of globalisation, technological change, and the information age, with business survival and development often reliant upon innovation (OECD, 2001). Innovation is considered to correlate with firm growth and success (Massey, Battisti, Perry, & Jurado, 2007). Furthermore, innovative SMEs perform dual innovation roles by both stimulating innovation individually and also
performing as necessary and corresponding innovation complements to larger firms (Nooteboom, 1994; Oke et al., 2007).

1.5.2 The New Zealand context

New Zealand firms develop unique innovation capacities in order to survive in a small, highly competitive domestic market and to address the challenge of imported products which can offer cost and quality advantages (Seidel, Seidel, Wait, Cross, & Little, 2008). New Zealand SMEs therefore innovate to overcome their lack of proximity to other markets and to compete effectively within the country’s small business arena, with improved returns justifying innovation activities (Shangqin, McCann, & Oxley, 2009). Statistics New Zealand’s Innovation Survey (2010c) found that innovation-active businesses report greater profitability and productivity than non-innovators (79%), supply a greater number of markets (64%), and experience improvements in efficiency (75%).

Similar to the majority of New Zealand industries, SMEs dominate the engineering sector. According to Statistics New Zealand (2010a, 2010b, 2010d), there are 4,560 small firms (0 to 19 employees) in the primary metal and metal product manufacturing and engineering related sectors. Engineering firms are perceived as specialist providers as well as outsource suppliers of R&D capabilities for other firms (Principe, 2000; van de Vrande et al., 2009). In these capacities, they have an important role as facilitators and partners in open innovation activities.

However, closed innovation aligns with the predominant “do it yourself” culture of New Zealand. Although open innovation may well address a number of the issues restraining economic growth at firm, industry, and national level, the embedded cultural attitude of self-reliance may veil the advantages of open innovation. A keen example of this pertains to the engineering industry. New Zealand engineering SMEs traditionally rely on internal innovation to realise objectives and meet customer requirements. Recent anecdotal evidence suggests that there is a shift in the industry towards innovation collaboration - open innovation - to achieve innovation goals and develop radical advancements. Presently, such firms remain in the minority, with most unreceptive to such activity. A better understanding of the impact of engaging in open innovation may encourage wider industry adoption.

1.6 Definitions

Maxwell (1998) recommends establishing a commonality of perspective through the provision of definitions. Articulation of definitions affords a platform from which this study springboards and presents the concepts that underpin its positioning. The definitions
employed form the basis for the literature review and research design. Derived from the literature and expounded in Chapters 2 and 3, the first definition relates to innovation and open innovation, followed by details qualifying the SME.

1.6.1 Terminological boundary of innovation

Zairi (1994) observes that, “what makes innovation challenging is the fact that it is very difficult to agree on a common definition.” (p. 27). Often, within and between academics and practitioners, the definitions diverge and compound confusion (J. R. Cooper, 1998; Jauhari, 2001; McFadzean, O’Loughlin, & Shaw, 2005). Linton (2009), recognising the quandary, suggests that differences in perspective may explain some of the confusion, with the same term used to explain different concepts, and the use of different terms to explain the same concept. However, some commonality exists with respect of newness as the core to interpretations (Gupta, Tesluk, & Taylor, 2007); yet others dispute what constitutes newness (Johannessen, Olsen, & Lumpkin, 2001; Smith, 2006; J. Storey, 2004). Negotiating the terrain of innovation terminology can therefore be problematic due to the lack of a singular description (J. Storey, 2004). The definition favoured for this study is from the OECD Oslo Manual (2005b): “the implementation of a new or significantly improved product (goods or services), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD, 2005b, p. 46). This definition encapsulates a wide range of innovation activities and defines new as “new to the firm”, not necessarily to an industry; with the emphasis herein the employment of an organisational perspective (Rickards, 2003).

While product and process innovations frequently dominate as innovation outcomes, other forms of innovation output exist (Fagerberg, 2003). Innovation may result in new services, structures, and administration systems (Bean & Radford, 2002; Damanpour, 1991). Innovations may be new business models, services, or management structures (Bean & Radford, 2002; J. R. Cooper, 1998; Damanpour, 1991; Davenport, 2006; Govindarajan & Trimble, 2005; Hamel, 2006; Hamel & Getz, 2004; Sathe, 2003; Thornberry, 2001). Further results of innovation endeavours are improved mechanisms for innovating (Kline & Rosenberg, 1986), and innovating new sources of raw materials for example, a substitute material which proves to be more cost effective (Pavitt, 1999). Less evidential innovations such as administrative, organisational, and marketing initiatives provide competitive advantages, improving firms’ internal mechanisms (OECD, 2005b). Innovations therefore

5 Repeated here from page 1
extend beyond commercialising new products and services (R. G. Cooper, 2001; Statistics New Zealand, 2004; Tarrant, 2005).

1.6.2 Open innovation

Chesbrough’s (2006) description is the most commonly adopted:

“Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market.” (p. 1)

However, West and Gallagher (2006) define open innovation as “systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels.” (p. 1). Their definition diverges from Chesbrough’s as it refers to resources in general, not simply knowledge. In addition, it does not focus on market introduction or commercialisation as the innovation outcome. The definition then recognises that the results of innovations extend beyond commercialisation to include other forms of output, such as social and business-model innovation. Even more simply expressed by Mortara and Minshall (2011), and the definition adopted by this study, open innovation is “in which organizations make use of internal and external resources to drive their innovation processes” (p. 586).

1.6.3 Small and medium enterprises

According to McMahon et al. (1993), defining what is an SME remains a challenge, with a marked absence of a singular description. Various interpretations flourish with different measures adopted by various countries ranging from employee numbers, assets, or annual turnover to qualify the SME (Mazzarol & Reboud, 2009). Commonly, the measures draw on the number of personnel as an acceptable measure (Damanpour, 1992). Many scholars affirm that the number of employees provides a valid measure of firm size (e.g., Barge-gil, 2010; Bayona, Garcia-Marco, & Huerta, 2001; Link & Bozeman, 1991).

Discrepancies within employee-number classifications compound the difficulty (O'Regan & Ghobadian, 2004). Countries apply the numerical criterion of staff numbers yet these vary in number when defining each category. For example, the OECD (2005a) defines an SME as having an upper limit of 250 employees, with 50 staff being a small firm. The
Nordic area, arguably similar in size to New Zealand, sets the parameters at 1-10 for micro-firms, small firms 11-25, and up to 250 staff for medium firms.

New Zealand’s Ministry of Economic Development (MED) also defines SMEs using staff headcount, yet deviates from other countries’ measures. The deviation relates to New Zealand’s similarity with most countries in that its economy is primarily composed of small firms. However, 97% have 19 or less staff (Ministry of Economic Development, 2011). Consequently, as the vast majority of SMEs consist of very small employee numbers, SMEs are defined as firms of fewer than 20 staff (Ministry of Economic Development, 2011). As such the MED’s definition distorts any evaluation with comparative studies and with the literature. The shortcoming is acknowledged by the MED, their measure making “comparisons of New Zealand SMEs with other countries problematic” (Ministry of Economic Development, 2011, p. 5). Therefore the parameters employed here reflect international comparative studies as “measurement implies commensurability” (Smith, 2006, p. 149) drawing on the OECD and Nordic countries’ SME criterion:

- 0-10 staff Micro-firm
- 11-25 Small firm
- 25-250 Medium-sized firm

1.7 Chapter summary

Open innovation offers firms additional practices to realise their innovation objectives beyond the closed innovation model; proponents consider practice engagement allows SMEs to address their inherent lack of innovation resource (S. Lee et al., 2010; van de Vrande et al., 2009; Vanhaverbeke et al., 2012). Innovative SMEs have distinctive characteristics: they demonstrate beneficial behavioural attributes while insufficient resources act as barriers to innovation (Hadjimanolis, 1999; Rush & Bessant, 1992). The innovative SME characteristics may experience beneficial or detrimental effects from open innovation engagement. In turn, the effects dictate the ability to maximise the opportunities presented by practice adoption. Yet, notwithstanding the interest in the suitability of open innovation to SMEs, the range of benefits and negative effects to adoption remain unclear (Chesbrough, 2010; Vanhaverbeke et al., 2012).

To answer the research question this study forms a conceptual framework derived from the literature to guide the empirical research. Research data collection primarily uses multi-case studies to ascertain how open innovation engagement influences the characteristics of innovative SMEs. This study culminates by offering an integrated model to illustrate the
Chapter 1: Overview

dynamics of open innovation on innovative SMEs’ characteristics, thereby contributing to both academics and practitioners’ knowledge.

1.8 The structure of this thesis

Chapter 1 introduces the topic and the research question, which addresses existent gaps in innovation literature regarding current understanding of open innovation engagement by SMEs. The research question underpins the conceptual framework and research design. Open innovation is, therefore the focus of the literature review in Chapter 2, and considers the development of open innovation and the differentiators to closed innovation. The chapter reviews the precedents, the reasons driving open innovation adoption, the benefits, and issues. Finally, the chapter considers the various forms of open innovation practices and examines the dimensions relevant to the external entities implicit with open innovation engagement.

Chapter 3 considers the literature on innovative SMEs, investigates what comprises the innovative SMEs’ characteristics, and develops a profile drawing on two strains of SME literature. The chapter then explores the current understanding of open innovation in the SME context. The two thematically structured literature-review chapters furnish a strong foundation, describe the terms and boundaries of this study, and the dimensions contributing to the conceptual framework to advance understanding (Webster & Watson, 2002).

Chapter 4 presents the conceptual framework and constructs thereof. Derived from the literature, the framework explains “a tentative theory of the phenomena” (Maxwell, 2005, p. 33). Chapter 5 explains the research method employment of a two-stage process in data collection. Chapter 6 narrates the six case study firms’ experiences of engaging open innovation. Chapter 7 presents the analysis of the data, arrived through comparing the empirical research with the literature-derived conceptual framework to identify where case SMEs support or extend existing understanding. In light of these empirical findings, this study revisits the conceptual framework, to incorporate the results and offer an integrated model, embodying the effects of open innovation engagement on innovative SMEs’ characteristics. Chapter 8 concludes by highlighting key findings, the implications of these findings, and the main contributions to theory and practice. The chapter closes by reflecting on the limitations of this study and offering suggestions for future research.
Chapter Two

SETTING THE SCENE: OPEN INNOVATION AND ASSOCIATED ASPECTS

Open innovation challenges the notion that innovation must be contained within firm boundaries. Instead, open innovation counsels firms use of external-orientated practices to pursue innovation (Chesbrough, 2003c; Chesbrough et al., 2006). Well promoted are the benefits of open innovation, there is far less awareness of the negative implications of adoption and application mechanics. However, indications are that open innovation in application is neither straightforward nor without cost (e.g., Berchicci, 2012; Dahlander & Gann, 2010; K. Hung & Chou, 2013; Laursen & Salter, 2006). Chapter 2 examines the literature on open innovation to link theory and practice and guide the development of a conceptual framework (Leshem & Trafford, 2007). Through appreciation of the relevance of open innovation in the current business environment, the following sections contribute to informing the research question and developing the conceptual framework.

The section order relates to the theoretical concepts of this study. Section 2.1 reviews the phenomenon and the academic landscape from which the concept of open innovation draws. Sections 2.2 and 2.3 present the reasons firms adopt open innovation and the challenges to engagement. Section 2.4 considers the practices associated with open innovation, while section 2.5 reviews the approaches to measuring open innovation. Open innovation relies on the presence of an external entity, Section 2.6 explores with whom firms collaborate and the complexities of the open innovation relationship. Section 2.8 summaries the chapter.

2.1 Open Innovation

Open innovation purports to solve firms’ innovation difficulties offering a variety of practices to access knowledge and other innovation-required resources. Chesbrough (2003a, 2003b, 2003c; 2006) coined the term open innovation to define multiple externally orientated innovation practices in contrast to the closed, internally contained innovation. Open innovation has gained popularity with both academics and practitioners over the last 10 years due to interest in the provision of alternative practices to realise innovation and the benefits gained from engagement (K. Hung & Chou, 2013). The open innovation paradigm supports innovative agility and, according to Chesbrough (2003c), levels the playing field in terms of
innovation. Chesbrough (2003c, 2007) cites numerous examples from his case study research of the advantages of open innovation. In particular, his research highlights the success of Linux’s open source software and of Xerox, Procter & Gamble, and IBM’s open innovation efforts. The initial appearance of open innovation in such high-tech firms’ open source software practices led Gassman and Enkel (2004) to name open source the “pioneer” of open innovation (p. 2). West (2003) argues that the tensions and strategies of open source compare favourably with open innovation in general. Sharing rights amongst parties and collaborating to develop innovation, illustrated by open source embedded in knowledge exchange, demonstrates a version of the open innovation concept (West, 2003). The realisation of innovation through external means differentiates open innovation from closed innovation.

2.1.1 Innovation locus from internal to external

Open innovation highlights the possibility of “innovating innovation” (Chesbrough, 2003c, p. ix). By developing relationships with external entities, firms access complementary expertise, technologies and knowledge to facilitate innovation and achieve desired results (Hagedoorn, 1993; U. Lichtenthaler & Ernst, 2007). Herstad et al. (2008) view open innovation as “a new landscape, rich of ideas and knowledge is ‘out there’; ready to be harnessed by those who master the trade of open innovation.” (p. 7). Advocates promote the beneficial nature of open innovation, the benefits apparent in firms who implement open innovation becoming more innovative (Fitjar & Rodrízues-Pose, 2012).

Until Chesbrough encapsulated the various externally orientated practices into one term, the generally accepted view of innovation was that it was self-contained, the responsibility of a single firm. Based on the Chandlerian view (1977, 1990) of internally contained and controlled innovation, the premise of closed innovation refers to innovation requiring the entire process to take place within firm boundaries. The internalised innovation process therefore has limited external interaction (Chesbrough, 2003a, 2003b; Chesbrough et al., 2006). Chesbrough (2003c) contends closed innovation exudes self-reliance, “if you want something done right, you’ve got to do it yourself.” (p. xx). Among other differences (Table 1), he differentiates the two innovation strategies as implicit in assumptions that the first to market will benefit most from an innovation, that protection of intellectual property requires full control, and that firms need to generate innovative ideas internally (Chesbrough, 2003c).

Open innovation does not invalidate closed innovation. As West and Gallagher (2006) observe, innovation opportunities to support open innovation endeavours are contingent on the continuance of closed innovation activities. de Faria, Lima, and Santos (2010) corroborate that view, stating that open innovation complements, rather than substitutes for
closed innovation. Others agree (e.g., Dahlander & Gann, 2010; Howells, James, & Malik, 2004; Poot, Faems, & Vanhaverbeke, 2009; Vanhaverbeke et al., 2007). The consensus is that firms’ internal R&D capability assists the recognition and incorporation of new technologies and the exploitation of new knowledge - requiring the intertwining of the two innovation strategies.

Table 1: Differences Between Closed and Open Innovation (Chesbrough, 2003b, 2003c)

<table>
<thead>
<tr>
<th>Closed Innovation</th>
<th>Open Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The firm has to employ all the right people.</td>
<td>There are more clever people than the firm can employ. The firm needs to externally access these individuals.</td>
</tr>
<tr>
<td>R&amp;D conducted in-house from conception to output.</td>
<td>R&amp;D external to the firm can provide value; internal R&amp;D complements and helps appropriate the value.</td>
</tr>
<tr>
<td>Discovering an innovation in-house means the firm can be first to market.</td>
<td>Innovative ideas abound; the company does not need to originate to profit.</td>
</tr>
<tr>
<td>First to commercialise an innovation will reap the greatest rewards.</td>
<td>To realise benefits being first to market is less important than having an effective business model</td>
</tr>
<tr>
<td>The firm with the most creative and innovative ideas will dominate the industry.</td>
<td>Utilising internal and external sources of innovation will improve results.</td>
</tr>
<tr>
<td>Controlling IP will prevent others from profiting from ideas developed internally.</td>
<td>Buying, selling, exchanging and sharing of IP should be considered if beneficial to the firm.</td>
</tr>
<tr>
<td>The business model is separate from innovation activities.</td>
<td>The business model is critical to appropriate value from open innovation activities.</td>
</tr>
</tbody>
</table>

Although practitioners are not generally familiar with the term open innovation, many are actively employing various open innovation practices (Luoma et al., 2010b). Tether (2002) suggests that firms employment of open innovation in the form of innovation collaboration demonstrates that open innovation has existed for some time. Nonetheless, closed innovation prevails as the main engine of innovation; van de Vrande et al.’s (2009) open innovation research found SMEs remain predominantly closed innovators. Similarly, Lichtenthaler’s (2008) research found closed innovation dominates, although many firms demonstrated a transition to openness. He elaborated that solely pursuing closed innovation negatively influences competitive positioning causing more organisations to appreciate the relevance of open innovation. Accordingly, firms can improve their overall return from innovation by retaining internal innovation and adopting open innovation for a more comprehensive innovation strategy (Belderbos, Carree, & Lokshin, 2004).

There is debate as to whether open innovation or closed innovation is the better innovation engine others question whether open innovation is actually a new phenomenon.
Trott and Hartman (2009) argue the absence of any revolutionary contribution to justify the growth of interest in the concept. Furthermore, they rebut the differences between open and closed innovation, noting Chesbrough’s distinctions (Table 1) is extreme and not representing a dichotomy; a notion shared by Dahlander and Gann (2010). However, the authors accept that open innovation validates firms increasingly interfacing externally for innovation and generates awareness of the various externalised innovation strategies available.

2.1.2 Precedents to open innovation

Factors relevant to open innovation predate Chesbrough’s empirical observations and his subsequent consolidation of principles into the single term. Reviews of current and historic literature congruent with open innovation demonstrate the use of various labels synonymously and simultaneously. These expressions span terms such as exogenous innovation, external or externalised innovation, collaborative innovation, cooperative innovation, co-innovation (Buur & Matthews, 2008; West & Bogers, 2010a), and, to a certain extent, strategic alliances (Hagedoorn & Schakenraad, 1994). Further terms encompass concepts such as interfirm collaboration (W. Powell, 1998; Tether, 2002; van de Vrande et al., 2009), cooperative innovation (Belderbos, Carree, & Lokshin, 2004; Rahman & Ramos, 2010; Tether, 2002), distributed innovation (Howells et al., 2004), interfirm linkages (Hoffman et al., 1998; OECD, 2005b) and networking for innovation (Dittrich & Duysters, 2007). Therefore, although the term open innovation is recent it does not signify the emergence of a new phenomenon (Chesbrough, 2003c; Herstad et al., 2008; Trott & Hartmann, 2009).

Consequently, there exists considerable evidence of firms applying externally-orientated innovation practices for some time (J. F. Christensen, Olesen, & Kjaer, 2005). Open innovation is associated with user innovation, referring to firms improving products and services as a result of gathering user experiences (von Hippel, 1988). It extends to Scotchmer’s (1991) cumulative innovation, where organisations build on others’ innovations in an additive process. However, there is some dispute that the two concepts differ to open innovation (West & Bogers, 2010a). Similarly, pre-existing origins are apparent in the National System of Innovation (NSI), the term and concept most often ascribed to Freeman (1987). NSI proposes that a network of influences exists through which technology and information flows between individuals, firms and other entities in order to develop, diffuse and use innovations. The NSI approach emphasises the interdependence of organisations in order to innovate (Edquist, 2006). Kline (1985) and Lundvall (1988) similarly refer to such interrelatedness as interactive innovation, describing the non-linear and multi-party nature of
the innovation process. Further, Kline and Rosenberg (1986) propose that innovation is an interactive process and an outcome of relationships between firms.

Previously, Dyer and Singh (1998) noted that “critical resources may span firm boundaries and may be embedded in interfirm routines and processes” (p. 661). Similarly, Eisenhardt and Schoonhoven (1996) speak of the need for alliances to source the resources required for innovation. Hagedoorn’s (2002) investigation of 40 years of formal interfirm relationships lists alliances, R&D partnerships and interfirm cooperation to illustrate the various forms of innovation collaboration apparent across the period. He references joint ventures as one of the oldest forms while finding a decline of this form as others have become more prominent. Further related concepts include inter-partner learning (Hamel, 1991), innovation networks (Freeman, 1991), and networks of learning (P. Powell et al., 1996). Furthermore, Powell (1998) talks about participation in interorganisational linkages as facilitating knowledge diffusion, learning and technological development in firms.

Further precedents present in the form of cooperative arrangements historically practiced by organisations. Tether argues for interorganisational innovation growing and the boundaries of the firm becoming increasingly fuzzy, agreeing with Teece (1992) who earlier contended firm boundaries blur due to interfirm innovation arrangements. Similarly, the necessity effect represents a key instigator of interfirm cooperation (Oliver & Blakeborough, 1998). Howell (2000b) defines the necessity effect as the compulsion of firms to turn externally to resolve critical internal resource inadequacies. Another practice is that of Harrigan and Newman (1990) who specify, “[a] virtue of joint ventures is that often they make use of a resource which hitherto has been left dormant because it was not coupled with the necessary handmaiden” (p. 425), suggesting exploitation of firms’ unused innovations by offering them to others.

Chesbrough himself acknowledges the existence of precedents to open innovation. Together with fellow scholars (Chesbrough & Crowther, 2006; Chesbrough et al., 2006) he ascribes early forms of open innovation to a number of authors. These include Nelson and Winter’s (1982) work on firms external search for technology, Cohen and Levinthal’s (1990) theory on external knowledge absorption as critical to firms’ innovation capabilities, firms use of networks to access external knowledge (Gomes-Casseres, 1996), and the use of strategic alliances to compensate for insufficient absorptive capacity (Gulati, 1998). Furthermore, open innovation relates to and depends upon a firm’s absorptive capacity which in turn pertains to the firm’s ability to assimilate external knowledge (Cohen & Levinthal, 1990).
Internal resources dictate firms appropriation of external knowledge to improve innovation endeavours and are pertinent to open innovation success (Hervas-Oliver, Garrigos, & Gil-Pechuan, 2011). Lack of absorptive capacity inhibits firms’ ability to absorb new knowledge, particularly if that knowledge challenges the status quo (Fagerberg, 2003).

Contrarily, Mowery (2009) proposes closed innovation is the newcomer, suggesting instead that open innovation is the long-established practice. He offers evidence from early twentieth-century industrial R&D in the United States of firms’ dependence on acquiring external technology and of firms monitoring others’ innovative developments to guide their own R&D efforts. Mowery (2009) also instances collaborative innovation activities between universities and firms. Gentlemen agreements, cartels, and relations facilitated by trade associations were common interfirn facilitators during this time. Likewise, Huizingh (2011) gives evidence from the nineteenth-century iron production industry which substantiates the longevity of open innovation. Furthermore, he contends that few firms truly follow a fully closed approach.

The investigation of open innovation and its precedents by Dahlander and Gann (2010) confirms the variety of related concepts, including von Hippel's user innovation (1988), Cohen and Levinthal's (1990) absorptive capacity, Teece’s (1986) complementary assets and the exploration/exploitation concept of March (1991). The inference drawn from the existence of numerous complementary concepts is that open innovation fraternises with an array of innovation practices. Origin, appellation, and concept debates aside, the various forms and practices analogous with open innovation are increasingly apparent and relate to innovation activities flowing across and through organisational boundaries.

### 2.2 Reasons for adoption

To appreciate why proponents advance open innovation, it is necessary to understand the underlying reasons driving engagement, consequently the benefits realised.

#### 2.2.1 External reasons for engagement

The increasing presence of open innovation represents the influence of underlying developments in the macro environment with evidential drivers in the business landscape causing a shift from closed to open innovation (Trott & Hartmann, 2009). Scholars (e.g.,

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6 Cohen and Levinthal (1990) introduced the concept of absorptive capacity, defining as “an ability to recognize the value of new information, assimilate it, and apply it to commercial ends.” (p. 128)
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Geroski, Jacquemin, Vickers, & Venables, 1985; Grimpe, Sofka, & Peters, 2008; Lawton Smith, Dickson, & Smith, 1991) identify drivers as:

- Dramatic increase in raw material prices, particularly oil
- Rapid rise of new industrialised countries exacerbating competition and eroding competitive advantages of firms in developed countries
- Electronic and biotechnology advances
- Changes in consumer demand
- Stringent investment demands
- Reduced product lifecycles
- Growing competitive tensions.

In addition, external conditions influencing innovation choices originate from globalisation, technology intensity and fusion, knowledge leveraging, shorter innovation cycles, escalating cost of R&D and resource scarcity (Gassmann, 2006; Gassmann & Enkel, 2004). Chesbrough (2003c) and others such as West (2003) and van de Vrande et al. (2009) direct attention to similar external developments as incentivising adoption. Summarising then from the literature, five external motivations are apparent:

1. Mobility of workers and the necessity of leveraging knowledge regardless of location
   - Development of globalisation demanding firms respond to increased competition and innovation opportunity
2. The rapid and changing domain of technology increasing the pressure on firms to maintain relevance while simultaneously acting to facilitate collaboration

And to a lesser degree:

4. Growing expense and intricacy of R&D
5. Improved access to venture capital for specialised innovation development.

Elaborating on the five categories:

1. Worker mobility and leveraging knowledge

   The shortage of highly skilled workers is a major issue for organisations. Shortages lead to recruitment occurring across country and firm boundaries due to knowledge and the knowledge worker featuring in the competitive firm and innovation endeavours (Blacker, 1995; OECD, 2002). To quote Drucker (1999, p. 79) “the most valuable asset of a 21st-century institution (whether business or non-business) will be its knowledge workers and their productivity”.

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7 A knowledge worker is, “that of a person, dealing in data and ideas” (Cortada, 1998, p. xiii).
The mobility of science and technology specialists substantially increased during the 1990s driven by technology changes shifting labour demand to favour highly skilled people (OECD, 2002). The demand for the highly skilled is attributed to globalisation, and the mass production toward greater individualisation of products requiring skill and flexibility (Tremblay, 2002; Winkelmann, 2002). Tremblay (2002) points to efforts made to secure the highly skilled with some countries relaxing immigration laws in order to attract sought-after expertise. The abundance of widespread knowledge shifts firms from dependence on internal R&D to externally searching for and incorporating this widely diffused knowledge (2010). Consequently, the locus of innovation activities changes as the volume and complexity of knowledge held by the mobile worker compels firms to look externally to acquire necessary innovation knowledge (Chesbrough, 2003a; de Jong, Vanhaverbeke, Kalvet, & Chesbrough, 2008; Elmquist et al., 2009). While creating skilled labour shortages, mobility among well qualified and well skilled individuals is accepted as strongly contributing to knowledge dispersion, development and innovative performance (Howells, 2000a; Winkelmann, 2002).

Mobile workers therefore function as transferees of accumulated knowledge and industry knowhow across boundaries (Capello, 1999). However, mobility increases firms’ difficulties in protecting proprietary knowledge since departing employees take their knowledge with them (de Jong et al., 2010). Stimulating interest in external sources for knowledge therefore causes firms to consider alternative innovation strategies (Porter & Stern, 2002). Chesbrough (2003c) argues that knowledge and technologies are now widely dispersed across country boundaries and all sizes of firms to declare, “there is simply too much good stuff out there for even the best companies to ignore” (2006c, p. 10). A variety of sources embody knowledge such as suppliers, customers, consultants, and research organisations (Chesbrough, 2003c). The benefit of firms’ knowledge workers connecting to and keeping abreast of developments through other skilled workers outside the firm leads to more effective innovation processes with less wasteful iteration (Huurinainen, Torkkeli, Viskari, & Salmi, 2006).

2. Globalisation

Global competition is changing the nature of business and how firms innovate (Gianiodis, Ellis, & Secchi, 2010; Narula, 2004; Rasmussen, 2007; Tojo, 2008). Increased competition, difficulty in affording required resources and technological developments all result in firms operating interdependently and influencing globalisation trends (Acs & Preston, 1997). Firms look abroad to access knowledge and ideas and seek new markets, interact with customers, identify and bargain with the most competent suppliers, and interface
with other entities for innovation (U. Lichtenthaler & Ernst, 2007). Globalisation has a facilitating role in reducing innovation times, costs and risks, and increasing flexibility. Simultaneously globalisation escalates competition between firms and between countries, creating new risks and threats that require managing (Narula, 2004): countries such as China and India highly influential motivators (Tojo, 2008).

Globalisation is therefore both a cause of change and a consequence of firm innovation developments. These issues require different forms of enterprises and new business models to address; open innovation contributes to supporting such firm developments (Chesbrough & Rosenbloom, 2002; Gassmann & Enkel, 2004; Westergren, 2010). Miotti and Sachwald (2003) believe firms inevitability need to draw on partnerships to create global R&D networks, seek complementary resources and to access knowledge, implying the use of open innovation-type arrangements to actualise.

3. The technology domain

Firms turn to open innovation to manage an environment typified by technological complexity and the distribution of information made easier due to new technologies (de Faria et al., 2010; Leiponen, 2002). Appreciation of technology sophistication resulted in Zhou, Kin and Tse (2005) coining the term “technology turbulence” (p. 42) to qualify the rate of technology developments. They posit that technological turbulence offers opportunities for radical and breakthrough innovations requiring accelerated innovation rates to avoid lagging. The rapid pace of change expands the scope of technical knowledge, and in turn the diversity enhances firms’ capability to combine internal learning with external knowledge through inter-organisational involvement to generate radical innovations (Bao, Chen, & Zheng Zhou, 2011; Gilsing, Nooteboom, Vanhaverbeke, Duysters, & Van Den Oord, 2008).

Firm boundaries erode as technology quickens and fuses different, previously heterogeneous fields, for instance biotechnology and engineering for medical equipment (Kodama, 1992). The technology fusion requires new approaches to support innovation strategies to cope with accelerating technology complexity. The result is greater interfirm cooperation in order to manage technology demands (de Faria et al., 2010; Herstad et al., 2008). Technology simultaneously facilitates access to a wider range of specialist individuals outside the boundaries of the firm, potentially connecting complementary businesses and likely collaborators (Chesbrough, 2003c).
Therefore, technology acts to accentuate innovation complexity and cost whilst offering tools supportive of alternative innovation strategies like open innovation. Moore’s Law\(^8\) predicts the increasing intensity of technology developments and reduction of product cycles now experienced, as noted by Trott and Hartmann (2009). Technology also facilitates alternative means of resource allocation in different and probably more productive ways (Shane, 2003). Arguably the reallocation of human resource from facsimile, letter, and telephone communication to Internet and email interface is more time efficient and illustrative of the human resource changes caused by technology (Shane, 2003).

4. **Expense of R&D**

Howell (2000a) asserts that worker mobility, globalisation, and technology complexity increases the risks and costs associated with R&D, a precursor and innovation generator. He premises the demise of simple discoveries *per se* leaving firms to manage increasingly intricate technological and scientific problems, subsequently increased costs and difficulties. The sophistication of products and shortening product lifecycles adds further complexity. Firms flounder to cope with insufficient scientific capability necessitating them turning externally to solve issues and to address limitations (Afuah, 2003; Haour, 1992). Furthermore, Herstad et al. (2008) contend increasing product and process intricacy demands greater dependency on external sources for information, ideas and knowledge to manage.

5. **Availability of venture capital**

The greater presence of private venture capital assists with commercialising innovative concepts, supports the introduction of new ventures to realise ideas, and bring to market spillovers\(^9\) from formal - primarily closed - research organisations (Chesbrough, 2003b). Spillovers are knowledge-based resources which are important to interfirm collaboration and considered a determinant of innovation (Ozman, 2007). The presence of spillovers correlates with worker mobility as innovation knowledge dispersers and the advent of globalisation blurring national boundaries. In turn, these developments inspire business initiatives to realise inherent opportunities (de Jong et al., 2008). Correspondingly, Grimpe et al. (2008) identifies venture capital as fostering specialist firms who offer new materials, equipment and services furthering innovation opportunities. Leveraging venture capital enables smaller firms to broaden their innovation activities and to undertake riskier ventures through strategic

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8. Electronics magazine article (1965) written by Intel co-founder Gordon Moore proposing the number of transistors on an integrated circuit will double ever two years leading to technology developments occurring at exponential rates.

9. Cohen and Levinthal define spillovers as “any original, valuable knowledge generated in the research process which becomes publicly accessible, whether it be knowledge fully characterising an innovation, or knowledge of a more intermediate sort.” (1989, p. 571)
alliances (Gianiodis et al., 2010). Chesbrough (2003b) argues for the new venture capital regime as a force contributing to erode firm boundaries and open innovation emergence.

Summing up the external conditions motivating firms, van de Vrande et al. (2009) note that external developments increasingly cause firms the inability to innovate in isolation. The macro factors pre-empt firms’ desire to stay encapsulated when innovating, forcing the adoption of alternative strategies (OECD, 2008). The developments increase the demand for innovative innovation practices ap propos open innovation. Enkel, Gassmann and Chesbrough (2009) warn that firms not adapting will experience “serious competitive disadvantages” (p.311).

2.2.2 Internal benefits to engagement

Having discussed how external conditions motivate open innovation, this section reviews the internal benefits of engagement. As argued by Chesbrough (2005), open innovation provides mechanisms to exchange resources for innovation, realise undeveloped but potentially lucrative innovations, and new paths to market. Montalvo (2006) describes firms’ view open innovation as a strategy to support alignment with industry norms, respond to competitive behaviour, address and stay abreast of technological developments, and realise customer expectations.

An open innovation survey conducted by the University of Cambridge Institute for Manufacturing (2010) revealed three prime advantages to engagement: reducing time to market, access to new technologies, and access complementary competencies to overcome firms’ innovation shortcomings. The study iterates the inclination to position open innovation in terms of product development. However Vanhaverbeke (2013) argues that such preoccupation limits thinking on the multitude of applications and beneficial outcomes that open innovation presents. Positioning open innovation as an interorganisational innovation strategy reveals further benefits. According to Gianiodis, Ellis and Secchi (2010) open innovation provides firms with greater innovation scope, the benefit of improved knowledge provision, and resource and capability exchange while reducing internal R&D activities with no adversity to output. Collaborating with external entities therefore complements and supplements firms’ internal innovation (Deeds & Rothaermel, 2003; Poot et al., 2009).

Huizingh (2011) advances two purposes for engagement: as a defensive motive to reduce costs and as an offensive strategy to invigorate growth. In addition to the exchange of resources, open innovation also facilitates the capture of rents from R&D activities and
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promotes the transfer of technology to commercialise innovations outside firms’ boundaries (Gassmann, 2006; Gussoni, 2009; U. Lichtenhaler, 2009; Rasmussen, 2007). Chesbrough and Crowther (2006) similarly promote growth as a principal benefit. They demonstrate from their survey research that engagement in open innovation is, “critical for profitable growth” (p. 232). Furthermore, access to complementary competencies to overcome information deficits, and risk reduction, are benefits strongly associated with open innovation (Keupp & Gassmann, 2009; West, 2003). Firm benefits consolidate to three areas:

1. Access knowledge and other innovation required resources
2. Enhance organisational learning and routines
3. Develop firms’ provision and reputation.

1. Access knowledge and other innovation required resources

The importance of acquiring knowledge as a function of open innovation is frequently emphasised (e.g., Huizingh, 2011; Laursen & Salter, 2006; U. Lichtenhaler & Lichtenhaler, 2009). A pervasive theme in strategic and innovation management points to the development and maintenance of competitive advantages by seeking out knowledge external to the firm (Foss, Laursen, & Pedersen, 2008; Major & Cordey-Hayes, 2003). Knowledge appears to be considered by many scholars as the most important input to the innovation process (e.g., Arrow, 1962; Tidd, Bessant, & Pavitt, 2005). British firms concur. They iterate the importance of external knowledge and report only 4% do not take advantage of such sources when innovating (Cosh & Zhang, 2011).

Knowledge acquisition may occur purposely through licensing-in and similar deliberate activities or as knowledge absorption during external interactions. Competitive advantages develop through access to and the exchange of knowledge overflows or knowledge spillovers (Cohen & Levinthal, 1990). Knowledge spillovers between firms have a central role in technology evolution by increasing firms’ existing knowledge (Appleyard, 1996; Salter & Martin, 2001). Spillovers are found to voluntarily occur between collaborating parties and are perceived as incentives for interfirm collaboration since they offer a valuable source of innovation opportunity (Belderbos, Carree, & Lokshin, 2004; de Faria et al., 2010). Accordingly, access to and exchange of knowledge comprises a primary reason to engage in open innovation (Y. Wang, Vanhaverbeke, & Roijakkers, 2012).

Although knowledge may be foundational to open innovation, it is not the only resource benefit. External searching and interorganisational resource access via open innovation provides firms with a larger range of resource solutions and problem solutions not
otherwise available to the firm internally (Coombs & Hull, 1998; Howells, 2000b; G. P. Pisano & Verganti, 2008; West & Gallagher, 2006). Engaging open innovation to compensate for firm innovation resource deficits is recommended by Ireland, Hitt and Vaidyanath (2002) who state that interorganisational collaboration represents a vital source of resources. They argue that firms rarely have sufficient resource capacity otherwise to suggest adherence to closed innovation may limit innovation realisation. Resolution of difficulties encountered by firms developing major innovations are beyond the ability of individual organisations; solutions require access to innovation-necessary resources to support endeavours (Chan & Heide, 1993). Chan and Heide view sharing risk and liability, together with management development as further benefits to such relationships; they view interorganisational linkages necessary to gain human, financial, and physical innovation resources. Similarly, the Oslo Manual (OECD, 2005b) refers to linkages amongst firms being advantageous for innovation activities through the provision of, “information, knowledge, technologies, practices, human and financial resources.” (p. 76).

Open innovation therefore furnishes avenues to needed resources and opportunities for firms to realise innovation (de Faria et al., 2010; Hoffmann & Schlosser, 2001; Mohr & Spekman, 1994; Spithoven, Clarysse, & Knockaert, 2009). It facilitates firms access to complementary resources, reduces innovation realisation times, assists entry to new markets, and spreads innovation risks and costs (de Faria et al., 2010). The acquisition of learning opportunities occurring directly or indirectly through involvement with other firms and their organisational processes (Dachs, Ebersberger, & Pyka, 2008; Inauen & Schenker-Wicki, 2011). Under the auspicious of open innovation the transference of ideas, resources, and technologies between firms improves innovation outcomes (Enkel et al., 2009).

2. **Enhancement of organisational learning and routines**

Organisational learning is congruent with knowledge, the many pressures of the business environment requiring firms to adopt or maintain the notion of organisational learning (de Geus, 1988; Finger & Brand, 1999). Innovation correlates to organisational learning and is contingent upon openness to new ideas (Calantone, Cavusgil, & Zhao, 2002; Hurley & Hult, 1998). Innovation is no longer considered the domain of the individual as was the case in the mid-twentieth century (Hidalgo & Albors, 2008); rather, innovation consists of variegated learning practices (Kline & Rosenberg, 1986), and a process of learning and knowledge exchange between entities (Patel & Pavitt, 1994). However, value realisation of any organisational learning depends on firms having the flexibility, structure and culture to
realise the learning opportunity in order to assimilate the knowledge, skills, and process improvements (Fiol & Lyles, 1985).

Promoted to prominence through Cohen and Levinthal’s (1990) seminal article on absorptive capacity, attention focuses on organisational learning as a necessary facilitator of innovation in firms. The ability to incorporate external information considered imperative to successful innovation and depends upon firms’ ability to recognise and assimilate knowledge to achieve innovation outcome (Cohen & Levinthal, 1990). Internal resources dictate the firm’s ability to appropriate external knowledge to improve innovation, endeavours pertinent to open innovation success (Hervas-Oliver et al., 2011). Consequently, organisational learning develops firms’ ability to integrate new knowledge and to turn external ideas into innovations (Jiménez-Jiménez & Sanz-Valle, 2011). Others associate organisational learning with the development of new knowledge and its internal and external exploitation (e.g., Dodgson, 1993; Lewin, 1983; March, 1991).

However, what constitutes organisational learning is abstruse, the focus of extensive attention and well debated (Bontis, Crossan, & Hulland, 2002; Brockman & Morgan, 2003; Dodgson, 1993; Fiol & Lyles, 1985; Gherardi, 2008; Stata, 1989). Concepts and definitions abound of the notion of organisational learning (Dodgson, 1993). Some, like Gavin (1992), speak of the exchange of knowledge as key to organisational learning. Wang and Almed (2003) reference Fiol (1994) to offer a definition complementary to open innovation highlighting knowledge management as the “acquisition, dissemination, refinement, creation and implementation: the ability to acquire diverse information” (p. 10), although they do not specifically relate to the external environment as a knowledge source. Yet the abundance of knowledge available externally implies a wide variety of new ideas and opportunities for innovation accessible via open innovation; therefore, complementary to organisational learning (Laursen & Salter, 2006; P. Powell et al., 1996).

Although there appears to be a direct link between organisational learning and accessing knowledge through open innovation practices, the literature appears lacking with few studies directly linking the two. Exceptions exist. For instance, Bao, Chen and Zhou (2011) refer to inter-organisational learning as a facet of open innovation. In their interview-based study of firms in high-tech Chinese industries, they emphasise the importance of learning from partners and the criticalness of relational ties for innovation. Their findings indicate that organisational learning occurs as a function of innovation-based collaboration due to the interaction and resource (especially knowledge) reciprocity. Externally sourced
learning then is a conduit for the firm to access new knowledge and increase innovation opportunities (Bao et al., 2011; Perez-Luno, Cabello Medina, Carmona Lavado, & Cuevas Rodriguez, 2011).

The research undertaken by Jiménez-Jiménez and Sanz-Valle (2011) represents another exception. Their study into the linkages between innovation, open innovation, and firm performance found a positive correlation. They note organisational learning has a greater influence on innovation than on performance, which alludes to organisational learning influencing performance through a positive association with innovation. Organisational learning is a functional response to the inflow of knowledge from and experiences with external entities in accordance with open innovation (Jiménez-Jiménez & Sanz-Valle, 2011). The learning therefore conversant with the useful application of new knowledge rather than simply “copying and pasting” (Bao et al., 2011, p. 5), leveraging the knowledge appropriately to meet firm requirements. Firm performance then improves through innovation, correspondingly supported by organisational learning – a view upheld by others (e.g., Chaston, Badger, & Sadler-Smith, 1999; Hurley & Hult, 1998; March, 1991).

Dodgson (1993) highlights the opportunity, often indirectly, to learn from organisations outside the firm through observing others work. He quotes Bandura (1977, p. 12) to underscore the advantages gained from observant learning: “The capacity to learn by observation enables people to acquire large, integrated patterns of behaviours without having to form them gradually by tedious trial and error.” In Leiponen’s (2002) opinion, collaboration exchanges knowledge for knowledge as each participant brings different expertise and understanding to the collaborative effort, with the interaction building tacit, subjective awareness. The inference is that learning is exchangeable both explicitly and tacitly. The exchange occurs as a natural extension to innovation relationships developing organisational learning within the firm and building organisational resources through process and system improvements.

The relationship between routine and innovation often aligns with firm learning and knowledge (Brown & Duguid, 1991). Therefore the enhancement of organisational routines represents another aspect of organisational learning (Transfield, Duberley, Smith, Musson, & Stokes, 2000). Firms are privy to others’ routines and operational processes as a function of collaboration and organisational learning (Dyer & Singh, 1998). Routines are identifiable as recurring time-based patterns developed to accomplish specific organisational work and
natural features of the workplace (Fieldman, 2000; Kanter, 1994).

Exposure to other organisations’ work practices, technology, and new opportunities drives changes to routines. The communal nature of the routine involving multiple actors, indeed distinguishes developments from individual skills by this collectiveness (Kanter, 1994). Therefore interaction with different modes of operating permits adoption, or adaption of accustomed routines (Dyer & Singh, 1998; Fieldman, 2000). Adaption of routines is a vital aspect to how organisational learning manifests (Spicer & Sadler-Smith, 2006). Open innovation therefore provides fertile grounds to purposefully learn new routines from others; simultaneously open innovation demands the adaption of routines to actualise the value of open innovation (Byron, 2008; Chiaroni, Chiesa, & Frattini, 2010; Vanhaverbeke et al., 2007). However, firm success can evolve as an anathema to learning as success reinforces the maintenance of existing routines, consequently is counterproductive to firm development (Spicer & Sadler-Smith, 2006).

3. **Improved firm provision and reputation**

Survival demands firms consider methods to grow and improve their business whether product, service or process-orientated. Almirall and Casadesus-Masanell (2010) propose that open innovation furnishes firms with avenues to realise features and benefits for products and services not otherwise envisaged. Furthermore, they predict that entry to new markets becomes viable through interacting with firms presently active in target areas. Furthermore, collaboration supports exploration of wider options through sharing risk in the pursuit of innovation objectives (Buisseret & Cameron, 1994).

In addition, open innovation practicing firms reap reputational benefits. Cosh and Zhang’s (2011) study of British firms revealed successful open innovation enriches firms’ status. Moreover, their research indicates firms’ benefit in terms of building capability and acquiring knowledge and resources through open innovation to enhance the overall business and presence. Developing a sound reputation in this capacity leads to new opportunities to collaborate, enhances the brand, and attracts new customers (Mortara, Napp, Slacik, & Minshall, 2009; Piller & Ihl, 2009; van de Vrande et al., 2009).

Open innovation also offers increased revenue avenues by exploiting internally developed ideas and innovations through external provision. Firms are able to commercialise

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10 The concept attributed to Nelson and Winter (1982).
unused innovations, concepts, and intellectual property through mechanisms such as licensing to provide additional revenue streams. Lichtenthaler (2006) considers the exploitation of firms’ internally held innovation by offering to outsiders is a proactive activity and rarely engaged by happenstance. The ability to sell or licence-out ideas and to leverage R&D developments realises the value of innovations through other entities due to the other firm having a more appropriate business model or other suitable attributes (Chesbrough, 2003c; Chesbrough & Rosenbloom, 2002; Dahlander & Gann, 2010). Chesbrough (2003c, 2006a) reasons that sharing intellectual property by incumbents generates greater barriers to market entry for new entrants, reduces competition, and promotes productive use of knowledge and resources. He also (2006c) refers to the new division of labour with one firm inventing or offering ideas, another developing the concept facilitated by new business models. Mortara et al. (2009) offered up Philips International as an example of an organisation turning old ideas into new ventures and capitalising on unrealised value through sharing intellectual property rights with outsiders.

Adoption of open innovation activities therefore seems economically worthwhile. De Propris’s (2002) study of firms’ cooperating on innovation found dramatic improvements in their capacity to innovate. Others note that open innovation improves the probability of innovation success and performance levels compared with firms who do not practice open innovation (e.g., Abramovsky, Kremp, Lopez, Schmidt, & Simpson, 2009; de Faria et al., 2010).

One may therefore conclude then that open innovation supports the realisation of innovation objectives through gaining required resources, offers additional revenue streams, enhances organisational learning, and reap reputational benefits. Whether motivated by macro demands or to embrace internal benefits, open innovation appears advantageous. However, while open innovation presents positive attributes, there are also difficulties. The next section reviews the innovation literature regarding challenges.

2.3 Open innovation challenges

If the reasons and positive attributes are any indication, open innovation represents an ideal remedy for firms’ innovation troubles. However, this view promotes a biased stance. References to problems imply open innovation is fraught with difficulties and risks. Van de Vrande et al. (2009) aptly state the “downsides of openness can also be considerable” (p. 699). Keupp and Gassmann (2009) stress that the costs and risks of open innovation should not be underrated, however they lament little is known of what the challenges and risks
Consequently, while the advantages of open innovation are popularised, knowledge of disadvantages pales in comparison. However, drawing from the few open innovation studies referring to difficulties offers clues.

Indeed, Enkel and Gassmann, ready promoters of open innovation (2008; 2004; 2010), found numerous concerns in their study (2009) of 107 SMEs and large firms. Loss of knowledge (48%), greater complexity, control issues (each 41%), and increased costs of coordinating activities (48%) are listed as risks frequently encountered with open innovation. Another study focused on open innovation challenges confirms open innovation contests firms’ existing practices and norms (Luoma, Paasi, & Valkokari, 2010a). Luoma et al.’s (2010a) interview-based research of 40 open innovation organisations in Finland and the Netherlands discerned barriers and challenges divided into two categories: firm specific and externally located (Table 2).

Table 2: Open Innovation Challenges

Based on Luoma et al. (2010a) supplemented by Dahlander and Gann (2010), Lichtenthaler (2010b), and van der Meer (2007)

<table>
<thead>
<tr>
<th>Location</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Externally-located</td>
<td>Partner related complexities including cultural fit and logistical factors&lt;br&gt;Collaboration nuances and effectiveness&lt;br&gt;Industry characteristics</td>
</tr>
<tr>
<td>Firm specific</td>
<td>Appropriateness of business model, strategy and culture&lt;br&gt;Resource usage&lt;br&gt;Managerial skill in terms of relationships and management of open innovation complexities&lt;br&gt;Appreciation of open innovation&lt;br&gt;Behavioural barriers</td>
</tr>
<tr>
<td>Both firm and environment</td>
<td>Knowledge and Intellectual property management</td>
</tr>
</tbody>
</table>

Likewise, Hamaoka’s (2008) research of open innovation adoption difficulties divides factors into two areas: internal and external. He lists the aspects of NIH, resource holding, and firms’ absorptive capacity as key internal barriers while suggesting environmental factors in terms of technology changes and access to resources outside the firm as key external factors. He also identifies relational facets as heavily influential to open innovation performance and comments that research in this area is embryonic and requires further development.
2.3.1 Externally-located

Among the costs highlighted, many relate to network and partner management complexities, as follows.

**Partner related challenges**

Firms have limited control of external partners in collaborative relationships. Whether stepping up to meet deadlines, mutual contribution to the innovation endeavour, or appropriate exchange and retention of valuable resources, external parties dictate the realisation of open innovation objectives (U. Lichtenthaler, 2010b; Luoma et al., 2010a; van der Meer, 2007). Lichtenthaler (2010) points to delays caused by problems with external partners and even their impediment of open innovation projects as serious risks, while Mohr and Spekman (1994) stress communication quality and willingness to participate as barriers.

Opinions differ on the severity of partner concern. Hoffman and Schlosser (2001) contend that good interfirm relations are only important as prerequisites to collaborating. Their research indicates that firms’ professionalism pervades consecutive stages of the relationship reducing partner-related issues. From their study, firms’ business ethics and focus on revenue return will mitigate relationship difficulties when pursuing a common innovation goal. Other researchers do not agree. Knudsen and Mortensen (2008) found firms who openly innovate on new product development experience poor market timing, slower timelines to develop projects and frequently incur greater costs. So consistent are their research findings that they recommend firms adhere to closed innovation as providing superior innovation outcomes.

Partner logistics are a dominant theme of challenges. The search and evaluation of appropriate parties to match firm and innovation agenda represents an uncertain exercise (Belderbos, Carree, Diederen, Lokshin, & Veugelers, 2004; Chesbrough, 2003c). Fredberg et al. (2008) and Fetterhoff and Voelkel (2006) add the difficulties of recruiting partners. The requirement to develop a persuasive argument to encourage collaboration and the ability to actually capture the resultant innovation value considered problematic (Fetterhoff & Voelkel, 2006). Luoma et al. (2010) contribute the specifics of right partner discernment, the difficulties of identifying and selecting appropriate partners among firms’ networks, and understanding and negotiating with the partner once chosen. They advise that, “the more unknown a partner is, the more difficult to find hidden agendas” (p. 9), referring to the necessity of transparency as a function of arrangements to support innovation objectives.
Relationship issues also impinge internally when employees search excessively for partners. Termed by Katila and Ahuja (2002) as over-searching, this is qualified as disproportionate time committed to finding partners, reducing the value benefit compared to time spent. Over-searching reduces the value of the open innovation to firms and comparatively neutralises innovation outcomes (J. F. Christensen et al., 2005; Laursen & Salter, 2006).

Relationship factors between organisations influence the outcome of open innovation endeavours due to partner dependence and uncertainty (Krishnan, Martin, & Noorderhaven, 2006). As a result, functional collaboration to afford open innovation relies on each organisation’s ability to create, maintain, and sustain the arrangement. Success contingent on accurate assessment, qualification and establishment of partnership suitability, facets associated with intricacy and costly to management (Belderbos, Carree, & Lokshin, 2006).

**Industry characteristics**

Luoma et al. (2010a) consider industry nuances influence open innovation activities between organisations. They explain industries often have legislative and regulatory differences that impose on open innovation practices between firms, for example anti-competitive laws. In addition, established industry norms create complexities during relationship negotiations and the division of open innovation benefits (U. Lichtenthaler, 2008; van de Vrande et al., 2009; West, Vanhaverbeke, & Chesbrough, 2006).

**Knowledge and intellectual property management (both internal and external challenges):**

Innovation processes depend strongly on knowledge: knowledge management therefore is representatively important in firms. The complexities of knowledge and intellectual property management span both firm and external specifics (Luoma et al., 2010a). Knowledge issues relates to exposure of intellectual property, and the difficulty of capturing and converting knowledge benefits for internal application (van de Vrande et al., 2009). As a consequence, the protection of firms’ knowledge grows increasingly critical (Candelin-Palmqvist, Sandberg, & Mylly, 2012; Gloet & Terziowski, 2004). Regardless of knowledge protection efforts, a quandary occurs with releasing details to the collaboration partner to convey the innovation opportunity without over revealing. Limiting the exchange may be necessary to protect firm intellectual property, yet not enough revealing compromises firms’ ability to cooperate (Dahlander & Gann, 2010; Keupp & Gassmann, 2009). Concerns relate to the difficulty of judging *a priori* the appropriate amount of information to reveal sufficient for open innovation collaboration to occur (West, 2006; West & Bogers, 2013).
Specific issues arise with legal instruments employed to protect intellectual property. The acquisition and management of patents involves extensive time is generally prohibitively costly, and requires firms to deal with legal complexities (Kitching & Blackburn, 1999). Despite difficulties encountered with intellectual property management through open innovation practices patenting remains crucial in order to realise the return from open innovation (van de Vrande et al., 2010). Legal intellectual property protection instruments, especially patents, help firms to publically declare ownership. The instruments allow better intellectual property control and the exclusion of others from capturing value from firms’ internally developed knowledge. Additionally, intellectual property protection prevents misappropriation of value from intellectual assets (Arundel, 2001; Hurmelinna, Kylheiko, & Jauhiainen, 2007; Teece, 1986; West & Bogers, 2010b).

Similarly, difficulties occur with valuing intellectual property and the necessity of sufficient revealing to the other party to assess value. Dahlander and Gann (2010) cast doubt on firms' ability to appropriate innovation value due to: firstly, identifying the value of the innovation hence the inability to appropriate return; secondly, referring to Arrow’s (1962) disclosure paradox. The paradox describes the difficulties buyers encounter in deciding the value of information offered thereby requiring the licensor to reveal sufficient detail which begs the question of how much information exposure is sufficient to achieve understanding?

2.3.2 Firm-specific

While externally located challenges represent partner difficulties and those of the wider environment, these also impose on firms’ internal environment. Firms tend to operate open innovation ad hoc, not apparent is any formality of practice with demands for research to better understanding open innovation management activities (Chesbrough & Crowther, 2006).

Lichtenthaler (2010b) emphasises the interdependencies and complementary natures of firms’ internal and environmental activities. He advises that open innovation application requires “systematic understanding and overview of the risks” (p. 3). The absence of understanding risks hampering the development of efficacious countermeasures and dictates the extent to which firms adopt open innovation (U. Lichtenthaler, 2010b). Continuing from Table 2, specific challenges relate to business structure (model, strategy, culture) and internally held resources, especially the human resources of management and staff.
Chapter 2: Open Innovation

Business model, strategy, and culture

The ability of the firm to engage open innovation relies on internal mechanisms including flexibility, level of bureaucracy, organisational attitude, and management relationships skills - encompassing partner identification and selection - and managing the trade-off between innovation activities and business as usual (Enkel et al., 2009; Luoma et al., 2010a). Luoma et al. identified problems with resourcing open innovation, particularly financial means to afford activities.

Resources

Firms participating in Enkel et al.’s (2009) study emphasise the negative impact to resources, highlighting financials and time as key internal barriers limiting search strategies and other facets of open innovation. Similarly, in van der Meer (2007) survey of open innovation-practicing Dutch firms found cultural and resource problems hampering open innovation endeavours. Additional negative aspects referenced as major challenges are:

- The roles and positioning of company planning and business model configuration
- Lack of diversity and flexibility preventing application and realisation of open innovation (Luoma et al., 2010a; van der Meer, 2007)
- Slower project times and costs higher than normal (2008)
- Cultural issues (Luoma et al., 2010a; van der Meer, 2007).

Managerial and staff related issues

Open innovation compels organisational change. The commitment of management and employees is critical to achieve open innovation success and the level of acceptance defines the depth of impact with which firms grapple (Luoma et al., 2010a; van der Meer, 2007). Studies of open innovation reference the attributes and efforts of firms’ human resources being crucial to effectiveness. The presence of motivated managers is a requirement to successful exploit open innovation and to overcome deficits in experience and competency. Furthermore, entrepreneurial managerial tendencies can effect how the SME implements and benefits from open innovation (Wynarczyk et al., 2013).

Management relational ability is an additional feature contingent to open innovation realisation. Barney (1995) considers the ability of management to interface with others requires relational capacity, competency in this area a competitive advantage congruent with open innovation success: relational proficiency found to be fundamental to effect open innovation (Chiaroni, Chiesa, & Frattini, 2009; Freel, 2000c; U. Lichtenhalter, 2010b). Therefore, without these necessary skills firms will struggle to attain open innovation benefits.
(U. Lichtenthaler, 2010b; van de Vrande et al., 2009). Chesbrough and Crowther (2006) suggest clear definitions of responsibilities and roles for staff and partners help ensure successful application.

Behavioural barriers also present as inhibitors to firms profiting from open innovation initiatives (Chesbrough & Crowther, 2006; Luoma et al., 2010a). The Not Invented Here (NIH) syndrome of Katz and Allen (1982) and Chesbrough’s (2006b) Not Sold Here (NSH) virus are two acknowledged problematic behaviours.

- NIH syndrome resists innovations originating outside the firm with staff rejection leading to the under-utilisation of acquired knowledge (Katz & Allen, 1982; Knudsen & Mortensen, 2010; Michailova & Husted, 2003). Whereas overemphasis on internally located knowledge has unfavourable consequences to open innovation and prevents the realisation of endeavours (U. Lichtenthaler & Ernst, 2006). Chesbrough termed NIH behaviour as xenophobic and demonstrated by the reaction, “we cannot trust it, because it is not from us” (2006b, p. 17). He argues (2006c) that how the firm introduces open innovation influences the level of internal resistance, and highlights the failure of in-house innovation efforts increases receptivity to open innovation. Likewise, Gassman (2006) recognised NIH as being contrary to open innovation, evident in staff opposition to externally sourced ideas. Establishment of open innovation as a viable innovation strategy will generally dissipate NIH according to Lichtenthaler and Ernst (2006), familiarity with outside knowledge neutralising concerns.

- Not Sold Here (NSH) Chesbrough (2006b) identifies a behavioural barrier parallel to NIH. NSH rebuffs others’ ability to appropriate the value of an innovation if the originating firm has been unable, or not chosen, to do so. Additionally, Chesbrough argues NSH prevents access by others to innovative opportunities thereby securing these to the firm, delaying realisation without penalty and the necessity of engaging resources otherwise allocated. He observes that the presence of NSH therefore results in undeveloped, arguably valuable - innovations. This in turn frustrates concept developers and limits revenue opportunities available through external provision (Chesbrough, 2006b).

- A concept parallel to NIH and NSH is Lichtenthaler and Ernst’s (2006) Only Used Here (OUH) syndrome, which argues that the syndrome can result in the underutilisation of firms’ internal innovations as lacking in external economic value,
or in offering it, risk improving competitors’ positions. Firms’ difficulties with value perception of their own internally developed innovations translates to difficulties anticipating the value potential to others (Chesbrough & Rosenbloom, 2002). Yet to successfully implement open innovation relies upon staff recognising the value of open innovation opportunities, therefore necessitates overcoming or methods to neutralise the three behavioural barriers to integrate and exploit open innovation. Even when identified, there may be problems incorporating externally sourced knowledge and innovations into firms’ routines (West & Gallagher, 2006).

Overall, the challenges appear to range from firm cultural suitability, staff willingness and skill, and resource demands, particularly in terms of management attention, time and finances (Salge, Bohne, Farchi, & Piening, 2011). Lichtenthaler’s (2010b) research of open innovation managerial challenges offers countermeasures to assist success. Commencing with deep appreciation of open innovation risks, he suggests developing personnel and organisational capabilities to assimilate and integrate the complexities of open innovation, not least to manage the internal and external relationship aspects of open innovation.

To summarise, as appreciation and research of open innovation develops so do the associated challenges to engagement. Yet despite the recognised importance of internal effects and managerial competence particularly in regards to the SME, research to develop understanding is scarce (van de Vrande et al., 2009; Wynarczyk et al., 2013). Dahlander and Gann’s (2010) research of the open innovation literature exposed the neglect of the negative aspects to declare, “the literature has been imbalanced” (p. 700), with benefits receiving the majority of attention. Ranging from behavioural, organisational, and other internal demands through to external-orientated complexities of partner relationships, knowledge protection concerns, and appropriating the value of innovations, there appears a cornucopia of difficulties lending assurance that success is not guaranteed.

Moreover, the efforts may not convert to adequate benefit. Love and Roper (2001) caution that their findings indicate external linkages do not automatically improve innovation outcomes while acknowledging the suitability of collaboration for some dimensions of innovation. Freel (2003) also advises caution. He stipulates that interfirm collaborations are not necessarily beneficial to innovative developments. The author stresses the importance to innovation success of internal resources, especially knowledge, either as complementary or to substitute for external collaboration, also argued by Lichtenthaler (2010b). Lichtenthaler
found from his research that firms do not often engage in open innovation as the risks posed are simply too great.

2.4 Dualistic nature of open innovation and associated practices

Open innovation manifests through various practices, what these practices comprise is the subject of this section and contributes to inform the research question. Firstly, subsection 2.4.1 reviews the practices division into two modes representing the directional flow of innovation knowledge and resources. Subsection 2.4.2 examines the different open innovation practices. Specifics on the practices then ensue (subsections 2.4.3 and 2.4.4)

2.4.1 Dual modes of open innovation

The practices fall within two modes: exploiting firms’ existing innovation opportunities externally; and in the reverse direction, exploring externally for organisations’ complementary resources and innovation offerings to employ internally (Dahlander & Gann, 2010; Gassmann & Enkel, 2004). To express the dual directions, Gassmann and Enkel (2004) label the open innovation practices as outside-in and inside-out respectively with Chesbrough and Crowther (2006) preferring inbound and outbound. The introduction of resources, transference of knowledge and innovation opportunity are additionally referred to as exploration (U. Lichtenthaler, 2009; van de Vrande et al., 2009), and inflow (Chiaroni et al., 2009).

An observation made by Huizingh (2011) is that for every inbound activity the reverse outbound one needs to occur. However, while inbound practices appear to flourish, outbound activities are less evident. He posits that perhaps only a few organisations extend knowledge and resources outwardly with multiple firms receiving as inbound mode partners.

2.4.2 Practices associated with open innovation

Practice adoption relates to firms’ innovation requirements to access and exchange required expertise, knowledge, other resources, and to share risk (Gomes-Casseres, 1997; Luoma et al., 2010a; Trott & Hartmann, 2009). In particular, the pursuit of innovation-required resources outside firms’ boundaries has garnered much attention to date (U. Lichtenthaler, 2009).
### Table 3: Compilation of Open Innovation Practices

<table>
<thead>
<tr>
<th>CITATION</th>
<th>INBOUND PRACTICES</th>
<th>OUTBOUND PRACTICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dahlander and Gann (2010)</td>
<td>Acquiring Sourcing</td>
<td>Selling Revealing</td>
</tr>
<tr>
<td>De Jong et al. (2008)</td>
<td>Networking Collaboration Corporate entrepreneurship IP management R&amp;D exchange</td>
<td>Bringing ideas to market via others Selling intellectual property Transfer of ideas</td>
</tr>
<tr>
<td>Gassmann and Enkel (2004)</td>
<td>Integrating supplier, customer and other knowledge sources to enrich firm’s knowledge base</td>
<td></td>
</tr>
<tr>
<td>Hagedoorn (1990)</td>
<td>Joint ventures  Joint R&amp;D Technology exchange Direct investment Customer-supplier relationships One directional technology flow</td>
<td></td>
</tr>
<tr>
<td>Lichtenthaler (2004) – Outbound only</td>
<td>Sale of patents Awarding licences Cross-licensing Grant-back agreements Contract research Technological cooperation Sale of firm unit (newly established companies) Spillovers Informal exchange of knowledge</td>
<td></td>
</tr>
<tr>
<td>Santamaria, Nieto, Barge-Gil (2009)</td>
<td>Joint R&amp;D/Venture Non-equity alliance</td>
<td></td>
</tr>
<tr>
<td>Trott and Hartmann (2009)</td>
<td>Licensing Supplier relations Outsourcing Joint venture Collaboration (non-joint venture) R&amp;D consortia Industry clusters Innovation networks</td>
<td></td>
</tr>
<tr>
<td>West and Bogers (2010a) (Inbound only)</td>
<td>Crowd sourcing Customer integration User interaction</td>
<td></td>
</tr>
</tbody>
</table>
Table 3 (continued)

<table>
<thead>
<tr>
<th>CITATION</th>
<th>INBOUND PRACTICE</th>
<th>OUTBOUND PRACTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Joint product development</td>
<td></td>
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<tr>
<td></td>
<td>Spinouts (establishing separate entity)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Selling complements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working with users</td>
<td></td>
</tr>
<tr>
<td>Cosh and Zhang (2011)</td>
<td>Informal:</td>
<td>Formal:</td>
</tr>
<tr>
<td></td>
<td>Engaging with users</td>
<td>Joint ventures/acquisitions.</td>
</tr>
<tr>
<td></td>
<td>Open source software participation</td>
<td>Contract research.</td>
</tr>
<tr>
<td></td>
<td>Use of websites and competitions</td>
<td>Outsourcing R&amp;D.</td>
</tr>
<tr>
<td></td>
<td>Innovation hubs/networks</td>
<td>Licensing-in</td>
</tr>
<tr>
<td></td>
<td>Sharing facilities</td>
<td>University joint research.</td>
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<tr>
<td></td>
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<td>Research consortia</td>
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<tr>
<td></td>
<td></td>
<td>Joint marketing and co-branding</td>
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<td></td>
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<td>Joint goods production</td>
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<tr>
<td></td>
<td></td>
<td>Joint purchasing of input materials</td>
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<td></td>
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<td>Joint R&amp;D</td>
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</tbody>
</table>

The practices (Table 3) do not always divide neatly into the two modes. Some scholars separate practices into equity and non-equity activities (Dahlander & Gann, 2010; West & Bogers, 2010b), formal and informal arrangements (Cosh & Zhang, 2011). Bonte and Keilbach (2005) argue for the popularity of informality particularly in the smaller firm. They explain that formal activities demand more resources than informal, restricting application by some organisations. Consequently, the choice of one practice over another is most likely to be individual to a firm (Keupp & Gassmann, 2009).

While the literature identifies various open innovation practices, these are based on large firm open innovation research and large-scale studies (Chesbrough & Crowther, 2006; Gassmann & Enkel, 2004). Apparently rare is empirical evidence of the types of practices relevant to SMEs. Hence, this study draws on one of the few studies considering open innovation in the context of the SME: van de Vrande et al.’s (2009) eight practices. The authors identified the practices in their research of SME practitioner application of open innovation, advising the practices are “broadly defined” (p. 435), and inclusive of equity and non-equity, formal and informal practices. Of the eight practices, the inbound mode has five with the outbound mode having three (Table 4).

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Each practice in Table 4 is explored in the following subsections 2.4.3 and 2.4.4.

**2.4.3 Inbound practices**

Inbound open innovation strategies take advantage of others’ discoveries to extend firms’ innovation capability (Huston & Sakkab, 2006). Firms have collaborated in the past with other entities to acquire innovation knowledge and resources (Chan & Heide, 1993; Spithoven et al., 2009). Inbound practices refer to activities conducted externally to source innovation required resources to compensate for internal deficits and complement internal innovation activities (Gassmann & Enkel, 2004; Vanhaverbeke et al., 2012). Gassmann et al. (2010) conclude from their research that practices within the inbound mode dominate outbound activities. Chesbrough and Crowther (2006) advise from their survey results that one reason for this is firms believe inbound activities are necessary for growth whereas outbound activities are of lesser importance due to their higher complexity.

1. **Customer interaction**

Van de Vrande et al. (2009) observe that firms prioritise customer demands and customer satisfaction as fundamental to firm continuation. Customer centricity often determines competitiveness with firms that orientate their provision around customer requirements enjoy increased client retention and loyalty (Piller & Ihl, 2009). Indeed, recognition of the unique value presented by this group motivates many firms to transition from provider-focused innovations to customer perspective developments (Tseng & Piller, 2003). The benefits of working directly with customers includes innovative product
developments, the identification of new provisions, or new markets – resulting in leading edge offerings not otherwise evident (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2002; Piller & Ihl, 2009).

The customer interaction practice appears comparable to von Hippel’s (1986, 1988) user innovation. Lead users modify current equipment, software or machines, to better meet their own requirements (von Hippel, 2005). Users provide product and service performance leading to the expedited development of promising new products and enhancements to existing products (Herstatt & von Hippel, 1991; P. J. Robson & Bennett, 2000). Shaw (1994) summarises the benefits as: the provision of complementary knowledge, helping to balance price and performance when commercialising innovation, and the provision of insights into user behaviour for further refinements likely to increase acceptance and adoption.

The relevance of von Hippel’s (1988) user innovation as a facet of open innovation seems subject to debate (Schroll & Mild, 2011). Chesbrough (2005) favours its inclusion according to Gassmann et al. (2010). However, there are differences: open innovation captures value from an innovation while user innovation relates to creating value (West & Bogers, 2010a). However, firms who interact with customers can identify original or alterative innovations prior to general market awareness (von Hippel, 1986). In this role, customers augment firms’ offering.

The practice presents problems for the firm. Customers may offer innovative suggestions that are myopic, capricious or difficult to interpret, limiting their value (Grimpe et al., 2008). In addition, potential problems arise relative to motivating the customer to interact and presenting integration difficulties, and once integrated, issues with customer dependency, misunderstandings, and the risk of losing an important client if the relationship sours (Enkel, Kausch, & Gassmann, 2005).

2. Collaborating with external network

Networks provide entities suitable to leverage for innovation, thereby reducing reliance on self-sufficiency (Coombs & Hull, 1998; Howells et al., 2004; West & Bogers, 2011): the network and network relationship form an inimitable and non-substitutable resource (Goerzen & Beamish, 2005). The network employed to access resources not available in the focal firm (Andersen, 2012; Gulati, 1998; Teece, 1986). Firms commonly turn to their networks for suitable open innovation parties to access resources and knowledge for innovation (de Jong & Hulsink, 2010; West & Bogers, 2010a). Engaging with entities in
firms’ networks supports innovation activity and significantly enhances innovation outcomes (Huang & Rice, 2009). SMEs with higher product levels emphasise having a wide range of network connections in order to access a variety of resources and support for innovation activities. Tomlinson and Fai’s (2013) analysis of 371 UK firms reinforced earlier studies showing a positive relationship between firm networks and innovation in SMEs. Conversely, not interfacing with the firm’s network reduces knowledge development over time (Y. Wang et al., 2012). The practice associates with network activities identified by de Jong et al. (2008), Trott and Hartmann’s (2009) supplier relations, and Gassmann and Enkel’s (2004) supplier integration activities.

West and Bogers (2011) distinguish two stages to this inbound practice: firstly, identification of external sources; and secondly, integrating internally the externally sourced resources. The practice highlights the demands of partner identification due to the variety of organisations available for open innovation relationships: suppliers, competitors, other firms within and outside an industry, universities, research and government organisations (de Jong & Hulsink, 2010; OECD, 2005b). In addition, the second stage of integrating the externally supplied innovation resources can be problematic. Difficulties occur with disparate cultures, knowledge transfer and information asymmetry between parties (Fliess & Becker, 2006; West & Bogers, 2011).

Whether supplier, university, or other entity, a dysfunctional (even acrimonious) relationship may occur. Unlike internal issues where project discontinuation or an employee being fired has limited ramifications, the disintegration of an interorganisational relationship may result in the termination of firms’ commercial interaction (Hart & Moore, 1990). However, in what appears to be an oversight, van de Vrande et al (2009) do not allude to how organisations outside of SMEs’ networks may be intentionally cultivated to meet a specific or unique innovation requirement.

3. External participation

External participation refers to establishing a separate entity - a start up or another business activity with others having the wherewithal to realise the innovation (Chesbrough, 2006c; Narayanan, Yang, & Zahra, 2009; van de Vrande et al., 2009). The practice affords the ability to actualise unrealised, potential or false negative innovations (Chesbrough, 2003c, 2004; West & Gallagher, 2006). The practice provides access to knowledge, technologies and discoveries through direct investment or other resource contribution, and thus participation in the value outcome (Hagedoorn, 1990; Narayanan et al., 2009). As a separate venture the
practice permits firms to diversify with the ability to monitor activities and invest further if worthwhile, yet high risk and failure rate as features to this practice (Husted & Vintergaard, 2004). The practice is considered beyond most SMEs’ abilities and presents only in a minority (van de Vrande et al., 2009).

4. Outsourcing R&D

The practice of outsourcing qualifies as reliance on another entity to provide R&D services rather than committing capital to internally acquire the required assets. An assumption of open innovation is that firms are not required to conduct R&D solo, instead it directs firms to draw on external knowledge and resources (Gassmann, 2006; Santamaria et al., 2009). Particularly relevant to the firms lacking R&D facilities or innovation-required resources, the ability to outsource equates to realisation of innovation efforts (Brusoni, Prencipe, & Pavitt, 2001). Santamaria et al. (2009) similarly observe that external R&D may replace internal R&D under transaction cost theory as offering improved usage of limited resources (G. P. Pisano, 1990; Williamson, 1985).

Van de Vrande et al. (2009) identifies universities; other types of research organisations, engineering firms and high tech enterprises contribute as providers of R&D services. From studying the R&D boundaries of the firm, Pisano (1990) recommends looking to other organisations to compensate for a lack of R&D capabilities. However, he warns of ex post bargaining problems referring to the difficulty of recognising and assessing the value of an innovation upfront, hence allocation of reward and issues with appropriating the R&D output at the end of the project. In addition, the service provider will most likely acquire associated knowledge that the originating firm did not want disclosed but revealed as a function of the joint innovation activity.

5. Licensing-in

The practice of licensing-in relates to the purchase and transfer of knowledge from one entity to another to appropriate pecuniary or strategic benefits. Licensing-in strictly relies on intellectual property protection (West, 2006). Leveraging the intellectual property of others provides a legitimate method of acquiring knowledge through buying patent rights, trademarks and copyrights (Chesbrough, 2006c; Dodgson et al., 2006; Teece, 1986). Cohen and Levinthal (1990) view the practice as advantageous and advise that exploiting others’ intellectual property through formal arrangements aids innovative success. Furthermore, licensing-in minimises innovation risk with the licensee investing in proven technologies (Chiaroni et al., 2009). Firms’ systematic access to externally generated intellectual property
accordingly develops their innovation activities and income (Badawy, 2011; West, 2006). The practice aligns with absorptive capacity: the ability to search for, acquire, and exploit others’ technology (Atuahene-Gima, 1992).

However there are specific issues relative to licensing-in. Atuahene-Gima (1993) refers to the practice as inward technology licensing finding that risk propensity and risk definition of firms dictates adoption success. Costs to the licensee may be high including negotiation and legal costs, and the actual cost of the licence (Atuahene-Gima, 1992). However, the costs may be lower than otherwise incurred by the licensee firm in developing similar technology should the firm have the wherewithal. Licensing-in found to substitute for lack in capital, expertise and time, to address internal deficits and access externally located knowledge (Garvin, 1993). Licensing-in assumes the licensee’s ability to exploit the knowledge, otherwise they run the risk of over dependency on the licensor in order to realise benefits (Luoma et al., 2010a). A relationship breakdown negatively impacts the parties with the investment becoming valueless if the opportunity discontinues (Teece, 1986).

In brief, the use of inbound practices enriches the firm by integrating knowledge from external entities to increase realisation innovation objectives (Laursen & Salter, 2006; Leiponen & Helfat, 2010; Lettl et al., 2006). Likewise, Dahlander and Gann (2010) describe inbound practice advantages as the ability to access numerous and varied sources of knowledge and other resources outside firm bounds.

Of the five inbound practices, van de Vrande et al. (2009) found involving the customer dominates SMEs’ open innovation practices, followed by network collaboration. Mattias and Schenker-Wicki’s (1972) research on inbound practices links relationships particularly with customers, suppliers and universities as being highly beneficial to innovation. The choices also allude to the SME preference to collaborate with familiar entities (S. Lee et al., 2010; Major & Cordey-Hayes, 2003). To a lesser extent collaboration occurs with competitors, and even less so with trade associations and consultants with universities and governments generally outside the SME-centric universe (Woolgar, Vaux, Ezingeard, & Grieve, 1998).

As a counterpoint to the benefits, Dahlander and Gann (2010) list disadvantages of inbound practice pursuit. They identify the potential for interorganisational cultural dysfunction and over reliance on external entities for innovation among the problems. Issues also occur with managing the tension of assimilating external knowledge into the firm while limiting the exposure of firm-held knowledge to partners (de Faria et al., 2010; Hsieh, Nickerson, & Zenger, 2007). Firms over-searching for suitable open innovation parties
receiving a lesser return from the time and effort invested, indicating a fine line exists between sufficient searching and too much (Dahlander & Gann, 2010; Katila & Ahuja, 2002; Laursen & Salter, 2006).

Another concern is raised by Lichtenthaler (2010b). He suggests that reliance on external parties may lead to insufficient development of crucial internal technological competencies thereby resulting in loss of knowledge and innovation ability, as previously identified by Cohen and Levinthal (1990). Consequently, he advises maintaining adequate internal innovation essential to firms’ innovation activities.

2.4.4 Outbound practices

Outbound open innovation leverages internally generated innovations and resources offering them externally to entities more suited to realising their value (Chesbrough & Crowther, 2006). Other than the practice of employee involvement, consideration is the outbound mode is less popular than inbound open innovation. This is due either to firms under valuing their intellectual property or their being daunted by the legal and patent complexities (Huizingh, 2011; Schroll & Mild, 2011). However, outbound open innovation and firm performance have a positive correlation predominantly in industries characterised by intense competition and technology turmoil (U. Lichtenthaler, 2009). In particular, Lichtenthaler suggests SMEs may find this open innovation practice relevant due to their resource lack and insufficient capabilities to realise internally generated innovations. Opportunities for increased revenue present with outbound practices: firms need not restrict themselves to currently served markets, instead firms may cater to other sectors through collaboration, sharing intellectual property and subsequent outputs (Dahlander & Gann, 2010).

6. Employee involvement

This open innovation practice draws on departments and individuals not typically associated with firms’ innovation activities to gather different innovation perspectives and maximise the use human resources (Chesbrough et al., 2006; Van de Ven, 1986; van de Vrande et al., 2009). Found to be a common practice by van de Vrande et al. (2009) firms solicit and capture ideas from employees not involved in innovation activities, therefore outside the firms’ internal innovation boundaries. Firms increasingly seek all employees’ input due to the interdependence of staff and complexity of work (Byron, 2008; Tourish & Robson, 2006). B. J. Gray, Matear, Deans, and Garrett (2005) point out that drawing on staff for innovation is common to most forms of innovation. However, van de Vrande et al. (2009) qualify the practice to specify the use of staff other than those assigned to R&D as
valued sources of internal information and informal networks. According to van de Vrande et al. (2009), leveraging staff expertise and encouraging initiatives supports firm success and external informal knowledge exchange. Knowledge developed through employees’ interactions with outside organisations facilitates knowledge dispersion and leads to new and enhanced products (Chesbrough, 2003c; van de Vrande et al., 2009). Indications are that the open innovation practice of all staff involvement generates greater sources of opportunity and increases employee engagement thereby providing twofold benefit to firms. Firms with engaged employees, the Economist Intelligence Unit research (2012) reports, outperform competitors.

Firms encouragement of suggestions, requests for input, the introduction of incentive schemes and internal competitions typifies the practice affording the ability to draw on a diversity of viewpoints and initiatives (Richardson & Taylor, 2008; van de Vrande et al., 2009). Employees in turn view their roles as valued contributors; equally, consistent negative responses by management can result in stress and a reluctance to contribute (O. Jones, 2003). The firm may become a victim of success if employees’ suggestions are numerous or handled incorrectly causing dissention, or if staff lack competency to offer sound concepts (van de Vrande et al., 2009).

7. Licensing-out

A key practice of outbound open innovation embodies offering internally developed innovation externally to others. The practice includes licensing-out technologies and selling off rights or similar activities to generate revenue streams and achieve more rapid realisation of the worth of an innovation than otherwise possible (Enkel et al., 2009; U. Lichtenthaler & Ernst, 2006). An advantage of the outbound process consists of selling unused or excess knowledge and resources held internally by the firm to others realising ordinarily dead value (Dahlander & Gann, 2010). The practice necessitates formal legal instruments to assist appropriating innovation value by the originating firm (West, 2006). Whereas de Jong et al. (2010) claim open innovation inverts the established view of intellectual property protection as a defensive mechanism preventing others from appropriating it. Firms are coming to realise that licensing-out provides the opportunity to gain additional revenue, selling unexploited intellectual property to others better suited to realise value or enter new markets (2006).

Lichtenthaler (2008) suggests the practice has previously been underutilised as limited to specific objectives, for instance entering a foreign market. This may be changing.
Lichtenthaler (2010) research indicates some firms now perceive licensing-out as a substantial revenue generator. Similarly, Fosfuri (2006) proposes that some organisations purposely create opportunities for licensing-out to reap the rewards of internal R&D beyond firm requirements. Furthermore, the ability of firms to take advantage of what Chesbrough (2006a) terms false-negative or rejected innovative concepts by licensing-out provides new avenues for revenue generation. Exploiting these undeveloped innovations realises market opportunities and accelerates both parties’ innovation activities (van de Vrande et al., 2009).

Complexities abound with licensing-out. Ideally to reap the advantages of licensing-out the firm has established a reputation as a knowledge provider - essential to appropriate intellectual property value (U. Lichtenthaler & Ernst, 2007). Lichtenthaler (2010b) cites issues such as loss of knowledge advantages to competitors and weakening of the firm’s technology position whilst strengthening others if not carefully managed. He suggests that fear of the occurrence of these issues negates adopting the practice of licensing-out; therefore the realisation of potential revenue gains. Managerial challenges are also evident from van de Vrande et al.’s (2009) research. Management difficulties range from pricing a firm’s technology, intellectual property disclosure parameters, negotiating terms, and even identifying alternative application for firm-developed innovations (van de Vrande et al., 2009). The authors’ warn that profits may erode if the licensor employs the technology in the same market as the licensee. Concerns additionally relate to the inbound mode practice of licensing-in (above, p. 55). Buying and selling intellectual property can create information asymmetry problems and power imbalances (Holmstrom, 1989).

Luoma et al. (2010b) emphasise the challenge of intellectual property management. The difficulty of revealing enough knowledge to establish suitability while not over-exposing, finding the right balance to enable parties to decide. Market failure may in fact occur due to poor revealing of developments hampering licensee appropriability of the intellectual property (Dahlander & Gann, 2010) consistent with Arrow’s (1962) paradox of disclosure. Hence while the licensor needs to divulge valued intellectual property to the licensee in order for the licensee to appreciate the opportunity, simultaneously the licensor desires to limit disclosure and exposure: the disclosure quandary considered a barrier to open innovation activities (Keupp & Gassmann, 2009; Luoma et al., 2010a).

Bogers (2011) in analysing this knowledge tension suspects that how the knowledge is embodied and the relational dimension of the parties have a mediating influence. Problems can be rectified through suggestions such Bar-Gill and Parchomovsky’s (2004) proposal to
overcome the paradox by first completing the patenting exercise then employing the patent instruments to protect firms’ intellectual property. Whereas Henkel (2006) suggests that some organisations best address the issue through selectively revealing.

8. **Venturing**

Van de Vrande et al. (2009) describe the outbound practice of venturing as starting up a new business to exploit an internally generated innovation. Using a different business model or market application to the parent firm, the innovation shows sufficient exploitation value to reward the parent firm’s resource commitment. The parent firm supports the new venture through investment of finances, staff, and other resources (van de Vrande et al., 2009). As a new venture, it demands extensive resources. The practice is considered inaccessible to SMEs due to its resource-rich nature (Chesbrough, 2003c). Van de Vrande et al.’s (2008) findings together with Enkel, Gassmann and Chesbrough’s (2009) research verify application of the practice is difficult, predominated by large firms, and reported as highly risky.

To conclude, the outbound mode practices (other than all staff involvement) are resource demanding and present great risk (e.g., E. Lichtenthaler, 2010; U. Lichtenthaler, 2009; van de Vrande et al., 2009). A study of Taiwanese firms by Tsai and Wang (2008) conclude that inbound practices positively influence innovation performance; but the outbound ones are less positive. While an interesting finding, the authors admit their sample firms are high tech manufacturers. Technological turbulence typifies the high tech industry restricting application of the results directly to lower tech industries.

2.4.5 **Practice adoption sequence**

Trott and Hartman (2009) posit that familiarity with open innovation engagement engenders adoption of other open innovation practices. Success in one practice is seen to advance the SME to employ more complex practices such as licensing-out - although adoption of the higher-level practices are more likely to occur in larger SMEs (van de Vrande et al., 2009). Open innovation practice adoption therefore often occurs in a sequence with customer and employee-related practices common, followed closely by network collaboration (van de Vrande et al., 2009). The propensity for licensing-in appears greater than licensing-out with venturing and external participation - all viewed as higher-level practices - less often adopted (S. Lee et al., 2010; U. Lichtenthaler, 2010b; van de Vrande et al., 2009).
2.5 Metrics for open innovation

To research open innovation requires identifying firms engagement. The variables are numerous, leading to question whether judgement of engagement should relate to say the number of practices adopted, frequency of application or number and depth of external relationships. Lazzarotti and Manzini (2009) describe the measuring of open innovation as “an interesting and rich avenue for investigation” (p. 618) and necessary to improve understanding. Table 5 illustrates the disparate approaches taken to measure open innovation, with debate continuing (West et al., 2006).

Table 5: Metric Approaches

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Citation</th>
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<tbody>
<tr>
<td>Extent of formality in collaborative partnership</td>
<td>Dahlander and Gann (2010)</td>
</tr>
<tr>
<td>Degree of intellectual property protection</td>
<td>Dahlander and Gann (2010)</td>
</tr>
<tr>
<td>Number of patents or (new) product production or portion thereof</td>
<td>Fabrizio (2009), Aylen (2010), Grimpe and Sofka (2009), Spithoven et al. (2009), Laursen and Salter (2006)</td>
</tr>
<tr>
<td>Number of external information channels</td>
<td>Fontana et al. (2004)</td>
</tr>
<tr>
<td>Degree of adoption</td>
<td>Gerybadez and Slowak (2008)</td>
</tr>
<tr>
<td>Number of problems solved through open innovation</td>
<td>Jeppesen and Lakhani (2010)</td>
</tr>
<tr>
<td>Breadth and depth of partners</td>
<td>Laursen and Salter (2006)</td>
</tr>
<tr>
<td>Outbound and/or inbound activities and sources</td>
<td>U Lichtenthaler (2008), Dahlander and Gann (2010), Keupp and Gassmann (2009)</td>
</tr>
<tr>
<td>Range of practices employed and partner number</td>
<td>Lazzarotti and Manzini (2009)</td>
</tr>
<tr>
<td>Percentage of internal and external innovation</td>
<td>Tether and Tajar (2008), Jaspers and van den Ende (2010)</td>
</tr>
<tr>
<td>Type of collaborative activity adopted</td>
<td>West and Gallagher (2006), Pisano and Verganti (2008), Dahlander and Gann (2010)</td>
</tr>
</tbody>
</table>

Popular is Laursen and Salter’s (2006) well cited metric. Their quantitative research of UK firms open innovation engagement found that multiple external sources and search channels equates to firms having a higher rate of innovation performance. From their study, the authors developed the concept of external search breadth - the number of external sources the firm draws on - and depth of firms’ search strategies, to judge level of openness. A popular measure in open innovation research, application of the metric determines firms’ extent of open innovation adoption (e.g., de Jong & Marsili, 2006; K. P. Hung & Chiang, 2010; Katila & Ahuja, 2002; Keupp & Gassmann, 2009; Sofka & Grimpe, 2008)

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12 Over 900 article citations (Google Scholar) June 2012
2.6 The relationship dimension of open innovation

Contingent to open innovation is the external entity. Understanding entity composition and the relationship dimension supports deeper insight into open innovation – crucial to explain engagement effects. As noted earlier, partner and relationship challenges command much attention and require close management (Knudsen & Mortensen, 2008; Krishnan et al., 2006). Howells et al. (2004) stress the importance of careful partner selection and relationship management as both critical for open innovation success.

The collaborative partner therefore is both the source of innovation-resource benefits, while simultaneously representing numerous difficulties in terms of establishing suitability, relational difficulties, and performance issues, (Luoma et al., 2010a). Overcoming the issues deemed worthwhile in order to address innovation shortfalls, share innovation costs and gain access to others’ resources and capabilities, especially in terms of knowledge acquisition (Dahlander & Wallin, 2006; de Faria et al., 2010; De Propris, 2002). The external entity then equally presents as facilitating innovation realisation and open hindering open innovation endeavours. Therefore, this section considers the relationship complexities to, firstly, explore who these partners may be and the why of entity preference selection (2.6.1). Next, section 2.6.2 considers where firms source entities for open innovation relationships, and the how - details of relationship stages and the challenges of relationship management (2.6.3). The chapter closes on the organisational practices firms adopt to manage open innovation.

2.6.1 The who and why: entity composition

Firms of all sizes establish relationships with a range of entities in order to innovate, exploit new opportunities, and achieve economies of scale (Chiaroni et al., 2009; de Faria et al., 2010). Open innovation endeavours therefore rely on a variety of external linkages to source knowledge, technologies, and human and financial resources (OECD, 2005b).

The who

The OECD’s Oslo Manual (2005b) offers a list of entities for innovation, expanded by others:

- Customers and users
  - (Enkel et al., 2009; Freel, 2000c; Gassmann, 2006; Grimpe & Sofka, 2009; von Hippel, 1986, 1988; West & Bogers, 2010b)
- Suppliers
  - (Gussoni, 2009; Li & Vanhaverbeke, 2009; West & Bogers, 2010b)
- Firms within industry
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- (Enkel et al., 2009; Freel, 2000c)
- Competitors
  - (Freel, 2000c; Hamel, Doz, & Prahalad, 1989; Lim, Chesbrough, & Ruan, 2010)
- Enterprises outside an industry
  - (Enkel et al., 2009; Freel, 2000c; West & Bogers, 2010b)
- Universities and other research organisations
  - (Enkel et al., 2009; Fabrizio, 2009; Harryson, 2008; Perkmann & Walsh, 2007; West & Bogers, 2010b)
- Communities
  - (Enkel et al., 2009; West & Bogers, 2010b).

Numerous national and academic surveys employ the Oslo list to guide understanding of firm innovation interactions (e.g. Community Innovation Survey (CIS), Cambridge Survey Herstad et al., 2008; Laursen & Salter, 2006; Tether, 2002).

The why of entity priority

Entities are not equally attractive for open innovation endeavours. Empirical evidence points to priorities in partner selection with different organisations serving different purposes (Belderbos, Carree, Diederen, et al., 2004; de Faria et al., 2010; Gussoni, 2009; Vanhaverbeke, 2006). Enkel, Gassmann and Chesbrough’s (2008; 2009) qualitative research of 144 open innovation practitioners across industries and countries notes firms’ preferences. The priority ranks customers first (78%) which relates to firms’ dependence on customers for survival, next suppliers (61%) followed by other organisations: a similar ranking to that found by others (Ritter & Gemunden, 2003; Vanhaverbeke, 2006). Tether’s (2002) results revealed similar preferences in his analysis of the 1997 UK CIS survey. His objective was to ascertain UK firms’ innovation relationship choices with findings showing the highest in partner choices are customers and suppliers. Similarly, the UK CIS 2000 survey iterated customers and suppliers as the preferred sources for innovation knowledge, followed by government and industry regulations (Laursen & Salter, 2006).

After favouring customers, firms most frequent interactions are with suppliers (Vanhaverbeke, 2006). Hagedoorn (1990) found supplier collaboration most often occurs in smaller firms with relationships based on casual arrangements, indicated by the lack of formal contracts. As innovation partners, suppliers provide quality input improvements and process innovations, even cost reductions (Hagedoorn, 1993). Furthermore, suppliers are well substantiated as sources of market intelligence (Hurley & Hult, 1998); thereby assisting with the development of new technologies (Clark, Chew, & Fujimoto, 1987; Jorde & Teece,
1990). They also perform an important R&D role, new product and process development and improvement, training, accessing finance and new markets (De Propris, 2002). Freel (2000c) endorses relationships with suppliers as playing a major role in supporting innovation capability, especially with the furnishing of tacit knowledge to complement and supplement resource holdings - as do others (e.g., Belderbos, Carree, Diederen, et al., 2004; Fliess & Becker, 2006; Rothwell, 1983). Gassmann and Enkel (2004) add supplier benefits as decreasing times to market and risk reduction, while West and Bogers (2010a) suggest suppliers introduce different development opportunities to the ones offered by customers. Such associations however come with a caveat however: disintegration of the partnership may result in losing an important supplier or client (Singh & Mitchell, 1996). Furthermore, suppliers are incentivised to collaborate. Involvement permits appropriation of value from future sales as outcomes to successful open innovation activity (VanderWerf, 1992; von Hippel, 1988; West & Gallagher, 2006). De Propris’s (2002) four firm case study highlighted suppliers as worthwhile innovation partners with the study underscoring interfirm collaboration as beneficial. Firms’ partner preference then lies with customers and suppliers, the two entity types often determining firms’ innovation success.

Notwithstanding the preferences, historically firms engage with other entities. Chiang and Hung (2010) study stresses that innovation relies on managers drawing comprehensively from varied external sources. For example, inter-industry firm collaboration is found to develop knowledge resulting in overall improvements to industry activities. Inter-industry relationships provide complementary technologies, equipment, and resources in pursuit of normal business operation, which in turn facilitates the innovation activities (Henkel, 2006).

Atallah’s (2002) research on interfirm collaboration recognised firms select partners from horizontal and vertical dimensions. Located on the horizontal dimension, Ahuja (2000a) considers competitors and other organisations attractive firstly for sourcing resources; secondly as conduits for knowledge spillovers and information. Additionally, he views the entities as provisionally innovative problem solvers, particularly competitors who offer opportunities to learn from earlier failures. Use of horizontally located organisations as partners may be characterised by collective invention where competing and complementary firms collaborate to develop innovations (Henkel, 2006; Scotchmer, 1991). However, Atallah (2002) warns that horizontal entity options are less desirable and present greater risk especially due to undesirable knowledge leakage. In addition activities are often monitored by government competition authorities to limit undesirable collaboration (Atallah, 2002).
Universities, on the other hand, provide a rich source of knowledge for open innovation activities (West et al., 2006). Perkmann and Walsh (2007) underscore open innovation between universities and firms as highly desirable due to the important role universities play in commercialising innovations. Integration with universities, public research and similarly R&D based organisations provides access to radically novel ideas and technology, thus offering new markets for the focal firm (Belderbos et al., 2006).

However, collaboration with other entities in firms’ networks offers a greater direct impact on innovation endeavours than science-based organisations (Klomp & Van Leeuwen, 2001). Universities now seek to monetize research, subsequently imposing greater contractual obligations than previously expected reducing their attractiveness in some cases (West & Bogers, 2010a). Grimpe et al. (2008) also cast doubt on universities as collaborative partners, referring to university research efforts as seldom commercially ready demanding greater input by firms and increased risk.

Competitors play a different role altogether. Miotti and Sachwald (2003) advise that competitor partnering is a rarity, recommending ensuring strong common goals to any involvement between rival organisations to alleviate risks. They advise that for the risks associated with competitor collaboration to be worthwhile the competitor should provide needed resources as well as cost reductions on large projects. Despite the risks, open innovation with competitors and other horizontally located organisations are popular; consultants and universities less so, although still sought after as collaborative partners on a regular basis (Tether, 2002).

2.6.2 The where: sourcing resources and relationship entities

Knowledge for innovation abundantly occurs in firms’ external environment and is a premise of open innovation (Chesbrough, 2003b; Chesbrough & Teece, 2002). By scanning widely for innovation information, resources, and solutions firms solicit an array of external sources to facilitate open innovation; highly rated are firms’ networks, conferences, trade fairs and industry organisations (2005b). The investment in search and relationship development efforts considered valuable, research finding the openness of firms to external sources for innovation results in a higher level of innovation and a greater variety of innovative opportunities (Laursen & Salter, 2006). Laursen and Salter’s (2006) study employed an existing UK CIS survey that identified where firms source innovation:

- **Markets:** Customers, suppliers, competitors, consultants, R&D organisations
- **Institutional:** Tertiary, government, and private research organisations
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Other: Professional conferences, meetings, trade associations, trade press, fairs, and exhibits

Specialised: Technical standards, government and environmental standards and regulations.

The OECD’s Oslo Manual (2005) refers to other and specialised as open information sources offering access to the public knowledge held therein. Furthermore, such information does not require interaction with the originator of the information nor financial investment in technology or similar infrastructure, making availability straightforward (OECD, 2005b). With the two groups market and institutional the OECD definition alludes to the provision of innovation resources through pecuniary acquisition and collaborative activity.

While conferences, trade press, trade associations, and similar are wellsprings of innovation knowledge and for gathering market intelligence, the network predominates for identifying and recruiting suitable entities for open innovation relationships (Vanhaverbeke, 2006). The necessity of firms to converge with external organisations for innovation is exemplified in Powell, Koput and Smith-Doerr’s earlier (1996) work in the biotech sector. The research recognises the network as frequently being the nexus of innovation, not the individual enterprise. Interorganisational relationships perceived as networks of learning to reap for innovation development: networks are acknowledged as relationships between firms to sustain a specific purpose and to source open innovation partners (Karkkainen & Hallikas, 2006; Ozman, 2007). Innovative firms are found to draw on network contacts to access needed resources, realise innovation and radically improve existing product offerings (Laursen & Salter, 2006). Few argue contrarily with the innovation literature supporting SME acquisition of supplemental and complementary resources through network collaboration (e.g., Fukugawa, 2006; Hewitt-Dundas, 2006; Zeng, Xie, & Tam, 2010). Networks therefore enhance innovation due to partners’ resource provision compensating for internal lack with the SME deferring to “the closest (and friendliest) set of networks SMEs are engaged” (Tomlinson & Fai, 2013, p. 318).

A main proposition explicit in the literature associates the type of network tie with application of firms’ open innovation activities. The type of tie is represented as strong or weak, informal or formal, deep or wide (Simard & West, 2006). The network concept of strong ties - expressed as close relationships embodying familiarity and trust (Gulati, 1995) are reflected in the ease of communication and intimacy between firms; similarly, frequency of interactions (as a proxy of closeness) offers efficient knowledge sharing (Szulanski, 2000).
Nevertheless, the supplied knowledge often lacks novelty due to its embodiment in familiarity and characterised by redundant information (Granovetter, 1973, 1983; Simard & West, 2006). Freel (2000c) concurs, suggesting that less innovative firms are characterised by their preference for a recurring relationship, in turn limiting innovation opportunities. Conversely, enterprises farther away in firms’ network, defined as weak ties, are alleged to offer greater knowledge novelty and diversity (Granovetter, 1973).

Weak ties expand the array of expertise and greater innovation output due to the diversity of knowledge on offer (Ahuja, 2000a; Granovetter, 1973; Levine & White, 1961). Overcoming inertia to achieve more transformative innovations probably occurs in relationships with organisations outside of firms’ familiar networks as representing a greater variety of knowledge (Bao et al., 2011). Although unfamiliarity poses risks in terms of trust and a lack of shared experience, the use of weak ties offers novelty and new opportunities, contrary to strong ties (Byron, 2008; Tourish & Robson, 2006). However, network-distant or irregular contacts provide knowledge more difficult to assimilate due to the lack of familiarity (Hansen, 1999; Szulanski, 2000). The two forms of ties therefore offer different yet important contributions to open innovation endeavours. Simard and West (2006) recommend a balance of both to benefit firms’ innovation activities.

It is increasingly apparent that the shift from firm-centric to network-centric innovation endeavours - exemplified by firms’ adoption of open innovation - points to interorganisational networks as commonly central to innovation activities. Networks are a crucial source of open innovation relationships (Enkel et al., 2009; Hagedoorn, 1996, 2002; S. Lee et al., 2010; 2011; P. Powell et al., 1996). Access to interorganisational networks for innovation extends firms’ innovation resources through open innovation.

2.6.3 The how: of stages and facets to managing relationships

Searching and evaluating potential sources that match a firm and its agenda are uncertain exercises, and a consistent theme of interorganisational relationship literature (Belderbos, Carree, Diederen, et al., 2004; Chesbrough, 2003c). Open innovation depends upon favourable relationships. The following subsection explores the stages and facets of relationships and the management thereof in order to gain appreciation of the complexity inherent with this unavoidable facet of open innovation.

Relationship phases

To develop understanding of the composition and phases of interorganisational relationships relative to open innovation, scholars draw on alliance partnerships and
interorganisational networks as guides (e.g., Bamford & Ernst, 2002; Batonda & Perry, 2000; Gassmann & Enkel, 2004; Vanhaverbeke, 2006). Various descriptions of relationship phases exist as demonstrated by Batonda and Perry’s review (2000). From their assessment of scholarly offerings, five stages dominate: the search for potential partners, commencing the relationship, development, maintenance, and termination. Munyon et al.’s (2011) article on firm relationships additionally provides clues by refining relationship intricacies into three phases encapsulating most version dimensions. The first step commences with information searching to identify and ascertain partner suitability and each party’s potential contribution; Koput (1997) refers to this phase as partner screening. Next, negotiating commences, concurrently with each party investigating the success of the other party’s previous collaborative experiences. The final phase, labelled the commitment phase, establishes accountability, clarifying partner responsibilities and time lines (Munyon et al., 2011). The phases are divided similarly to Kanter’s (2004) three phases of courtship, engagement, and housekeeping. Table 6 details the role of each phase.

Firms possessing necessary and required resources are considered attractive partners; the greater the resource wealth the more attractive the firm and the increased likelihood of collaborative opportunities (Ahuja, 2000b). The characteristics of the reciprocal organisation are a determinant of partner selection while implicitly the partner possesses the required resources to contribute to the relationship (Belderbos, Carree, & Lokshin, 2004; Frenken, 2000; West & Bogers, 2011). Belderbos et al. (2006) stipulate open innovation relies on the ability to assess, qualify and establish suitable relationships. Consequently, contingent to effective relationships and thus successful open innovation endeavours is partner suitability, which depends on appropriate selection.

Keupp and Gassman (2009) stipulate the initial phases of open innovation - search and evaluation of sources - demand significant costs with suitability of organisational fit remaining unknown a priori. They warn that too much openness by firms could be disadvantageous and reduces collaboration feasibility due to poor fit and intellectual property costs. Relationship costs may be offset if arrangements are managed properly and operated well (S. Lee et al., 2010). The management structure, firm size and technology status act as indicators of partner suitability and consequently are important attributes (Howells et al., 2004). Another perspective is presented by Tether and Tajer (2008). They posit that innovation objectives may dictate the choice and type of relationship and partner propensity.
Table 6: Relationship Phases (Based on Munyon et al., 2011)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activities</th>
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<tbody>
<tr>
<td>First</td>
<td>The initial step focuses on mutual benefits of collaborating to overcome any lack of relationship history. Each having a reputation as a sound partner supports acceptance and increases opportunities for collaboration. Lack of information on a partner may create problems with establishing compatibility, thus increasing reliance on clarity and defining future expectations to mitigate concerns. Kanter (1994) adds that selective perception dominates transactions at this stage, identified as an entity’s tendency to highlight positive features - not the dangers - of the relationship. The early step of partner identification is a complicated process, as is qualifying partner suitability (Luoma et al., 2010a).</td>
</tr>
<tr>
<td>Second</td>
<td>The relationship develops through further information gathering to support assessment of partner suitability. Appraisal progresses to value judgements with the extension of additional benefits to secure understanding and develop trust. Trust described as believing the other to be honourable, of integrity, honest, and fair in dealings – trust considered the most critical facet of a relationship.</td>
</tr>
<tr>
<td>Third</td>
<td>Relationship commitment apparent with each party viewing the other as mutually agreeable and the relationship marked by loyalty, support, and empathy. Flexibility may present as an aspect of the relationship with firms agreeing to modify or adjust behaviour and offer support. Accountability also features; too much, the partner may rebel; too little, and the relationship lacks boundaries to inform behaviour. By this stage the parties’ experience of each other underscores awareness of business differences as well as similarities (Becker, 2004). Not explicit is the requisite to measure the relationship, particularly afterwards as the lack of monitoring risks late identification of problems.</td>
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Further to phase two, Munyon et al. (2011) stipulate that successful open innovation relationships rely heavily on building and sustaining trust. Trust is, “a state of mind, an expectation held by one trading partner about another, that the other behaves or responds in a predictable and mutually acceptable manner” (Winter, 1964, p. 37). A key characteristic of relationship effectiveness, trust mitigates uncertainty concerns according to Krishnan et al. (2006). The results of Fliess and Becker’s (2006) case study research emphasise trust as essential for productive innovation relationships to address uncertainties and reduce opportunistic behaviour: another is clear and constant communication. The latter helps ameliorate Chan and Heide’s (1993) concern of hidden agendas with partners having disparate objectives and resultant partnership difficulties. Indeed, Barney and Hansen (1994)
go so far as to identify trustworthiness as a competitive advantage; their definition of trust refers to mutual confidence, with the parties to the exchange not exploiting another’s vulnerabilities. Trust frequently relies on firm reputation to engender commitment, the collaborative experience then proving validation - or not - of the trust invested in the relationship (Munyon et al., 2011; Winter, 1964).

Therefore open innovation success depends upon incorporating and building trust and is integral to appropriating value (Ireland et al., 2002). Trust cannot be underestimated in the creation of a functional relationship and the sustaining of it over time (Ring & Van de Ven, 1992). The proclivity to partner with known entities is congruent with trust and based on the experience of prior engagements and the development of familiarity and respect over time (Bogenrieder & Nooteboom, 2002; Lankhuizen & Woolthuis, 2003). Consequently, the importance of trust means firms default to familiar partners, thus reducing risk and relationship management concerns (Gussoni, 2009; Y. Lee & Cavusgil, 2006; Shepherd & Ahmed, 2000).

**Conditional facets of relationship management**

As a sophisticated tenet, relationship management requires appropriate competence (Ritter & Gemunden, 2003). Open innovation causes the intermingling of separate organisations to realise an innovation outcome, firms that are inherently disparate and heterogeneous in nature, with disparity likely leading to misunderstandings and relational difficulties (van de Vrande et al., 2009). The likelihood of issues arising from disharmonious firms and culture-misfits causes irreconcilable differences, and associated costs highlight relationships as crucial to open innovation efficacy (Dahlander & Gann, 2010; Luoma et al., 2010a).

Relationships demand, “deliberate management by both parties to translate optimism into results” (Munyon et al., 2011, p. 97), to which Keupp and Gassmann (2009) stress the fit with and between firms - inclusive of managing divergent views and the establishment of mutually beneficial objectives. Relationships may be pecuniary or non-pecuniary depending on the relationship, desired innovation outcome and partner type (Dahlander & Gann, 2010; West & Bogers, 2010b). As such, relationships range from informal arrangements through to formal agreements using legal instruments (Gussoni, 2009; Simard & West, 2006).

Boschma (2005) suggests a number of important factors to consider with interorganisational relationships. Difficulties arise, he advises, due to the absence of familiarity with each entity’s culture and organisational norms. Moreover, he argues that
both over-familiarity and too little familiarity in terms of the interfirm relationships can impede innovation relative to strong and weak ties: too close compromises idea novelty, too far apart leads to misunderstandings (Boschma, 2005). Relevant to risk reduction, partner firms may not derive innovation benefits equally so transparency of value exchange purports as being fundamental and a function of relationship management (Tether, 2002). Any asymmetry may be mitigated by long term association according to Ring et al. (1992) as the length of engagement establishes favourable terms for relationship success iterating the default attribute of preferring partnering known entities.

A multiplicity of challenges exists with interorganisational relationships according to the literature. Relationships require managing partner behaviour uncertainty including parties who fail to meet obligations (Krishnan et al., 2006). Negative behaviour consists of attempts to derive benefit from open innovation outcome without contributing one’s own resources, or prevaricating to protect resources when one partner suspects the other intends not to contribute (McCarter, Mahoney, & Northcraft, 2011). Multi-partner projects demand an even higher degree of coordination and control resulting in increased organisational risks, and the greater complexity equates to greater susceptibility and vulnerability (Dahlander & Gann, 2010). Karkkainen and Hallikas (2006) add the necessity to manage divergence in goals between various parties, which calls for the alignment of cultures to overcome the lack of commitment. However, they warn that from their research the difficulty of managing the intricacies of interorganisational collaboration repeatedly leads to failure of the relationship.

Another condition relates to knowledge exchange. Firms find intellectual property management exceptionally difficult when involved with external organisations in open innovation relationships (Huizingh, 2011; Luoma et al., 2010b). Luoma et al. (2010b) elaborate that difficulties arise due to the dynamics of interfirm relationships being inclusive of changing conditions between parties and as a consequence of arrangements made to afford open innovation. Divulging knowledge to external organisations simultaneously facilitates open innovation activities while causing vulnerability concerns for firms (Badawy, 2011). Parallel to this, Dahlander and Gann (2010) add issues in identifying and evaluating external ideas for innovation when ascertaining suitability.

Consequently, despite efforts desired outcomes may be thwarted (Simonin, 1997). The innovation value depends upon nurturing successful relationships, an area recognised as rife with complexity and adversity (Howells et al., 2004). Earlier dissenting voices point to the difficulties of relationships, for instance Williamson. Williamson (1967) advises of the costs
incurred in relationships, listing the expenditure of resources inclusive of time devoted, effort invested, and financial commitment - often scarce resources that require careful management to obtain best return. Freel (2000c) contrasts this by proposing that the “real barriers to partnership, as perceived by the firms themselves” (p. 260) are more likely associated with the absence of trust and the difficulties of finding suitable partners.

Simonin (1997) highlights the necessity of examining previous relationship successes and failures to improve future engagement. From his survey of 151 firms, the achievement of desired benefits firstly requires internal development of collaborative relationship knowledge. That experience then begets further experience to improve relationship management ability.

Relational difficulties risk compromising the value of the open innovation relationship, emphasising the intrinsic nature of relational efficacy to open innovation. The relationship capabilities of management and staff largely determine firms’ ability to realise the benefits of open innovation (Chiaroni et al., 2009). Referred to as relational ability, competence in this capacity forms a competitive advantage congruent with building and maintaining relationships (Barney, 1995; Dyer & Singh, 1998; Stuart, 2000). Relational ability is therefore key to initialising cooperation, organisational and innovation relevance, and continuity of the relationship (Darr & Kurtzberg, 2000). The relationship management inadequacies of technical and science-oriented professionals compounds difficulties as often demonstrating poor interpersonal skills (Capaldo, Volpe, & Zollo, 1996). The creation, maintenance and exploitation of relationships therefore relies on the relational competences of all parties regardless of the basis of the interorganisational relationship (2003).

Open innovation is steeped in risks congruent with hegemony where one entity dominates the arrangement (Walker & Poppo, 1991). Consequently conflicts arise through asymmetrical power relationships (Tether, 2002), concerns with undue influence and unintentional information leakage (Hamel, 1991), and lack of transparency (R. Larson, Bengtsson, Henriksson, & Sparks, 1998). These allude to the difficulties in maintaining the balance of power between partners and ensuring equitable outcomes to open innovation.

Further insights can be gleaned from Camagni’s (1993) discussion on interfirm relationships. Although he focuses on scale economies rather than innovation per se he lists vulnerabilities, risks and costs which are correspondingly relevant to open innovation endeavours:

- Weaknesses in human, organisational and managerial resources in either firm imposing on the ability to perform.
Minimising commitment of effort by one or other firms to reduce risk.

The inability of firms to value assets committed to the relationships, therefore to identify the contribution of the partners.

The different abilities of the parties to exploit the outcomes of open innovation.

Difficulties with interfirn coordination due to disparate business cultures and routines, managerial styles.

Firms may be partners and competitors simultaneously underscoring relationship difficulties and issues with the appropriate degree to the revealing and sharing of information.

The challenges of task and responsibility designation when project demands are unknown.

Further complicating identification of interorganisational relationship issues is firms’ reluctance to discuss relationship failures due to their concealing the risks or are simply being ignorant of them (Camagni, 1993). Furthermore, Zaheer et al. (1998) warn that conflict may result in premature relationship breakdown and costs associated with the occurrence of early termination. Trust again iterates as critical to building connections between partner firms and defusing such situations (Gulati, 1998; Krishnan et al., 2006).

For better or for worse interorganisational relationships are conditional to open innovation: the presence of external entities necessary to provide resources, expertise, and knowledge to improve and realise innovation (Laursen & Salter, 2006; S. Lee et al., 2010; Tether, 2002). However, relationships are time consuming, fraught with difficulty and risky (Dahlander & Gann, 2010; Luoma et al., 2010a). Partners therefore simultaneously present as being critical to open innovation while the inherent risks and complex dynamics integral to the interorganisational relationship threaten to compromise efforts. Firms therefore employ strategies to manage relationships; a popular practice is defaulting to known partners to mitigate concerns. Relational intricacies rely on management possessing the ability and time to interface and exploit relationships and so reap benefits. However, despite the dominance of disadvantages over advantages with open innovation relationships, a firm going it alone can be more costly (Camagni, 1993).

2.7 Chapter summary

Typifying the contemporary business environment are developments including worker mobility, the associated diffusion of knowledge, and the competitive pressures of globalisation. Therefore, firms are motivated to adopt open innovation to address
developments and exploit innovation opportunities. A convenient meta-term, open innovation amalgamates a range of externally orientated practices. Employment of open innovation rewards firms. Not the least, access to resources encompassing diverse knowledge, organisational learning, and innovation opportunities.

This chapter establishes the theoretical foundations of the study from the innovation, open innovation, and the related literature to form a picture of open innovation in application. The chapter identifies three key constructs relative to the research question. These, together with constructs from the literature on the innovative SME (Chapter 3) form the conceptual framework for the study. From the review of the literature in this chapter the three constructs are:

- The practices of van de Vrande et al. (2009) as manifesting open innovation
- Compilations of the beneficial and detrimental effects of open innovation
- Organisational practices employed by firms in response to experiences of open innovation demands.

2.7.1 Open innovation practices

The study qualifies SMEs’ open innovation engagement as manifest through the eight practices empirically identified by van de Vrande et al (2009): the practices embodying equity and non-equity arrangements, formal and informal activities. The eight practices offer guidance on SMEs’ open innovation activities; therefore, provide the means to differentiate effects of engagement by practice. Five inbound practices bring into the firm innovation-required resources:

1. Customer interaction
2. Network collaboration
3. External participation
4. Outsourcing R&D
5. Licensing-in.

Outbound practices direct internal resources and innovation opportunities outwardly and identified as:

6. Employee involvement
7. Licensing-out
8. Venturing.
2.7.2 Identifying the open innovation firm

Ascertaining the open innovation active firm is an area of much debate. However, a popular choice is Laursen and Salter’s (2006) breadth and depth metric based on the number of partners and depth of involvement. Contingent then to open innovation is the presence of one or more external entities. Entities range from customers, suppliers, firms within and external to the industry, private and government funded organisations and even competitors.

2.7.3 Clarifying practice effects

Additional to the well-recognised critical advantage of accessing innovation-required resources, there are other internal benefits associated with engagement. Firms’ experience enhanced organisational learning to improve products and services. Exposure to other organisations’ work activities and procedures directly and indirectly improves organisational routines. The success of open innovation also offers reputational rewards, with the firm promoted as an attractive open innovation partner and one competent in satisfying client requirements (Table 7).

<table>
<thead>
<tr>
<th>BENEFICIAL EFFECTS</th>
<th>Citation</th>
</tr>
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<tbody>
<tr>
<td>Acquisition of knowledge and other innovation-required resources</td>
<td>(e.g., Bougrain &amp; Haudeville, 2002; Bretherton &amp; Chaston, 2005; Chesbrough, 2010; Chesbrough et al., 2006; Das &amp; Teng, 1998; de Faria et al., 2010; De Propris, 2002; Fritsch &amp; Lukas, 2001; Hausman, 2005; Hewitt-Dundas, 2006; O. Jones &amp; Macpherson, 2006; Miotti &amp; Sachwald, 2003; Nieto &amp; Santamaria, 2010; Nooteboom, 1994; Rogers, 2004; West &amp; Gallagher, 2006)</td>
</tr>
<tr>
<td>Increased revenue sources: new products and services, markets</td>
<td>(Chesbrough, 2003a, 2003c; Chesbrough et al., 2006)(Lilien et al., 2002; Piller &amp; Ihl, 2009)</td>
</tr>
<tr>
<td>Brand and reputation enhancement</td>
<td>(Chesbrough &amp; Crowther, 2006; Cosh &amp; Zhang, 2011; U. Lichtenhaler &amp; Ernst, 2007)</td>
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</table>

Another side of open innovation is discernable, that practice incurs resource demands and challenges to practitioners; engagement therefore presenting advantages and disadvantages. From the literature relating to open innovation are suggestions on challenges, which demand firms to develop strategies to overcome and realise the benefits of open
innovation. However, knowledge is scarce on the negative implications of open innovation adoption - an important gap in the literature. Derived from innovation literature, discernable detrimental implications are divisible between firm internal and external entity-located as summarised in Table 8.

Table 8: Detrimental Effects of Engagement

<table>
<thead>
<tr>
<th>DETRIMENTAL: INTERNALLY LOCATED</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade off between BAU and open innovation</td>
<td>(J. F. Christensen et al., 2005; Enkel et al., 2009; Tushman &amp; O'Reilly, 1997; van de Vrande et al., 2009)</td>
</tr>
<tr>
<td>Disintegration of internal innovation</td>
<td>(Cohen &amp; Levinthal, 1990; U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Management-orientated: Reliance on adequacy of management time, expertise, and relational ability; relationship efforts not always equal to success</td>
<td>(e.g. Belderbos et al., 2006; Dahlander &amp; Gann, 2010; Freel, 2004; Hadjimanolis, 2003; Hewitt-Dundas, 2006; Hoffman et al., 1998; Katila &amp; Ahuja, 2002; Laursen &amp; Salter, 2005; U. Lichtenthaler, 2010b; Luoma et al., 2010a; Major &amp; Cordey-Hayes, 2003; Narula, 2004; Terziiski, 2010; van de Vrande et al., 2009; van der Meer, 2007)</td>
</tr>
<tr>
<td>Dependence and stress on internal resources: - Hampers open innovation realisation - Limits search and partner identification and ability to manage partnership risks - Inability to recognise or fully appropriate rewards including knowledge absorption - Lack of expertise among human resources</td>
<td>(Enkel et al., 2009; Laforet &amp; Tann, 2006; E. Lichtenthaler, 2010; Luoma et al., 2010a; Major &amp; Cordey-Hayes, 2003; Narula, 2004; Nieto &amp; Santamaria, 2010; Rothwell, 1989; van de Vrande et al., 2009; van der Meer, 2007)</td>
</tr>
<tr>
<td>Increased or too high financial costs</td>
<td>(Atuahene-Gima, 1992; Enkel et al., 2009; U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Business structure inadequacies</td>
<td>(Major &amp; Cordey-Hayes, 2003; Nieto &amp; Santamaria, 2010; van de Vrande et al., 2009)</td>
</tr>
<tr>
<td>Staff ability and behavioural issues including NIH, NSH, OUH, lack motivation</td>
<td>(Chesbrough, 2006b; Chesbrough &amp; Crowther, 2006; Dahlander &amp; Gann, 2010; Hamaoka, 2008; U. Lichtenthaler, 2010b; Luoma et al., 2010a; Major &amp; Cordey-Hayes, 2003; Salge, Farchi, Barrett, &amp; Dopson, 2012; van de Vrande et al., 2009; van der Meer, 2007)</td>
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</table>
Table 8 (continued)

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<thead>
<tr>
<th>DETRIMENTAL: INTERNALLY LOCATED</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulties with knowledge management including knowledge exposure and integration</td>
<td>(Andersson &amp; Loof, 2009; Cohen &amp; Levinthal, 1990; Dahlander &amp; Gann, 2010; de Faria et al., 2010; Enkel et al., 2009; Ipe, 2003; Luoma et al., 2010a; van de Vrande et al., 2009; van de Vrande et al., 2010; van der Meer, 2007; West &amp; Bogers, 2013; West &amp; Gallagher, 2006)</td>
</tr>
<tr>
<td>Discerning property rights</td>
<td></td>
</tr>
<tr>
<td>Tendency to informality with arrangements, inability to afford intellectual property mechanisms, management, risks and legal protection issues</td>
<td>(Arundel, 2001; Arundel &amp; Kabla, 1998; Bonte &amp; Keilbach, 2005; B. H. Hall, Lotti, &amp; Mairesse, 2009; Hoffman et al., 1998; Hurmelinna et al., 2007; Kitching &amp; Blackburn, 1998; Luoma et al., 2010a; Nieto &amp; Santamaria, 2010; Sparrow, 2001; van der Meer, 2007)</td>
</tr>
<tr>
<td>Preference for known entities</td>
<td>(Granovetter, 1985; Laforet &amp; Tann, 2006; Y. Lee &amp; Cavusgil, 2006; Munyon et al., 2011; Sampson, 2007; Shepherd &amp; Ahmed, 2000)</td>
</tr>
<tr>
<td>Partner and outcome delays impacting BAU and internal resources</td>
<td>(Enkel et al., 2009; Knudsen &amp; Mortensen, 2008; U. Lichtenthaler, 2010b; Luoma et al., 2010a)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>DETRIMENTAL: EXTERNALLY LOCATED</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems interpreting customer requirements and ideas, relational risks</td>
<td>(Enkel et al., 2005; Grimpe et al., 2008; van de Vrande et al., 2009)</td>
</tr>
<tr>
<td>Costs and uncertainty in partner identification, qualification and establishment of suitability</td>
<td>(Belderbos et al., 2006; Dahlander &amp; Gann, 2010; Katila &amp; Ahuja, 2002; Y. Lee &amp; Cavusgil, 2006; U. Lichtenthaler, 2010b; Luoma et al., 2010a; Munyon et al., 2011; Sampson, 2007; van de Vrande et al., 2009; van der Meer, 2007)</td>
</tr>
<tr>
<td>Interfirm relationship complexities, including cultural, organisational modes, knowledge transfer, communication dissimilarities and attribution of effort impose on managerial resources and relational ability</td>
<td>(Dahlander &amp; Gann, 2010; Fliess &amp; Becker, 2006; Hofer &amp; Adametz, 2007; S. Lee et al., 2010; Luoma et al., 2010a; Major &amp; Cordey-Hayes, 2003; Terziowski, 2010; van de Vrande et al., 2009; van der Meer, 2007)</td>
</tr>
<tr>
<td>Dependence on firm network to compensate for innovation inadequacies</td>
<td>(Dahlander &amp; Gann, 2010; U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Inability to control partner actions</td>
<td>(Dahlander &amp; Gann, 2010; U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Financial consequences due to loss of customer/supplier if relationship deteriorates</td>
<td>(Enkel et al., 2005; Hart &amp; Moore, 1990)</td>
</tr>
</tbody>
</table>

To summarise (Tables 7 and 8):

- Externally located challenges embody the partner dimension. Collaborative arrangements rely on the hypothesis that firms act deliberately to address deficits in
required innovation resources such as knowledge (Montalvo, 2006; Penrose, 2009). Hence, while contingent to open innovation, the demand for the extensive investment of resources to find, qualify, and establish the relationship, difficulties arise for example with mismatched cultures and communication styles. Experience of partner reluctance or inability to perform, asymmetry in resource and contribution exchange, and delays incurred present among the multiplicity of issues.

- Firms often default to familiar entities regardless of suitability to avoid or reduce relationship complexities. Exacerbating relationship complexities are interfirm differences. Cultural dissimilarities, innovation objectives, and communication specifics hamper understanding and development of effective open innovation engagement.

- Knowledge and intellectual property issues relate to both internal and external detriments. Firms must ensure sufficient and relevant internal knowledge exists to appropriate the benefits of open innovation endeavours. The admonition is therefore open innovation not to replace closed innovation with the two innovation strategies being mutually supportive (U. Lichtenthaler, 2010b).

- Furthermore, while organisational learning is an acknowledged function of innovation, the opportunity to enhance internal knowledge through exposure to others’ activities open innovation appears to be a specific benefit. Yet recognising organisational learning opportunities relies on tacit and explicit knowledge, the lack of recognition hindering organisational learning opportunities, limiting assimilation and application.

2.7.4 Organisational responses

To offset negative effects and maximise positive benefits, the open innovation practitioner can employ a range of organisational practices. The organisational practices include managing external relationships which is well recognised as prone to complexity and requiring appropriate competence. Another is the use of methods to integrate externally sourced knowledge and open innovation outcomes to advance organisational learning and innovation reward. Engagement success relies on appropriate organisational responses and practices to benefit from open innovation endeavours (Table 9).

Finally, if the flourishing literature on open innovation is a gauge, firms’ innovation loci are increasingly external due to open innovation engagement. Firms adopt open innovation not simply to reap the benefits of resource access. Open innovation contributes to firms’ ability to manage the issues evident in the business environment characterised by the
increasing speed of business, worker mobility, globalisation, and technology rapidity.

Table 9: Organisational Practices as Open Innovation Countermeasures

<table>
<thead>
<tr>
<th>ORGANISATIONAL PRACTICE</th>
<th>Citations (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation champion to drive internal and external innovation</td>
<td>(Hadjimanolis, 2003; Lefebvre &amp; Lefebvre, 1992; Sharma, 1999)</td>
</tr>
<tr>
<td>Administer open innovation management strategy including knowledge integration</td>
<td>(Birkinshaw &amp; Mol, 2006; Hadjimanolis, 2003; U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Intentional incorporation of learning to enhance relational skills</td>
<td>(Hadjimanolis, 2003)</td>
</tr>
<tr>
<td>Incentives to motivate employees</td>
<td>(Fu, 2012; Salge et al., 2011)</td>
</tr>
<tr>
<td>Defer to more common open innovation practices to minimise risk and lack of managerial competence</td>
<td>(van de Vrande et al., 2009)</td>
</tr>
<tr>
<td>Persist with internal innovation to support knowledge appreciation and integration</td>
<td>(U. Lichtenthaler, 2010b)</td>
</tr>
<tr>
<td>Establish methods to identify, and exploit new knowledge and new partners</td>
<td>(O. Jones &amp; Macpherson, 2006)</td>
</tr>
<tr>
<td>Favour familiar partners: develop relationships with preferential partners due to established trust and relationship/open innovation efficacy</td>
<td>(Granovetter, 1985; Y. Lee &amp; Cavusgil, 2006; U. Lichtenthaler, 2010b; Munyon et al., 2011)</td>
</tr>
<tr>
<td>Preference for informality in partner arrangements</td>
<td>(Bonte &amp; Keilbach, 2005)</td>
</tr>
<tr>
<td>Close management of knowledge sharing with partners: selective revealing</td>
<td>(Alexy, George, &amp; Salter, 2013; Arundel &amp; Kabla, 1998)</td>
</tr>
</tbody>
</table>

Of the few studies on open innovation and the SME, indications are that innovative SMEs respond to business changes and realise innovation objectives by adopting open innovation. Yet, the innovative SME has specific characteristics that hamper and others that support innovation activities influencing their experience of open innovation. The next chapter investigates the nature of these characteristics and the influence of open innovation engagement on the innovative SME.
Chapter Three

THE INNOVATIVE SMALL AND MEDIUM ENTERPRISE (SME)

Predominately open innovation research to date focuses on firms in general or the large and high tech firm in particular. Although the SME is increasingly subject to interest, understanding remains scarce on the dynamics of open innovation engagement and SMEs (Hausman, 2005; S. Lee et al., 2010). Subsequently, Chapter 3 places the innovative SME centre stage. Due to their small size, SMEs experience innovation differently to large firms (Rothwell, 1989; Rothwell & Zegveld, 1982; Sawang & Unsworth, 2011). A significant SMEs characteristic is that of resource deficits and one that demands much attention in pursuit of innovative activities (Freel, 2004; Rothwell & Zegveld, 1982; Terziovski, 2010; Vossen, 1998b). The ability to acquire innovation-required resources through open innovation presents as ideal to address SMEs’ innovation shortcomings, while detriments indicated in the innovation literature suggest implications of SME engagement threaten the feasibility of practice adoption.

This chapter concentrates on three areas:
- The attractiveness of open innovation from the perspective of the SME (section 3.2)
- Defining the characteristics of innovative SMEs (section 3.3)
- The consequences of open innovation engagement, through the lens of these characteristics, to inform the research question (section 3.4).

The chapter commences with a brief review of SMEs’ need to innovate, and the quandaries associated with doing so (3.1). Section 3.5 consolidates the aspects herein that combine with the open innovation dimensions explored in Chapter 2 to form the conceptual framework.

3.1 SMEs’ innovation dilemma

The consensus is that innovation is worthwhile. Considerable agreement exists that innovation correlates with increased SME productivity and is an important determinant to SME growth and survival (e.g., J. R. Baldwin, 1995; Heunks, 1998; Hoffman et al., 1998; Kumar & Subrahmanya, 2010; Laforet & Tann, 2006; Madrid-Guijarro, Garcia, & Van Auken, 2009; Oke et al., 2007). “Innovation is consistently found to be the most important characteristic associated with success in the population of growing small and medium-sized firms.” (J. Baldwin & Gellatly, 2003, p. 130). While Oakey (1993) and Storey (1994) note that not all SMEs innovate and not in all sectors, Freel (2000b) upholds that innovating SMEs
outperform non-innovators. Innovative SMEs are faster growing, enjoy better profitability, greater success, and improved organic growth (Freel, 2000a).

Yet, innovation presents a minefield of issues to SMEs often precluding innovation realisation (Madrid-Guijarro et al., 2009; Sawang & Unsworth, 2011). O’Regan et al. (2006) suggest that for SMEs to innovate effectively they face, “a complex and formidable task” (p. 251). Acknowledged is that the complexity frequently places innovation beyond their ability (Laforet, 2008). Yet, effort is required to confront external changes occurring in the contemporary business landscape (S. Lee et al., 2010).

Drawing on external organisations to compensate for innovation resource shortages becomes increasingly crucial for SMEs to cope with a business environment characterised by complexity, shortened product lifecycles and knowledge-intensity (van de Vrande et al., 2009). Welsh and White (1981) point out that external changes impact more heavily on smaller firms, thus necessitating the development of actions to respond appropriately. SMEs are obliged to manage changes through developing relationships with outside firms to thrive and survive (S. Lee et al., 2010; Street & Cameron, 2007).

SMEs’ resource deficiencies are recognised as particular barriers to realising the benefits of innovating (Hadjimanolis, 2000; Hausman, 2005; Massa & Testa, 2008). Scholars such as Welsh and White (1981) categorically state, “resource poverty results because of various conditions unique to smaller companies.” (p. 18). Deficits in financial and human resources and the inability to spread the risks associated with innovation are common in SMEs, often thwarting innovation realisation (Acs & Audretsch, 1990; Damanpour, 1992). Consequently, how SMEs respond to innovation barriers either prevents innovation efforts or conversely propels growth and innovation performance (Barber et al., 1989; Madrid-Guijarro et al., 2009; Rothwell, 1989).

### 3.2 SMEs and open innovation

SMEs have specific characteristics correlated with their size, which influence their experience of open innovation (Chesbrough, 2010; Wynarczyk et al., 2013). Appreciated is that for SMEs to realise innovation objectives explicitly relies upon their possession of or access to adequate resources. Appropriation of innovation resources considered essential to compete and survive in the contemporary business environment. According to Susman, Jansen and Michael (2006) “small firms, which often have limited human, physical and financial resources... need to collaborate with other firms and institutions in order to generate ideas and gain access to complementary resources” (p. 11). Evidence exists of SMEs
innovating less on their own, instead are turning outside for critical innovation-required resources and sources of innovative opportunities (van de Vrande et al., 2009).

Given that many SMEs do heed the call to be innovative, understanding is attractive on how open innovation influences SMEs. Chesbrough (2010) suggests the benefits SMEs receive from open innovation prove the pursuit of endeavours is worthwhile. Proponents advocate SMEs engage in open innovation to address shortcomings, to realise innovation more frequently, and to create greater value (Chesbrough & Crowther, 2006; Das & Teng, 2000; Gassmann et al., 2010; S. Lee et al., 2010; U. Lichtenthaler, 2008; van de Vrande et al., 2009). Furthermore employing an open innovation strategy leads to improved innovation through access to a wider pool of knowledge, aids information exchange, pooling and acquisition of resources, technology transfer and the management of risk (Chesbrough, 2010; Gassmann et al., 2010; Laursen & Salter, 2006; Nieto & Santamaria, 2010; van de Vrande et al., 2009; Vanhaverbeke et al., 2012).

Due to their close interface with their network, SMEs have an open innovation advantage in terms of exploiting their network for innovation opportunities (S. Lee et al., 2010). Lee et al.’s (2010) research emphasise that the benefits of open innovation to the SME appear greater than the disincentives. Indeed, it is recognised that interorganisational collaboration strongly influences SME success (Maxwell, 1992; Richardson & Taylor, 2008). Open innovation therefore appears to be a self-evident strategy for SMEs to address resource deficits: deficits that would otherwise constrain innovation efforts.

The suitability of open innovation to SMEs relates to the systematic nature of innovation (Dodgson et al., 2006). Dodgson et al. speak of how the integration of external entities with the firm’s innovation process is necessary for innovation success and appreciated as a function of, “mutual dependencies and reciprocal relationships” (p. 334) and the role of innovation systems. SMEs thus leverage internal resources and external resources to improve realisation of innovation (Chesbrough, 2010). Chesbrough (2010) proposes that innovative SMEs have five structural innovation advantages:

- Small size equates to ease in meeting the demands of niche markets unattractive to larger firms.
- SMEs can focus on sustainable competitive advantages in markets ideally suited to the smaller firm characterised by expertise, knowledge, and service.
- SMEs can specialise and so lend value to open innovation relationships as contributing specific capabilities.
SMEs usually have entrepreneurial individuals promoting innovation endeavours with a strong product and market orientation.

Response times are shorter in SMEs; they react more quickly to seize opportunities, an inherent innovative SMEs' characteristic.

However, his article also raises important SME structural disadvantages to open innovation engagement:

- Lower absorptive capacity due to resource limitations
- SMEs inability to appropriately survey for suitable external knowledge hampering engagement activities
- SMEs lack the internal expertise to fully exploit the many benefits of open innovation
- SMEs likely present as unattractive open innovation partners due to resource shortcomings and the lack of valued knowledge
- A tendency to informality and absence of a structured innovation process hampering endeavours
- The inability of SMEs to capture the value of open innovation-sourced outcomes: their financial and human resource limitations preventing investment in necessary legal protection.

Consequently, not all SMEs are capable of open innovation. Alexander Schroll (2009), an open innovation researcher at WU Vienna argues the SMEs most likely to adopt open innovation are the ones possessing the necessary mind-set and agility to do so. Furthermore, he points out that familiarity with one or more open innovation practices reduces the perceived risk of further endeavours.

However, open innovation appears ideal to support resource-strapped SMEs realise innovation objectives through necessary resource provision. Conversely, innovative SMEs have characteristics that appear to hamper realising the rewards of open innovation. Therefore, to better understand the SME open innovation relationship, clarification of what constitutes SME advantages and disadvantages, or characteristics of the innovative SME, is critical to guide this study.

3.3 Establishing the characteristics of innovative SMEs

SMEs have unique innovation attributes contingent to their small size (Rothwell & Dodgson, 1991; van de Vrande et al., 2009; Wynarczyk et al., 2013). From Schumpeter (1934) to modern scholars it is well appreciated that innovative SMEs have characteristics
different to those of larger firms (Rothwell, 1983; Rothwell & Dodgson, 1994; Vossen, 1998b; Welsh & White, 1981; Westhead & Storey, 1996). Yet, few studies comprehensively or cohesively specify what constitutes these distinguishing characteristics. From the perspective of open innovation this limits understanding on how engagement imposes on SMEs innovative nature (S. Lee et al., 2010; West et al., 2006).

McMahon et al. (1993), recognised the difficulty of defining the characteristics to suggest determination may be facilitated through qualitative measures. This study adopts their recommendation to consider two key measures of innovative SMEs’ characteristics. The first approach captures the characteristics defined when comparing small firms with larger firms (3.2.1). The second approach draws characteristics from the literature on the innovative SME (3.2.2). In combination, the two offer complementary perspectives to develop appreciation of innovative SMEs' characteristics.

The compilation is subject to conditions. Rothwell and colleagues’ seminal work on innovative small firm characteristics appears prefaced with expressions such as “generally ascribed” and “tales abound” (respectively, Rothwell, 1989, p. 52; Rothwell & Dodgson, 1994, p. 310), “generally believed” (Rothwell, 1983, p. 15), “generally argued” (Vossen, 1998a, p. 1). Despite vagaries, the works of Rothwell (1983, 1989; 1982) and Rothwell and Dodgson (1991, 1994) in particular underpin numerous SME-related studies. Rothwell himself observed that the list is “by no means exhaustive” (1983, p. 15), although representative of generally appreciated attributes. One can posit that the characteristics of innovative SMEs are well-accepted axioms, as indicated by their self-evident nature.

3.3.1 Differences of innovative small and large firms

Firm size is associated with firm resource capacity and capability and the realisation of innovation benefit (Romero & Martinez-Romain, 2011). The Schumpeterian debate on whether large or small firms are more innovative continues to attract the interest of innovation scholars (Acs & Audretsch, 1990; Camison-Zornoza, Lapiedra-Alcami, Segarra-Cipres, & Boronat-Navarro, 2004; Damanpour, 1992; Nieto & Santamaria, 2010; Tether, Smith, & Thwaites, 1997; Vaona & Pianta, 2008). Yet recognised in the innovation is that small and large firms experience innovation differently (Acs & Audretsch, 1988; Tether, 1998).

13 (For example: Bayona et al., 2001; Bougrain & Haudeville, 2002; Edwards et al., 2005; Huang & Rice, 2009; Major & Cordey-Hayes, 2003).
Despite discernable differences, the imposition of large firm principles on small firms complicates distinguishing innovation contribution relative to size, yet such imposition commonly occurs. The view frequently adopted is that small firms are little-big firms simply having less staff, less sales and less assets (Welsh & White, 1981). Westhead and Storey (1996) challenge such assumptions, “the small firm is not a “scaled-down” version of a large firm” (p. 18). In short, they state that theories relating to SMEs should consider the motivations, constraints, and uncertainties that smaller firms face as differing from those of larger firms.

Rothwell and Dodgson’s (1991, 1994) consideration of the variations between innovative small and large firms found small firm advantages expressed in managerial dynamism, propensity to risk, and their entrepreneurial attributes. In addition, innovative small firms are flexible and highly responsive to change. Conversely, large firms possess sufficient resources for commitment to innovation while presenting challenges such as bureaucracy and risk-aversion (Table 10).

The two categories are diametrically disparate with large firms holding material innovation advantages while SMEs are associated with beneficial behavioural attributes (Edwards et al., 2005; Rothwell, 1983; Rothwell & Dodgson, 1994; Vossen, 1998b). As Rothwell (1989) and Rothwell and Dodgson highlight, one of the key differences of small firms vis-à-vis large firms is the availability of resources giving large firms innovation advantages. Lee, Lim and Tan (1999) state that the lack of resources in small firms is frequently cited as a major impediment to growth and is evidenced by restrained employee numbers, the juggling of finances, and working long hours to meet multiple demands. Rothwell (1983) summarises small firm advantages as people embodied in beneficial behaviour. The disadvantages he summarises principally relate to resource limitations.

Acs and Audretsch (1987) highlight the differences between large and small manufacturers. They explain that large firms’ innovation advantages are market related, particularly in capital intensive, concentrated situations in the production of differentiated goods. Conversely, small firms have an advantage in highly innovative industries where skilled employees prevail. Furthermore, the authors (1987) advocate that markets with a range of firm sizes are most conducive to innovative activity, suggesting the advantages of complementarity.
### Table 10: Innovation Advantages, Disadvantages of Small and Large firms


<table>
<thead>
<tr>
<th></th>
<th>Small Firms</th>
<th>Large Firms</th>
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</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>Management</td>
<td>Large Firms</td>
</tr>
<tr>
<td></td>
<td>Little bureaucracy; Entrepreneurial, dynamic management; rapid decision-making, quick to take advantage of new opportunities; risk taking; organic style.</td>
<td>Professional managers able to control complex organisations and establish corporate technology strategies. Often controlled by risk-adverse accountants; managers become bureaucrats and lack dynamism.</td>
</tr>
<tr>
<td></td>
<td>Organisation</td>
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<tr>
<td></td>
<td>May simply be too small to implement some innovative organisational forms (such as cross functional teams)</td>
<td>Generally complex; multidivisional, and increasingly multinational. Mechanistic organisation. Danger of sclerosis, rigidity, unwieldiness, institutional inertia.</td>
</tr>
<tr>
<td><strong>Learning Ability</strong></td>
<td>Capable of fast learning, and adapting routines and strategies. If new, no unlearning problems.</td>
<td>May lack resources for systematic and continuous technological scanning. Have resources to do scanning for benchmarking and identification of best practise. Slow to learn; often locked in to well-established practices and routines.</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Technical personnel well plugged in to other departments.</td>
<td>Able to attract highly skilled specialist, can support the establishment of a large R&amp;D laboratory; economies of scale and scope in R&amp;D. Technical manpower can become isolated from other corporate functions.</td>
</tr>
<tr>
<td></td>
<td>Often lack high-level technical skills. Full time R&amp;D can be too costly. (Need technical specialist for external links.) Can suffer diseconomies of scope in R&amp;D.</td>
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</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Rapid and effective internal communication; affords a fast response to internal problem solving; provides ability to reorganise rapidly to adapt to change in external environment; informal networks.</td>
<td>Time shortages and resources to forge sui: external scientific and technological expertise. Able to establish comprehensive external science and technology networks. Internal communication can be cumbersome; long decision chains result in slow reaction times.</td>
</tr>
</tbody>
</table>
### Table 10 (Continued)

<table>
<thead>
<tr>
<th></th>
<th>Small Firms</th>
<th>Disadvantages</th>
<th>Large Firms</th>
<th>Disadvantages</th>
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</thead>
<tbody>
<tr>
<td><strong>Finance</strong></td>
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<tr>
<td>Innovation can be less costly in SMEs; SMEs can be more R&amp;D efficient.</td>
<td>Innovation represents a large financial risk; inability to spread risk; accessing external capital for innovation can be a problem. Cost of capital can be relatively high.</td>
<td>Able to borrow; can spread risk over a portfolio of products; better able to fund diversification.</td>
<td>Shareholder pressure can force a focus on short-term profits. Can access external capital on favourable terms.</td>
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<tr>
<td><strong>Market</strong></td>
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</tr>
<tr>
<td>Fast reaction to changing market requirements; can dominate narrow market niches.</td>
<td>Market start-up abroad can be prohibitively costly.</td>
<td>Comprehensive distribution and servicing facilities; high market power with existing products.</td>
<td>Can ignore emerging market niches with growth potential; see new technologies as a threat to existing products and not as an opportunity in the marketplace.</td>
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<tr>
<td><strong>Growth</strong></td>
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<tr>
<td>Potential for growth through niche strategy/techno/market leadership.</td>
<td>Problems in accessing external capital for growth; entrepreneurs often unable to manage growth.</td>
<td>Able to obtain scale and learning curve economies through investment in production; can fund growth via acquisitions; can gain price leadership.</td>
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<tr>
<td><strong>Joint Ventures/Strategic Alliances</strong></td>
<td>Can prove attractive partner if technological leader.</td>
<td>Little management experience; power imbalance if collaborating with large firms.</td>
<td>Possess strategic managerial resources to enable the selection of appropriate partners and the proper management of collaboration.</td>
<td></td>
</tr>
<tr>
<td><strong>Supplier Relations</strong></td>
<td>May enjoy closer personal relations with suppliers.</td>
<td>Can exert little control over suppliers.</td>
<td>Can encourage innovative suppliers. May be big and powerful enough to impose standards (such as JIT/just in time).</td>
<td>May be too big and too distant to enjoy the personal relations that may be conductive to innovation.</td>
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<tr>
<td></td>
<td>Small Firms</td>
<td>Large Firms</td>
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<tr>
<td><strong>Advantages</strong></td>
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<tr>
<td><strong>Disadvantages</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Government/Regulations</strong></td>
<td>Regulations sometimes applied less stringently to SMEs. Many schemes established to assist innovation in SMEs.</td>
<td>Often cannot cope with complex regulations; unit costs of compliance can be high; often unable to cope with patenting system; high opportunity costs in defending patents. Accessing government schemes can be difficult; high opportunity costs. Poor awareness of available schemes. Difficulty in coping with collaborative schemes.</td>
<td></td>
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<tr>
<td></td>
<td>Able to cope with government regulations; can fund R&amp;D necessary for compliance; able to defend patents. Can employ specialists to assist in accessing government schemes. Able to manage collaborative schemes.</td>
<td>Regulations often applied more stringently to large firms. Increasingly, government innovation support focuses on SMEs.</td>
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</tbody>
</table>

While Table 10 details Rothwell and colleagues’ list of different characteristics of innovative small and large firms, Table 11 lists the views of other scholars. According to various scholars, despite firms being heterogeneous consistencies exist relative to the two sizes (J. Baldwin & Gellatly, 2003; Galende & de la Fuente, 2003; Rizzoni, 1991). The characteristics listed in Table 11 demonstrate congruency with Rothwell and Dodgson’s innovative small firm characteristics (Table 10). Congruency is explicit in scholarly agreement regarding large firm bureaucracy and the absence of bureaucracy in small firms. Less bureaucracy in innovative SMEs translates to more openness and flexibility to innovation opportunities (Acs & Audretsch, 1988, 1990).

Although the various perspectives on innovative SMEs’ characteristics share similarities, there are also inconsistencies; Table 11 lists variations, for example, risk factors. Rothwell (1983) proposes small firms accept greater risk due to their flexibility and agility to seize opportunities, he points out the financial implications to such risk-taking are highly hazardous reducing innovation propensity.
### Table 11: Differences of Innovative Small and Large Firms (compilation of authors)

<table>
<thead>
<tr>
<th>Management</th>
<th>Organisation</th>
<th>Behavioural advantages</th>
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<tbody>
<tr>
<td><strong>Small Firms</strong></td>
<td><strong>Large Firms</strong></td>
<td><strong>Small Firms</strong></td>
</tr>
<tr>
<td>Advantages</td>
<td>Disadvantages</td>
<td>Advantages</td>
</tr>
<tr>
<td>Less bureaucratic (Acs &amp; Audretsch, 1990; Nooteboom, 1994)</td>
<td>Ability to bear losses therefore takes more risks (Damanpour, 1992; Hitt, Hoskisson, &amp; Ireland, 1990)</td>
<td>Ability to bear losses therefore takes more risks (Damanpour, 1992; Hitt, Hoskisson, &amp; Ireland, 1990)</td>
</tr>
<tr>
<td>Owner/leader more influential, able to successfully instil entrepreneurial dynamism (de Jong &amp; Marsili, 2006)</td>
<td>Formal management skills, able to control complex organisation, spread risk (Vossen, 1998a)</td>
<td>Formal management skills, able to control complex organisation, spread risk (Vossen, 1998a)</td>
</tr>
<tr>
<td>Entrepreneurial tendencies, rapid responsiveness encourages innovativeness (Nieto &amp; Santamaria, 2010)</td>
<td></td>
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</tr>
<tr>
<td>Little bureaucracy, rapid decision-making, risk taking, motivated management and labour (Vossen, 1998a)</td>
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</tr>
<tr>
<td>Flexible, therefore better able to adapt, improve and change more readily (Damanpour, 1996)</td>
<td>Absence of infrastructure (S. Lee et al., 2010)</td>
<td>Absence of influence (S. Lee et al., 2010)</td>
</tr>
<tr>
<td>More open to innovative developments and have a greater willingness to innovate (Hartley &amp; Hutton, 1989)</td>
<td>Oligopolists, needlessness of innovation (S. Lee et al., 2010)</td>
<td>Oligopolists, needlessness of innovation (S. Lee et al., 2010)</td>
</tr>
<tr>
<td>Tacit knowledge of unique skills (Nooteboom, 1994)</td>
<td>Advantages of scale and scope therefore better equipped for innovations requiring large, specialised teams, equipment (Nieto &amp; Santamaria, 2010)</td>
<td>Advantages of scale and scope therefore better equipped for innovations requiring large, specialised teams, equipment (Nieto &amp; Santamaria, 2010)</td>
</tr>
<tr>
<td></td>
<td>Functional expertise, specialised labour, distribution, and servicing facilities, economies of scale and scope (Vossen, 1998a)</td>
<td>Functional expertise, specialised labour, distribution, and servicing facilities, economies of scale and scope (Vossen, 1998a)</td>
</tr>
<tr>
<td></td>
<td>R&amp;D department without influence (S. Lee et al., 2010)</td>
<td>R&amp;D department without influence (S. Lee et al., 2010)</td>
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<tr>
<td></td>
<td>More formalised structure inhibits innovation behaviour (Damanpour, 1996)</td>
<td>More formalised structure inhibits innovation behaviour (Damanpour, 1996)</td>
</tr>
<tr>
<td></td>
<td>Barriers to innovation largely internal: lack of motivation and incentives, communication problems (Hadjimanolis, 2003)</td>
<td>Barriers to innovation largely internal: lack of motivation and incentives, communication problems (Hadjimanolis, 2003)</td>
</tr>
<tr>
<td></td>
<td>Employee resistance to change more evident in large firms (Hewitt-Dundas, 2006)</td>
<td>Employee resistance to change more evident in large firms (Hewitt-Dundas, 2006)</td>
</tr>
<tr>
<td></td>
<td>Innovative behaviour inhibited as characterised by formalised organisation and bureaucracy (Hitt et al., 1990)</td>
<td>Innovative behaviour inhibited as characterised by formalised organisation and bureaucracy (Hitt et al., 1990)</td>
</tr>
<tr>
<td></td>
<td>Small Firms</td>
<td>Large Firms</td>
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</tr>
<tr>
<td><strong>Advantages</strong></td>
<td>Faster learning and adapting routines and strategy, reward appropriation through tacitness of knowledge (Vossen, 1998a)</td>
<td>Realise learning curve economics, capacity for new knowledge/technology absorption (Vossen, 1998a)</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Specialised, matching technology with specific customer requirements (Pavitt, 1991)</td>
<td>Broader technological activities, based on R&amp;D laboratories or in design and operation of complex technology (Pavitt, 1991)</td>
</tr>
<tr>
<td></td>
<td>R&amp;D efficiency, capacity for customisation (Vossen, 1998a)</td>
<td>Deeper specialisation, science based knowledge (Nooteboom, 1994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greater technical knowledge, providing ability to absorb more innovations (Nord &amp; Tucker, 1987)</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Informal communication, better understanding of overall project (Nootebroon, 1994)</td>
<td>Weak external contacts (Srinivasan, Lilien, &amp; Rangaswamy, 2002)</td>
</tr>
<tr>
<td></td>
<td>Fast and productive communication, shorter decision chains (Vossen, 1998a)</td>
<td></td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td>Financial restraints inhibit innovation development and limit success of innovations (Hewitt-Dundas, 2006)</td>
<td>Larger and cheaper financial resources and spreading of risks (Nootebroon, 1994)</td>
</tr>
<tr>
<td></td>
<td>Poor financial resources (S. Lee et al., 2010)</td>
<td>External capital access, able to fund diversification (Vossen, 1998a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Financial objectives inhibit innovation (Hewitt-Dundas, 2006)</td>
</tr>
</tbody>
</table>
Table 11 (continued)

<table>
<thead>
<tr>
<th>Small Firms</th>
<th>Large Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market</strong></td>
<td></td>
</tr>
<tr>
<td>Finding and exploiting niches</td>
<td>Able to establish entry barriers (Vossen, 1998a)</td>
</tr>
<tr>
<td>Benefiting from user experience (Pavitt, 1991)</td>
<td></td>
</tr>
<tr>
<td>Proximity to market (Nootbooom, 1994)</td>
<td></td>
</tr>
<tr>
<td>Fast reactions to changing markets, able to dominate narrow market niches (Vossen, 1998a)</td>
<td>Resource-related barriers: time, staff, and money. Dependence on external sources of support (Hadjimanolis, 2003)</td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td>Superior resources (Acs &amp; Audretsch, 1990)</td>
</tr>
<tr>
<td>Resource and capability shortages (Hewitt-Dundas, 2006)</td>
<td>Superior range of resources, capabilities, and experts (Damanpour &amp; Evan, 1984)</td>
</tr>
<tr>
<td>Labour shortages, lack of information (which they state may be relived through external collaboration activities (S. Lee et al., 2010)</td>
<td>Have necessary resources and knowledge (Hadjimanolis, 2003; Vossen, 1998a)</td>
</tr>
</tbody>
</table>

Additional inconsistencies evident in Tables 10 and 11 from the literature are:

- Close communication and use of external sources compensates SMEs for internal resource lack. Contrarily, insufficient resources limit competence and ability to manage external relationships.
- Poor external contacts contrasts with the advantage of sound use of external sources, although SMEs having fewer external contacts often resulting in deeper involvement.
- Dedicated R&D staff offered as a facilitating characteristic while others refute the availability of financial resources to employ specialist staff.

As expressed by Camison-Zornoza et al. (2004) the variations in literature on firm size and innovation leads us to, “appreciate the lack of general agreement in the literature.” (p. 350).
3.3.2 Characteristics attributed to the innovative SME

This second qualitative determinant of characteristics draws from the innovative SME-related literature. Various perspectives abound. Khan and Manopichetwattana (1989a, 1989b) agree that innovative SMEs have higher survival rates while observing that many opinions on their characteristics are subjective. They therefore relied on the entrepreneurial\(^{14}\) attributes of innovative SMEs to distinguish the characteristics. Exemplified by managerial resources they list features as proactive in market leadership, dynamic, and risk takers. In addition, the innovation-orientated SMEs have less formal and more decentralised organisational structures to empower individuals and encourage innovation.

Lefebvre and Lefebvre’s (1992) study of small manufacturing firms shows that SMEs adoption of new technologies - as an innovation facet and facilitator - requires the presence of an innovation champion: this characteristic is similarly identified by others (e.g., Garvin & Levesque, 2004; Sharma, 1999; van de Ven, Polley, Garud, & Venkataraman, 1999): the champion is usually the CEO or a senior manager. Conversely, the absence of individuals with an innovative tendency is representative of non-innovating SMEs (Lefebvre & Lefebvre, 1992; Rothwell, 1983). Hausman (2005) offers another perspective. Through in-depth interviews, her research reveals the innovativeness of SMEs depends upon managers being able and willing to manage (rather than simply control) individuals through changes. Secondly, collaborating with organisations that are innovative equate to improved innovativeness in SMEs. These and other views on the characteristics of the innovative SME consolidate in Table 12.

Of note in Table 12 is the discrepancy between the perceived advantages of informality in SMEs. Terziovski (2010) found formal structures advantageous to innovation in manufacturing SMEs, similarly the existence of an innovation strategy, arguably also a formal mechanism. His findings support Prakash and Guta (2008) who earlier identified a positive correlation between formalisation and innovation in SMEs. It is argued that formality supports employees’ understanding of their role and improves organisational efficiency (Prakash & Gupta, 2008; Terziovski, 2010). These research findings are then contrary to the conventional view of lack of formality as positively associated with innovative SMEs (Acs, Morck, Shaver, & Yeung, 1997; Damanpour, 1992). Terziovski (2010) considers the discrepancy between formality/informality relates to firm age and structure with formality established in older and better performing SMEs.

\(^{14}\) Entrepreneurship being “of eminent importance for carrying out innovations.” (Carree & Thurik, 2005, p. 438). Carree and Thurik define entrepreneurship as one or a small number of people who control and shape a firm and its future. Schumpeter (1950) defined the entrepreneur as combining resources in new ways.
### Table 12: Characteristics of Innovative SMEs

<table>
<thead>
<tr>
<th>SME Advantages</th>
<th>SME Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management</strong></td>
<td><strong>Lack of management time, dependency on manager/owner to interface with environment and identify innovation opportunities (Hadjimanolis, 2003)</strong></td>
</tr>
<tr>
<td>Plan for innovation, inclusion in firm strategy (Birchall, Chanaron, &amp; Soderquist, 1996; de Jong &amp; Marsili, 2006; Kickul &amp; Gundry, 2002; Laforet &amp; Tann, 2006)</td>
<td>Difficulties with managing BAU with innovation (Freel, 2000c, 2004; Johannessen, 2008; Ocasio, 1997)</td>
</tr>
<tr>
<td>Visionary, future orientated, exploiting external opportunities. CEO shows commitment to innovation, involved in innovation development, dynamic, risk takers (Bougrain &amp; Haudeville, 2002; Khan &amp; Manopichetwattana, 1989a, 1989b; Kickul &amp; Gundry, 2002; Laforet &amp; Tann, 2006; LeBlanc, Nash, Gallagher, Gonda, &amp; Kakizaki, 1997; Souitaris, 2001)</td>
<td>Insufficient time (Garsombke &amp; Garsombke, 1989; C. Gray &amp; Mabey, 2005)</td>
</tr>
<tr>
<td>Strong, well educated leadership (LeBlanc et al., 1997)</td>
<td>Hampered by lack of management skill (Massey et al., 2007)</td>
</tr>
<tr>
<td>Presence of an innovation champion (Garvin &amp; Levesque, 2004; Laforet &amp; Tann, 2006; Lefebvre &amp; Lefebvre, 1992; Sharma, 1999; van de Ven et al., 1999)</td>
<td>Managerial limitations in effectively exploiting external sources of knowledge (Rothwell, 1991)</td>
</tr>
<tr>
<td>Managers have formal education/training. Are willing to manage individuals through change (Hausman, 2005)</td>
<td>Over-involvement in operational level decisions (Massa &amp; Testa, 2008)</td>
</tr>
<tr>
<td><strong>Organisation</strong></td>
<td>Amplified impact on strategic direction and overt control of business, may suffer overwhelm in attempting to cope; micro-managing firm (Hausman, 2005)</td>
</tr>
<tr>
<td>Less formalised, more decentralised organisational structure (Khan &amp; Manopichetwattana, 1989a, 1989b)</td>
<td>Tendency to informality (Acs &amp; Audretsch, 1990; Terziovski, 2010)</td>
</tr>
<tr>
<td>Simple structure and friendly internal environment facilitating innovation (Hadjimanolis, 2003)</td>
<td>Insufficient staff and skilled labour (Garsombke &amp; Garsombke, 1989; Hadjimanolis, 2003)</td>
</tr>
<tr>
<td>Little bureaucracy or cliques (Massa &amp; Testa, 2008)</td>
<td></td>
</tr>
<tr>
<td>Flexibility (Freeman, 1982; Terziovski, 2010)</td>
<td></td>
</tr>
<tr>
<td>Innovations more readily adopted by staff (Hausman, 2005)</td>
<td></td>
</tr>
<tr>
<td>Employee suggestion schemes (Laforet &amp; Tann, 2006)</td>
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</tbody>
</table>
### Table 12 (continued)

<table>
<thead>
<tr>
<th>SME Advantages</th>
<th>SME Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Ability</strong></td>
<td></td>
</tr>
<tr>
<td>In-house training schemes (Laforet &amp; Tann, 2006)</td>
<td>Change resistance due to threatened routines; poor training (Madrid-Guijarro et al., 2009)</td>
</tr>
<tr>
<td></td>
<td>Underdeveloped training and education (Romano, 1990)</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td></td>
</tr>
<tr>
<td>High incidence technically qualified personnel in successful innovators (Hoffman et al., 1998)</td>
<td>Lack adequate money to recruit skilled labour (Hadjimanolis, 2003)</td>
</tr>
<tr>
<td>Skilled staff may prefer to work in SME (Hadjimanolis, 2003)</td>
<td>Inability to invest in technical specialists (Rothwell, 1991; van de Vrande et al., 2009)</td>
</tr>
<tr>
<td>Higher number of technically qualified staff, constant R&amp;D efforts (Wood, 1997)</td>
<td>Intense focus generates technical near-sightedness (Nooteboom, 1994)</td>
</tr>
<tr>
<td>Competence in technology strategy and management thereof (Hoffman et al., 1998)</td>
<td></td>
</tr>
<tr>
<td>Operational expertise and customer knowledge (Massa &amp; Testa, 2008)</td>
<td></td>
</tr>
<tr>
<td><strong>Resources</strong></td>
<td></td>
</tr>
<tr>
<td>Lack resources for scanning environment (Hausman, 2005)</td>
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</tr>
<tr>
<td>Limited time (de Jong &amp; Marsili, 2006; Hadjimanolis, 1999)</td>
<td></td>
</tr>
<tr>
<td>Dependence on external sources to meet resource inadequacies and lack of expertise internally (Hadjimanolis, 1999)</td>
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</tr>
<tr>
<td><strong>Communication</strong></td>
<td></td>
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<tr>
<td>Direct communication (Freeman, 1982; Hadjimanolis, 2003).</td>
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</tbody>
</table>
The absence and limitations of resources in SMEs appears a significant and recurrent theme and precisely what defines SMEs (Alvarez & Barney, 2002). SMEs suffer from, “smallness and lack of resources which are acknowledged liabilities” (Gassmann et al., 2010, p. 4). Garsombke and Garsombke’s (1989) survey found SMEs lack capital, staff, time and knowledge, all resource issues. Resource constraints therefore inhibit innovation which causes SMEs to be, “inherently disadvantaged” (Hewitt-Dundas, 2006, p. 259). Importantly, efficacious allocation and management of resources correlates to innovation success while deficits limit their ability to appropriate innovation value (Hadjimanolis, 2000). Efficacious

<table>
<thead>
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<th>Table 12 (continued)</th>
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<tbody>
<tr>
<td><strong>SME Advantages</strong></td>
</tr>
<tr>
<td><strong>Financial</strong></td>
</tr>
<tr>
<td>Have an innovation budget (de Jong &amp; Marsili, 2006)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Market/Network</strong></td>
</tr>
<tr>
<td>Use of external sources to support innovation (Freel, 2003; Hoffman et al., 1998; Laforet &amp; Tann, 2006; Romijn &amp; Albaladejo, 2002; Wood, 1997)</td>
</tr>
<tr>
<td>Use of external opportunities. Regularly studies the market (Laforet &amp; Tann, 2006)</td>
</tr>
<tr>
<td>Greater ability to utilise external networks and create astute networks (Massa &amp; Testa, 2008)</td>
</tr>
<tr>
<td>Supply niche markets, use of external linkages for innovation (Hoffman et al., 1998)</td>
</tr>
<tr>
<td><strong>Government/Patenting</strong></td>
</tr>
<tr>
<td>High costs and lack of suitable personnel limits searching, filing, and defending patents. Lack resources and specialisation to manage government procedures and bureaucracy (Hadjimanolis, 2003)</td>
</tr>
</tbody>
</table>
use of resources is therefore paramount to sustain innovation (R. Hall, 1993; Johannessen, 2008).

Another important characteristic is SMEs’ limited managerial resources (O. Jones & Macpherson, 2006). Smaller firms are often characterised by their having few managers to run the business necessitating managers to “concentrate their energy, efforts and mindfulness on a limited number of issues” (Ocasio, 1997, p. 203). It is widely accepted that the balancing of scarce resources with conflicting and multiple demands are a perennial challenge for SMEs (e.g., Freel, 2000c; Freel, 2004; Hewitt-Dundas, 2006). SME managers focus on making best use of scarce resources, therefore managers are less likely to consider long term strategies with immediate demands taking priority (C. Gray & Mabey, 2005; Ocasio, 1997). The problem is perpetuated by time constraints, which are appreciated as especially imposing on SME managers due to the inability to delegate responsibilities: SMEs by nature have few staff to assign additional duties (Garsombke & Garsombke, 1989). Concerns with managerial time are readily apparent as a prime SME resource concern, as is the related concern of deficiency in staff slack (C. Gray & Mabey, 2005). A number of authors identify the time limitation of managers as an obstacle to SME innovation activities (e.g. C. Gray & Mabey, 2005; Rahman & Ramos, 2010; Street & Cameron, 2007). According to Gray and Mabey (2005) SMEs, “can ill afford to release precious staff for development activities because of time and skills pressures related to their small size” (p. 469).

Similarly, various factors inhibit developing the skill base and expertise of staff - in other words the intangible resource of knowledge. Up-skilling is seen as arduous by the SME financially and time-wise (Hewitt-Dundas, 2006). However, the SME may develop specific attributes and skill sets amongst the close-knit team (Vossen, 1998b). The multi-talented aspect of SME staff aligns with personnel qualifications and experience, which in turn is considered a determinant of innovation (Becheikh et al., 2006).

Size variations

Hoffman et al.’s (1998) research on SMEs reveals distinctions occur within the size category of SMEs. They propose larger innovative SMEs tend to greater formality whereas smaller SMEs are more ad hoc. In addition, they identify internal factors are of greater importance to innovation success than external factors. Among internal innovation factors specified is the presence of qualified personnel while the lack of highly qualified technicians limits growth. Laforet and Tann (2006) also differentiate on size identifying that very small firms (under 20 staff) benefit from individualism, larger SMEs (50 plus staff) have greater
resources and systems, while SMEs with 20-49 employees lack both. Likewise, Laforet (2008) states firms with 5-20 employees have greater difficulties accessing finances to support innovation than larger SMEs (over 21 employees). Larger SMEs have a higher number of innovations, while micro-sized firms insufficient financial resources and competencies inhibit innovation realisation (Mazzarol & Reboud, 2009).

However, regardless of size variations the literature (Tables 10, 11 and 12) shows some uniformity. In particular, SMEs’ behavioural advantages of organisational adaptability to meet market changes and customer demands. Cameron and Massey (1999) conclude that resources deficit typify the innovative SME while the presence of simple management structures that facilitate behaviours such as flexibility and the lack of bureaucracy. Additionally, closeness of staff, the immediacy of task with reward, and recognition that firm survival depends on innovation success are supportive characteristics of innovative SMEs (Cameron & Massey, 1999).

The variances in opinions and findings from empirical research on SMEs and innovation led Massa and Testa (2008) to state that the vastness of SME innovation literature iterates the importance of the subject. The multiplicity of conflicting opinions and divergent views suggests that the field of SME innovation continues to be rich with opportunity to advance understanding.

### 3.3.3 Characteristics of innovative SMEs: a compilation

Considering the characteristics identified by various authors (Tables 10, 11, 12 and associated literature) the characteristics may be synthesised: Table 13 draws on scholar consensus to offer a compilation of innovative SME characteristics. However, Hoffman et al. (1998) warn of the extensiveness and diversity of the SME innovation literature; consequently, although committing considerable effort in scrutinising the literature the resultant compilation of innovative SMEs' characteristics neither claims to be exhaustive nor definitive.

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15 Compilation Process:

- **Step 1:** Merged Tables 10, 11, 12 using Table 10 (Rothwell et al.) as basis for compilation.
- **Step 2:** Reduced categories: removed Communication, Government and Supplier categories and merged under existing relevant categories. Finances and Technical merged under Resources.
- **Step 3:** Data reduction. Removed duplications across tables, collapsing attributes keeping key characteristics identified as having substantial support (most cited, routinely repeated).
Table 13: Compilation of the Characteristics of Innovative SMEs

<table>
<thead>
<tr>
<th>Innovative SME Advantages</th>
<th>Innovative SME Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MANAGEMENT</strong></td>
<td><strong>MANAGEMENT</strong></td>
</tr>
<tr>
<td>Entrepreneurial tendencies, dynamic, risk takers</td>
<td>Hampered by lack of management skill</td>
</tr>
<tr>
<td>Rapid decision making</td>
<td>Lack of management time</td>
</tr>
<tr>
<td>Little bureaucracy</td>
<td>Dependency on manager/owner to interface and identify innovation opportunities</td>
</tr>
<tr>
<td>Plan, budget for innovation</td>
<td>Inability to exploit external sources of knowledge</td>
</tr>
<tr>
<td>Exploit external opportunities</td>
<td>Over-involvement at operational level</td>
</tr>
<tr>
<td>Presence of innovation champion</td>
<td></td>
</tr>
<tr>
<td>Managers have formal education/training</td>
<td></td>
</tr>
<tr>
<td><strong>ORGANISATION</strong></td>
<td><strong>ORGANISATION</strong></td>
</tr>
<tr>
<td>Generally simple and focused, flexible</td>
<td>Lack infrastructure</td>
</tr>
<tr>
<td>Innovations more readily adopted by staff</td>
<td>Tendency to informality</td>
</tr>
<tr>
<td>Better understanding of overall project</td>
<td></td>
</tr>
<tr>
<td>Fast and effective internal communication</td>
<td></td>
</tr>
<tr>
<td>Informal networks</td>
<td></td>
</tr>
<tr>
<td><strong>LEARNING</strong></td>
<td><strong>LEARNING</strong></td>
</tr>
<tr>
<td>Capable of fast learning and adapting routines and strategies</td>
<td>May lack resources for systematic and continuous technological scanning</td>
</tr>
<tr>
<td></td>
<td>Change resistance due to threatened routines</td>
</tr>
<tr>
<td></td>
<td>Poor training (both resource and behavioural)</td>
</tr>
<tr>
<td><strong>RESOURCES</strong></td>
<td><strong>RESOURCES</strong></td>
</tr>
<tr>
<td>R&amp;D efficiencies</td>
<td>Limited resources (e.g. time, staff, finances, expertise)</td>
</tr>
<tr>
<td>High incidence of technically qualified staff</td>
<td>Lack time and resources to forge suitable external expertise</td>
</tr>
<tr>
<td>Specialised, matching technology with specific customer requirements</td>
<td>High cost and lack staff to search, file, defend patents</td>
</tr>
<tr>
<td></td>
<td>Often lack high-level technical skills</td>
</tr>
<tr>
<td></td>
<td>Full time R&amp;D can be too costly</td>
</tr>
<tr>
<td></td>
<td>Lack adequate money to employ technical specialists.</td>
</tr>
<tr>
<td></td>
<td>Intense focus generates technical myopia</td>
</tr>
<tr>
<td><strong>MARKET</strong></td>
<td><strong>MARKET</strong></td>
</tr>
<tr>
<td>Methods developed for external information scanning (both resource and behavioural)</td>
<td>Weak external contacts</td>
</tr>
<tr>
<td>Use of external sources to meet resource/expertise inadequacies</td>
<td>Difficulties interfacing with external sources</td>
</tr>
<tr>
<td>Find and exploit niche markets, agility to respond to changes, opportunities</td>
<td>Customer dependency</td>
</tr>
<tr>
<td>Greater ability to utilise external networks and create astute networks</td>
<td>Reliance on familiar/long term relationships</td>
</tr>
<tr>
<td>Can prove attractive partner if technological leader</td>
<td>Little alliance management experience</td>
</tr>
</tbody>
</table>

Neither does the compilation indicate advantage and disadvantage weightings nor sectoral variations: rarely does the literature discriminate in such ways although doing so is considered desirable (Hoffman et al., 1998; Leseure, 2000). However, results of one sector-specific study on manufacturing SMEs suggest there are few differences between innovative manufacturing SMEs and SMEs in other industries (Laforet & Tann, 2006). Furthermore,
Laforet and Tann’s (2006) study found manufacturing sector SMEs differed little from other sectoral SMEs in terms of innovation profile. Lichtenthaler (2008) likewise found little industry variations from his research on innovation in various industries.

### 3.3.4 Two primary features of innovative SMEs’ characteristics

The literature consistently emphasises the characteristic of resource deficiencies as a significant feature of innovative SME. Likewise, the literature iterates SMEs’ positive behavioural characteristics, therefore a compelling argument exists that the innovation characteristics divide between two key features: resource deficits and behavioural benefits (among others, Nooteboom, 1994; Rothwell, 1983; Rothwell, 1991; Rothwell & Dodgson, 1994; Rothwell & Zegveld, 1982; Vossen, 1998a, 1998b). The innovation literature often refers to the characteristics from the perspective of one or the other (e.g., Birchall et al., 1996; Galende & de la Fuente, 2003; Link & Bozeman, 1991; Rizzoni, 1991; Weerawardena, O’Cass, & Julian, 2006). However, generally there is little feature specificity. Given that the aim of this study is the determination of how open innovation influences innovative SMEs’ characteristics, the characteristics summarised by these two key features, the following briefly reviews each feature.

#### Summarising resources

Considering resource deficits are a defining SME characteristic, examination of the literature reveals few studies define what constitutes resources with resources understood in different ways (Amit & Schoemaker, 1993; Black & Boal, 1994). Barney (1991) and Peteraf (1993) categorise resources as physical, human, or organisational, defining these as:

- **Physical resources**
  - Refer to firms’ plant and equipment, physical location, facilities, raw material access and physical technology. Das and Tang (1998) add production capacity and distribution channels.

- **Human Resources**
  - Managerial and employee insights, training, intelligence, experience, judgement, relationships and knowledge (Barney, 1991; Miller & Shamsie, 1996). Human resources in smaller firms are represented by less individuals usually with multiple and divergent responsibilities (Hadjimanolis, 2003; Hausman, 2005). Fewer staff limits the repertoire of skills available and the capability to manage complexity of diverse relationships (Major & Cordey-Hayes, 2003).

- **Organisational Resources**
Consist of processes, formal reporting configuration, planning both formal and informal, and control and coordinating systems, informal internal and external relationships. Additionally, software and firmware (Maranto-Vargas & Gomez-Tagle Rangel, 2007), while Hall (1993) contributes culture and firm reputation. Firm reputation is considered a valuable resource and one that slowly depreciates unless supported by appropriate investment (Grant, 1991).

Two facets of human resources deserve attention as being particularly relevant to SMEs: that of management and time; secondly, knowledge and intellectual property. SMEs are acknowledged as limited in managerial resources (O. Jones & Macpherson, 2006). While management remains the most valuable of firm resources, smaller firms are characterised by management balancing multiple activities, conflicting demands, and myriad roles (Ocasio, 1997, p. 203). Hadjimanolis (1999) contends that lack of time is the greatest SME barrier to innovation; time is a finite resource and often an obstacle to SME innovation activities (C. Gray & Mabey, 2005; Rahman & Ramos, 2010; Street & Cameron, 2007).

Secondly knowledge: the precursor and facilitator to innovation according to Major and Cordey-Hayes (2003). The creation of intellectual property ensues from knowledge development. The ability to profit from firms’ unique knowledge is an important aspect of innovation management and a revenue generator when on-sold to other entities (Candelin-Palmqvist et al., 2012).

**Summarising behavioural properties**

Despite the extensive literature on innovation in SMEs (for reviews, see Acs & Audretsch, 1990; Chanaron, 1998; Cobbenhagen, 2000) behavioural attributes lack examination (Hoffman et al., 1998). The intangibility of behavioural attributes creates difficulties with measurement, reflected in limited empirical investigation specifically examining this innovative SME feature (Cohen, 1995). However, the range of behavioural benefits attributed to innovative SMEs, drawing from the literature on the characteristics (above) comprise:

- Managerial entrepreneurial tendencies
  
  Described as a personality trait relative to individual propensity to be innovative and “catalysts of change who continually do things that have not been done before” (Schwartz & Malach-Pines, 2007, p. 2).

- Managerial risk propensity and dynamism
Managers’ quick response to seize new opportunities and accept risk important contributes to innovation (Bougrain & Haudeville, 2002; Laforet & Tann, 2006; Rothwell & Dodgson, 1991)

- Flexibility and agility
  Management flexibility found to positively contribute to innovation performance (Kickul & Gundry, 2002). Similarly, flexibility and agility impact SMEs’ organisational structures and systems which support rapid response to market changes, and the ability to adapt and improve (Damanpour, 1996; Terziovski, 2010).

- Low levels of bureaucracy
  Fewer levels of management support adaptability and responsiveness (Vossen, 1998b). Decentralisation favours greater participation in firm activities and facilitates communication and idea exchange (Khan & Manopichetwattana, 1989a). Acs and Preston (1997) stipulate less bureaucracy equates to structurally lower costs.

- Efficiencies in internal communication
  Complementary to low bureaucracy and the presence of fewer people, communication tends to be rapid and effective with short decision chains (Nooteboom, 1994; Vossen, 1998b).

- Strategic and innovation planning
  Although counter to a lack of formality, the planning by innovative SMEs supports innovation performance, utilisation of assets and internal cohesion (de Jong & Marsili, 2006; Kickul & Gundry, 2002).

- Fast organisational learning
  Motivated staff and willingness to adapt assists with the assimilation of innovation (Damanpour, 1996; Hausman, 2005).

- Use of external sources to support innovation
  Many agree that SMEs utilise external sources supports innovation (Freel, 2003; Massa & Testa, 2008; Romijn & Albu, 2002). However, others question whether SMEs have the manpower and competencies to successfully exploit external sources (Rothwell, 1991; Srinivasan et al., 2002). The discrepancy likely relates to a managerial attitude to barriers and innovation objectives individual to the firm (Hadjimanolis, 1999).

The studies of Galende and Suares (1999) and Galende and de la Fuente (2003) found SME behaviour favourable to innovation activities. However, the innovative SMEs’
characteristic of resource deficit is contrary to the mandate that sufficient resources are present to support innovation objectives. Essentially, the beneficial behavioural attributes support the realisation of innovation objectives and offer some compensatory advantage to the resource deficits.

3.4 Open innovation and SMEs: mixed blessing?

From defining the characteristics of innovative SMEs, this section considers the innovative SME from the perspective of open innovation. The literature stresses the quintessence of innovation to SMEs while demonstrating the recurring theme of characteristics facilitating, dictating, and thwarting innovation endeavours. Of crucial importance to innovation endeavours is overcoming resource limitations. Lee, Park, Yoon and Park (2010) posit that containing the full innovation sequence internally relies on the presence of necessary resources, therefore innately challenging to SMEs. Numerous studies cite scarcity of resources as a substantial barrier to innovation limiting SMEs actualising innovation (e.g., Hadjimanolis, 2000; Hausman, 2005; Massa & Testa, 2008).

SMEs “cannot possibly have internal access to all the knowledge and skills required” to afford innovation (Richardson & Taylor, 2008, p. 28). Likewise, Baum et al. (2000) point out that small firms enhance their survival through collaborating and to not “go it alone” (p. 267). Indeed, scholars repeatedly refer to the liability of smallness, represented by resource deficits, which hinder innovation in SMEs (Aldrich & Auster, 1986; Gassmann, 2006; Hadjimanolis, 2003). SMEs therefore rely on their ability to externally access critical resources (apropos open innovation), not otherwise held by the organisation (Combs & Ketchen, 1999).

While SMEs face a certain inevitability of external engagement to realise innovation objectives, engagement may be troublesome. As Hoffman et al. (1998) stress, “management of external linkages to ensure that positive benefit is extracted is neither straightforward nor costless and requires the allocation of considerable technical and managerial resources.” (p. 47). In addition, SMEs struggle with external relationships and often lack the expertise to appropriate external knowledge (Rothwell & Dodgson, 1991).

However, Freel (2003) advises that if sufficient internal resources exist for innovation requirements this neutralises the need for outside resource assistance. Hoffman et al. (1998) express a similar notion to state that SMEs choose to maintain their independence by relying solely on internal resources. Yet empirical evidence from Fitjar, Rodrizues-Pose’s (2012) case
study of Norwegian firms found those involved in collaboration are more innovative than those reliant on internal resources.

Imperatively, in order to survive SMEs must innovate; however, correspondingly the inherent negative characteristics hamper efforts. Therefore, to realise innovation objectives SMEs by necessity adopt alternative innovation strategies to closed innovation, these alternative strategies paramount to overcome SMEs’ intrinsic limitations (Das & Teng, 1998; U. Lichtenthaler, 2008). Therefore, the use of external entities to compensate and supplement internal resources is apparently crucial for the innovative SME. Yet, successful use of externally sourced resources demands the skilful management (Narula & Zanfei, 2005). According to Mortara et al. (2009, p. 14) “open innovation is an innovation in itself” which requires effective management to implement successfully. While the benefits and costs of SME application of open innovation are underexplored (Dahlander & Gann, 2010), analysis of the literature indicates various ways in which open innovation specifically affects the characteristics of innovative SMEs.

3.4.1 Benefits of engagement

It would appear from the literature that open innovation ably provides the means to address SME internal resource deficits to afford greater innovation realisation. Growth orientated SMEs are compelled to determine methods to address innovation inadequacies (Mahoney & Pandian, 1992). Bridging the resource gap through external collaboration - open innovation - is particularly advantageous for the SME to improve innovation activities and competitiveness (Bougrain & Haudeville, 2002; Fritsch & Lukas, 2001; Hewitt-Dundas, 2006; Nieto & Santamaria, 2010; Nooteboom, 1994; Rogers, 2004). Collaborating on innovation, Das and Teng (1998) found, does increase the availability of resources to SMEs.

De Propris (2002) is another advocate for open innovation-related practices. Her research suggests SMEs can replace or supplement R&D efforts through innovation collaborative activities. Hausman (2005) similarly advocates innovation collaboration as being key to overcoming internal resource shortcomings and to address SMEs “substantial roadblocks” (p. 777) to innovation. External entities thereby fulfil a crucial role in providing supplementary and complementary resources.

The value of engagement is supported by Tether (2002). He found that although less than a fifth of UK SMEs were involved in some form of external innovation collaboration, those doing so produced higher level innovations. Moreover, Bretherton and Chaston’s (2005) research on external relationships usage to offset SME resource limitations confirmed
firms with access to sufficient resources outperform other SMEs. SMEs that do collaborate, despite being resource-poor, experience improved market growth through interfirm partnerships (Laursen & Salter, 2006).

Facilitated by open innovation engagement and of relevance to the smaller firm, scholars consider organisational learning is instrumental to SME success (Adler & Kwon, 2002; Colombo & Piva, 2008; Spicer & Sadler-Smith, 2006). Proclivity to organisational learning presents in SMEs’ desire to continually improve in order to realise benefits and is a feature of innovative SMEs’ characteristics (Rothwell & Dodgson, 1994). Choueke and Armstrong (1998) advocate that successful change management requires continuous learning, which is necessary for SMEs to negotiate increasing demands and to survive.

However, according to (Fiol & Lyles, 1985), success depends upon the managers’ respect of organisational learning and the requirement to facilitate knowledge sharing across the firm. Further, they posit that firm survival frequently relies on managers’ ability to develop mechanisms to identify, acquire, and exploit new knowledge within and outside of the firm. This may require conscious effort to recognise learning occurrences and the value of assimilation.

3.4.2 Engagement detriments

There is a dearth of knowledge regarding open innovation affects resulting from SME involvement (Huizingh, 2011; S. Lee et al., 2010). Indeed van de Vrande et al (2009) stress the lack of literature on the consequences of open innovation engagement. Instead, they call on previous research in collaborative innovation as a proxy to advise SMEs that “potential problems may arise due to insufficient knowledge, cultures or modes of organisation or bureaucratic elements.” (p. 427). As previously recognised, Rothwell (1989) posits that small firms “often lack the time or resources to identify and use important external sources of scientific and technological expertise” (p. 53).

Possible detriments from the literature indicate a greater diversity among negative aspects compared to open innovation benefits. Detriments divide between internal resource issues and the external entity-related dimension contingent to open innovation. The division of effects is not absolute with some spanning both. For example, the ability to manage the partner is an imposition on internal resources as well as relating to effects external to the firm.
**Internally located issues**

While resource deficits hamper innovation in SMEs, their limited resources additionally feature as a liability for open innovation. SMEs’ resource shortages inhibit open innovation endeavours and limit SME attractiveness as an interorganisational partner (Chesbrough, 2010; Chesbrough et al., 2006; Park, Chen, & Gallagher, 2002). SMEs rich in resources are better suited to realise the benefits of partnerships: interfirm relationships do not transform weak firms into strong ones, rather are more likely to be formed in the first instance by firms strong in resources (Park et al., 2002).

Whether sourced internally or externally, the identification and exploitation of new ideas is critical to sustain innovation and key to interfirm collaboration (Gassmann, 2006; Nag & Gioia, 2012; W. Powell, 1998; Wiklund & Shepherd, 2003). However, deriving benefit from knowledge can be challenging (Sparrow, 2001). Sparrow (2001) suggests that the resource constraints dictate the effectiveness and even the ability of SMEs to manage knowledge and the application thereof appropriately. Effective appropriation of knowledge is highly dependent on staff (Ipe, 2003). Consequently, the presence of suitable knowledge-orientated individuals is necessary to internally absorb, integrate, and develop new knowledge and technology, however SMEs often lack the financial capacity to employ such expertise (Bougrain & Haudeville, 2002). As a result, while SMEs are generally under-resourced in terms of sufficient knowledgeable staff, appreciation and application of knowledge depends upon the employment of appropriate staff with the ability to assimilate and recognise its value (Andersson & Loof, 2009; Cohen & Levinthal, 1990; Sparrow, 2001).

SMEs’ restricted financial resources appear to persistently hamper innovation efforts (Acs & Audretsch, 1987; Bessant, 1999; Akiyama & Furukawa, 2009; van de Vrande et al., 2009). The protection of intellectual property plays a critical role with the in and outflow of knowledge to generate and realise innovation (Arora, 2002; Chesbrough, 2003c; U. Lichtenthaler, 2010a). Especially for SMEs, patenting is fraught with difficulty (Hall et al., 2009; Kitching & Blackburn, 1999). Previous research establishes that SMEs engage less frequently in legal protection than large firms. Protecting firms’ intellectual property via patenting is generally considered to be outside the financial ability of SMEs with costs perceived as often outweighing benefits. Protection instruments often incur costly legal advice, thus making them prohibitive to the cash-strapped SME (Kitching & Blackburn, 1998). Likewise, the cost to management and efforts of monitoring and enforcing the patent inhibit SMEs adopting legal protection strategies, which are preferable for collaborative

Rahman and Ramos (2010) encapsulate SMEs’ specific internal open innovation barriers as behavioural related. They list management predisposition to minimise risk and employee resistance to incoming innovation (apropos NIH), lack of internal funds, technical expertise, and management time. Firms’ human resources demonstrate detrimental behaviour in terms of NIH where staff refute the value of the open innovation-sourced innovation (Chesbrough & Crowther, 2006) and unsupportive staff (Luoma et al., 2010a). Hausman (2005) advises that employees are more reluctant to adopt intangible innovations as implying change. She elaborates that a key facet of innovation success is change while frequently a cause of conflict, division, and disruption. Change demands careful handling in order to drive innovation through the organisation and the presence of highly trained managers often required to achieve adoption (Hausman, 2005).

With open innovation, van de Vrande et al (2009) state that the managerial and organisational issues are diverse. From their study, they allude to the presence of internal issues from SME open innovation engagement, many relating to the characteristics of innovative SMEs. The issues likewise refer to human resources: organisational culture and structure dictating open innovation success, administrative hurdles and balancing business as usual (BAU) with innovation endeavours. External issues include communication and task division problems between collaborating parties. In addition, they advise that time restrictions and resource problems span various open innovation practices. Their findings indicate that SMEs are generally limited in their ability to search and contract external entities due to resource deficits.

Time and relational ability are recognised SME barriers to developing and managing external relationships. Likewise, the necessity of balancing BAU and managing multiple demands on resource are perennial challenges exacerbated by open innovation activities (J. F. Christensen et al., 2005; Enkel et al., 2009; Freel, 2000a, 2004; Hewitt-Dundas, 2006; Major & Cordey-Hayes, 2003). However, the main challenges arise from engaging with external partners; in other words, partnership challenges. The challenges ranging across open innovation practices as each incurs collaborative arrangements and the demands thereof (van de Vrande et al., 2009).
External-orientated

Open innovation relies on the assessment, qualification and establishment of partner suitability compounded by the complexity and management costs associated with partnering arrangements (Belderbos et al., 2006). SMEs may have neither the time nor expertise to effectively exploit relationships and tend to be generally poor at interfacing with other organisations, therefore unable to develop effective collaborative relationships (Hadjimanolis, 2003; Terziovski, 2010). Equally, managing partners require considerable technical and managerial resources and extensive investment of effort. Complications are accentuated by SMEs’ tendency towards informality in cooperative relationships (Bonte & Keilbach, 2005). Furthermore, Bonte and Keilbach (2005) point out informality limits response options should the relationship deteriorate, whereas Lichtenthaler (2010) notes difficulties with SMEs collaborating with others is compounded by their limited control of partner firm activities.

The criticalness of partner selection corresponds with the SME imperative to reduce risk (Belderbos, Carree, & Lokshin, 2004; Chung, Singh, & Lee, 2000; Das & Teng, 2003). The search for innovation partners can be time consuming, costly and arduous (Laursen & Salter, 2006). Furthermore the value gained in the partnership may be offset if the SME over-searches as efforts incur costly time commitment and distracts management, thereby impacting results (Katila & Ahuja, 2002; Laursen & Salter, 2006). Rothwell (1983) earlier recognised the difficulties that SMEs confront in identifying and employing external sources to support innovation endeavours.

Aspects of relational ability present as particularly problematic for SMEs who often experience problems with external partnerships (Hofer & Adametz, 2007; S. Lee et al., 2010). Human capital in SMEs is represented by fewer individuals often with multiple and divergent responsibilities and low staffing, both recognised as limiting firm interaction with wide networks and impeding development of skills to manage differing relationships (Major & Cordey-Hayes, 2003). Similarly, criticism is rife of SMEs’ interorganisational relationship competency (Hofer & Adametz, 2007). Ascribed to SME managers having neither the time nor expertise to identify best partner, hindering the formation of effective relationships (Terziovski, 2010).

While many agree to SMEs’ effectiveness in exploiting external networks, also appreciated is that partnership selection does not automatically translate to best choice (Nooteboom, 1994; Rothwell & Dodgson, 1994; Van Dijk, Den Hertog, Menkveld, & Thurik, 1997). Due to difficulties, SMEs do not readily select the optimum partner. Rather,
risk avoidance results in SMEs gravitation to the most straightforward choice (Munyon et al., 2011). SMEs commonly find the familiar partner more attractive than collaborating with unknown - more suitable - entities (Lee and Cavusgil, 2006). However, adherence to known entities negates the opportunities and novelty presented by unfamiliar partners (Sampson, 2007). Shepherd and Ahmed (2000) concur; noting that while collaboration supports open innovation, the risks of compromising efficacy through SMEs’ predilection to choose familiar entities prevail. This default to known partners additionally incurs the risk of over similarity, which in turn reduces the learning available from the relationship. For SMEs to continue to commit scarce resources and time to open innovation activities requires the organisation learn from their partners and develop necessary collaborative skills (Hadjimanolis, 2003).


Relationship complexities therefore solicit the SME experience of open innovation erring towards greater cost than benefit. Moore (1993) found that SMEs do not always realise partnership investment. He draws on the results of his case studies of 12 SMEs engaged in collaborative ventures that the disadvantages are higher than advantages. Likewise, Oakey (1993) raises concerns regarding the benefits gained from innovation collaboration with the result of his research on the UK biotechnology industry which indicated the dominance of problems. Costs therefore often deter adoption. Hoffman, Parejo, Bessant and Perren (1998) report SMEs often perceive the benefits not offsetting risks. Similarly, Baldwin and Gellatley (2003) found SMEs dependent on supplier innovation relationships are overall less successful, while those depending on customers’ experience average success.

Despite costs however addressing internal resource deficiencies are a primary consideration encouraging interfirm collaboration; subsequently access to innovation required resources takes precedence over the incurrence of internal expenses (Combs & Ketchen, 1999). However, human, organisational, and cultural issues arising from SME engagement in open innovation hamper the ability to fully realise benefits (van de Vrande et al., 2009). Consequently, although open innovation provides solutions to many SME innovation woes application is problematic. Those that do engage recognise the interrelated aspects of firm
innovation endeavours and business functionality developing practices to ensure benefit from open innovation endeavours. Organisational practices address partnership challenges and internal implications to adoption (Vanhaverbeke et al., 2012).

### 3.4.3 SME practice variations

Within the category of SMEs, van de Vrande et al. (2009) determined that application of open innovation differs across size bands. Although their research did not include microfirms (less than 10 employees), they found small firms (10-99 staff) engage in open innovation less often than SMEs in the medium size band (100-499). The latter group applies open innovation practices including venturing. Their findings for the larger SMEs are similar to those of Lichtenthaler’s (2008) study of medium to large manufacturing firms. He found that larger firms who have the resources to invest in the complex open innovation practices engage in intellectual property trading and the practice of participation more so than other sized firms do.

However, the largest group, in which small firms dominate, defer to more informal open innovation practices. The practice selection driven by the informal practices (such as external networking) appearing to require less resource investment (van de Vrande et al., 2009). Van de Vrande et al. (2009) also found inbound innovation practices more common with fewer SMEs implementing outbound activities.

The outbound practices, other than the practice of all employee involvement, are considered beyond managerial and resource demands (van de Vrande et al., 2009). This is reinforced by the SME preference for knowledge and resource acquisition through nonpecuniary interactions rather than invest firm funds (Harryson, 2008; van de Vrande et al., 2009). Similarly, SMEs reluctance to adopt such resource intensive strategies such as equity alliances or acquisitions is noted by Dahlander and Gann (2010). Lichtenthaler and Ernst (2009) explain that SMEs’ lack of interest in outbound practices likely indicates the shortage of internal resources to pursue opportunities, further consistent with SME hesitancy to adopt such practices. However, Lee et al. (2010) suggests otherwise - that SMEs regularly engage both inbound and outbound modes of open innovation, underscoring the variance in the scarce literature on SMEs and open innovation.

### 3.5 Chapter Summary

In the economic environment, the role of SMEs continues to grow in importance. However, in order to succeed and thrive SMEs face a multitude of challenges not the least the requirement to be more innovative, more often. The imperative to innovate encourages SMEs
to implement alternative options to internalised (closed) innovation in order to overcome innovation deficits. SMEs are recognised as relying on external partners to gain needed innovation resources; consequently, an innovation strategy such as open innovation appears to be a natural development for the innovative SME.

Dictating innovative SMEs experience of innovation, and by extension open innovation, is their intrinsic characteristics. The characteristics associated with their size, particularly resource poverty, cause innovation difficulties. To better understand what comprises the innovative SMEs’ characteristic profile, this study examines the literature from two fields: innovative small firms in comparison to large firms (Tables 10 and 11); secondly, characteristics attributable to innovative SMEs (Table 12). The pooling of the two sources of characteristic determinants establishes an appreciation of the innovative SMEs’ characteristics. The characteristics can be further refined into two main features: beneficial behaviour and resource deficits. The compilation of the innovative SMEs’ characteristics (Table 13) contributes to the conceptual framework.

Open innovation - with the associated promise of resource access - appears ideal to compensate for SMEs’ resource lack. Investigation of the scarce existent literature on open innovation in SMEs presents both proponents and opponents of the suitability of SME engagement. Proponents point out that open innovation facilitates innovation through resource access and increased opportunities. The naysayers highlight the requirement for practitioners to have specific skills to manage open innovation. Among these requirements is managerial competency, firm capacity to learn from endeavours, staff acceptance, and commitment to realise success. Many of the effects are particularly burdensome to the SME, for example impositions on scarce internal resources and behavioural problems, and offset the rewards of open innovation endeavours.

The implications of engaging in open innovation to innovative SMEs remain underexplored. Especially absent is understanding the internal costs, managerial impositions, and other innovative SME characteristic-related consequences to endeavours (van de Vrande et al., 2009; Wynarczyk et al., 2013). However, open innovation may be worthwhile with the few “pioneering articles” (Vanhaverbeke et al., 2012, p. 10) agreeing to identifiable improvements in SMEs innovation results through open innovation (U. Lichtenthaler, 2008; van de Vrande et al., 2009).
Constructs for the conceptual framework draw directly from the literature referencing innovative SMEs’ characteristics (Table 13) and constructs drawn from Chapter 2 in order to answer the research question. The next chapter (Chapter 4) presents the details of the conceptual framework underpinning this study and guiding the empirical research. This study addresses this fertile research area in order to enrich the open innovation literature and to support practitioner engagement.
Chapter Four

THE CONCEPTUAL FRAMEWORK

Key aspects from Chapters 2 and 3 combine to form the conceptual framework. The conceptual framework is a systematic ordering of ideas about the phenomenon under scrutiny (Maxwell, 2005; Miles & Huberman, 1994). Maxwell (2013) advises a conceptual framework is, “a conception or model of .... what you plan to study, and of what is going on with these things” (p. 39), drawing on prior theory and research. Leshem and Trafford (2007) in citing (C. Robson, 1993) advise that “developing a conceptual framework forces you to be explicit about what you think you are doing. It also helps you to be selective; to decide which are the important features; which relationships are likely to be of importance or meaning; and hence what data you are going to collect and analyse” (p. 97).

The term conceptual framework is consistent with similar usages, the term and concept appropriate for application in this context (Kerin, Varadarajan, & Peterson, 1992; Leshem & Trafford, 2007; C. Robson, 2011; Wejnert, 2002). It is also consistent with the research design: according to Miles and Huberman (1994), “a conceptual framework explains, either graphically or in narrative form, the main things to be studied…. and the presumed relationships among them” (p. 18). However, Maxwell (2013) warns that every framework is an oversimplification of a complex reality, congruent with the constructivist/interpretivist perspective. Consequently, the conceptual framework of this study is offered to guide the study, to provide insights and broaden understanding, not a theory of the phenomenon (Maxwell, 2013).

The framework therefore conceptualises the relationship between open innovation and the innovative SME to guide the research and to answer the research question:

*How does engagement in open innovation influence the characteristics of innovative SMEs?*

Three objectives arise from the question:

1. Determine what beneficial effects to innovative SMEs' characteristics accrue from open innovation engagement.
2. Determine what detrimental effects to innovative SMEs' characteristics result from engagement.
3. Determine how SMEs manage these effects.
From the literature, the effects of open innovation engagement appear to advantageously influence some characteristics of innovative SMEs. SMEs primarily benefit through the receipt of innovation-required resources to address resource deficits and realise innovation objectives. Equally from the literature, although scarce on the subject, there are indications of open innovation negatively imposing on SMEs’ internal resources and behavioural attributes - key features of innovative SMEs’ characteristics.

During framework formation, potential constructs were repeatedly reviewed for inclusion in order to achieve a viewpoint that was neither too restrictive nor too generous (Anfara & Mertz, 2006a). In determining parameters, it was necessary to discard apparently valuable constructs, weighing these against the ones eventually adopted. The inclusion criteria are based on academic articles cited most often, most reputable journals, or attracting the most attention, for example, the SME practices of van de Vrande et al. (2009)\textsuperscript{16}. Taken together, the final constructs offer valuable insights into the impact of open innovation on the innovative SMEs’ characteristics. Addenda support the constructs to better inform the research question; for example, the OECD’s Oslo manual for the list of external entities. Another is the application of Laursen and Salter’s (2006) open innovation metric.

4.1 The framework constructs

Derived from the literature, four constructs form the conceptual framework, from left to right:

1. The open innovation practices represented by the eight practices of van de Vrande et al. (2009) (Table 4)
2. Indications of beneficial and detrimental effects (Drawn from Tables 7 and 8)
3. The characteristics of the innovative SME (Table 13)
4. Organisational practices developed to manage open innovation effects (Table 3).  

Figure 1 illustrates the constructs and their relationship. Details regarding the constructs follow in order of appearance, commencing with open innovation practices (subsections 4.1.1 – 4.1.4).

\textsuperscript{16} Most downloaded article in Technovation 2013, 453 citations Google Scholar 2014-06
4.1.1 Open Innovation practices

Open innovation represents a locus of commonality for externally directed innovation practices. This study draws on the eight practices identified in van de Vrande et al.’s (2009) research on open innovation in SMEs to qualify SMEs’ open innovation engagement as manifest through these practices. The practices embody equity and non-equity arrangements, formally and informally based activities. The practices divide between two modes (Gassmann & Enkel, 2004): Inbound, representing resources sourced externally and brought into the firm; outbound referring to resources flowing out from the firm.

Table 4 (repeated): Open Innovation Practices in SMEs

<table>
<thead>
<tr>
<th>INBOUND PRACTICES</th>
<th>OUTBOUND PRACTICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Network collaboration</td>
<td>7. Licensing-out</td>
</tr>
<tr>
<td>3. External participation</td>
<td>8. Venturing</td>
</tr>
<tr>
<td>4. Outsourcing R&amp;D</td>
<td></td>
</tr>
<tr>
<td>5. Licensing-in</td>
<td></td>
</tr>
</tbody>
</table>

4.1.2 Effects of engagement

According to the literature, open innovation engagement results in a number of effects for the SME. This study draws from the literature to construct the list of effects to inform the conceptual framework. While a key benefit of open innovation is the ability of innovative SMEs to compensate for their characteristic of resource deficits, there are other benefits (Table 14).
Table 14: Open Innovation Beneficial Effects
(Represented as (+) in Figure 1)

<table>
<thead>
<tr>
<th>BENEFICIAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of knowledge and other innovation-required resources</td>
</tr>
<tr>
<td>Augmentation of organisational learning/</td>
</tr>
<tr>
<td>Improved organisational processes and routines</td>
</tr>
<tr>
<td>Increased revenue sources</td>
</tr>
<tr>
<td>Brand and reputation enhancement</td>
</tr>
</tbody>
</table>

The literature also indicates a range of detrimental implications to innovative SME characteristics resulting from engagement in open innovation. Divisible between two categories: internally and externally located, the negatives relate to innovative SMEs’ characteristics indicating resource and behaviour effects (Table 15).

The effects (Tables 14, 15) of open innovation adoption include:
- Whether the business structure supports open innovation and suitability of the culture to cope with changes integral to open innovation.
- The call on resources demanded by open innovation, especially managerial and financial. For example, the time demanded to assess open innovation partner suitability.
- Managerial competency in terms of external relationships, management of partner arrangements and internal staff behaviour.
- Behavioural issues present as outright rejection by staff of introduced innovations (representative of NIH) through to subtle and not-so subtle indications of learning and change resistance. In addition, the NSH syndrome and OUH limit external exploitation of firm held innovations.

Dividing implications between the internal and external environments assists in discerning the source of an effect.
Table 15: Open Innovation Detrimental Effects
(Represented as (-) in Figure 1)

<table>
<thead>
<tr>
<th>INTERNALLY-LOCATED DETRIMENTAL EFFECTS</th>
<th>EXTERNALLY-LOCATED DETRIMENTAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade off between BAU and open innovation</td>
<td>Problems interpreting customer requirements and ideas, relational risks</td>
</tr>
</tbody>
</table>
| Management-orientated:  
  - Reliance on adequacy of management time, expertise, and relational ability; relationship efforts not always equal to success | Costs and uncertainty in partner identification, qualification and establishment of suitability |
| Dependence and stress on internal resources:  
  - Hampers open innovation engagement | Interfirm relationship complexities, including cultural, organisational modes, communication dissimilarities imposes on managerial resources and relational ability |
  - Limits search and partner identification and ability to manage partnership risks | Dependence on firm network to compensate for innovation inadequacies |
  - Inability to recognise or fully appropriate rewards including knowledge absorption | Inability to control partner actions |
  - Resource-lack reduces attractiveness as open innovation partner |  |
  - Lack of financial resources hamper knowledge application and ability to employ specialists suitable to recognise value |  |
| Increased costs |  |
| Business structure inadequacies |  |
| Behavioural issues (NIH, NSH, OUH) |  |
| Difficulties with knowledge management including knowledge exposure and integration |  |
| Tendency to informality with arrangements. Inability to afford intellectual property mechanisms, management, risks and legal protection issues |  |
| Preference for known entities |  |
| Partner and outcome delays impacting BAU and internal resources |  |

4.1.3 Characteristics of the innovative SME

That the characteristics of innovative SMEs remain ambiguous is well recognised in the literature (McMahon et al., 1993). In order to address the difficulty of defining the characteristics, this study draws on two approaches in the literature that offer guidance:

1. Innovative small firms compared to large firms
2. The characteristics of innovative SMEs.

A synthesis of the two approaches provides a compilation of the characteristics (Table 13 repeated here). The characteristics further divide between resource-deficits and behavioural
benefits, as recognised by scholars (e.g. Nooteboom, 1994; Rothwell, 1983; Vossen, 1998a, 1998b).

Table 13 (repeated): Characteristics of the Innovative SME

<table>
<thead>
<tr>
<th>INNOVATIVE SME ADVANTAGES</th>
<th>INNOVATIVE SME DISADVANTAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MANAGEMENT</strong></td>
<td></td>
</tr>
<tr>
<td>Entrepreneurial tendencies, dynamic, risk takers</td>
<td>Hampered by lack of management skill</td>
</tr>
<tr>
<td>Rapid decision making</td>
<td>Lack of management time</td>
</tr>
<tr>
<td>Little bureaucracy</td>
<td>Dependency on manager/owner to interface and identify innovation opportunities</td>
</tr>
<tr>
<td>Plan, budget for innovation</td>
<td>Inability to exploit external sources of knowledge</td>
</tr>
<tr>
<td>Exploit external opportunities</td>
<td>Over-involvement at operational level</td>
</tr>
<tr>
<td>Presence of innovation champion</td>
<td></td>
</tr>
<tr>
<td>Managers have formal education/training</td>
<td></td>
</tr>
<tr>
<td><strong>ORGANISATION</strong></td>
<td></td>
</tr>
<tr>
<td>Generally simple and focused, flexible</td>
<td>Lack infrastructure</td>
</tr>
<tr>
<td>Innovations more readily adopted by staff</td>
<td>Tendency to informality</td>
</tr>
<tr>
<td>Better understanding of overall project</td>
<td></td>
</tr>
<tr>
<td>Fast and effective internal communication</td>
<td></td>
</tr>
<tr>
<td>Informal networks</td>
<td></td>
</tr>
<tr>
<td><strong>LEARNING</strong></td>
<td></td>
</tr>
<tr>
<td>Capable of fast learning and adapting routines and strategies</td>
<td>May lack resources for systematic and continuous technological scanning</td>
</tr>
<tr>
<td></td>
<td>Change resistance due to threatened routines</td>
</tr>
<tr>
<td></td>
<td>Poor training (both resource and behavioural)</td>
</tr>
<tr>
<td><strong>RESOURCES</strong></td>
<td></td>
</tr>
<tr>
<td>R&amp;D efficiencies</td>
<td>Limited resources (e.g. time, staff, finances, expertise)</td>
</tr>
<tr>
<td>High incidence of technically qualified staff</td>
<td>Lack of time and resources to forge suitable external expertise</td>
</tr>
<tr>
<td>Specialised, matching technology with specific customer requirements</td>
<td>High cost and lack staff to search, file, defend patents</td>
</tr>
<tr>
<td></td>
<td>Often lack high-level technical skills</td>
</tr>
<tr>
<td></td>
<td>Full time R&amp;D can be too costly</td>
</tr>
<tr>
<td></td>
<td>Lack adequate money to employ technical specialists.</td>
</tr>
<tr>
<td></td>
<td>Intense focus generates technical myopia</td>
</tr>
<tr>
<td><strong>MARKET</strong></td>
<td></td>
</tr>
<tr>
<td>Methods developed for external information scanning (both resource and behavioural)</td>
<td>Weak external contacts</td>
</tr>
<tr>
<td>Use of external sources to meet resource/expertise inadequacies</td>
<td>Difficulties interfacing with external sources</td>
</tr>
<tr>
<td>Find and exploit niche markets, agility to respond to changes, opportunities</td>
<td>Customer dependency</td>
</tr>
<tr>
<td>Close to user</td>
<td>Reliance on familiar/long term relationships</td>
</tr>
<tr>
<td>Can prove attractive partner if technological leader</td>
<td>Little alliance management experience</td>
</tr>
</tbody>
</table>
4.1.4 Organisational practices

The response of SMEs to the results of open innovation engagement to their characteristics is the employment of various organisational practices. The literature provides some indications of the organisational practices adopted (Table 16). The organisational practices are implemented to maximise open innovation return on endeavours and to minimise or compensate for negative effects (Radas & Bozic, 2009). The list in Table 16 forms the final construct in the conceptual framework.

Table 16: Summary of Organisational Practices

<table>
<thead>
<tr>
<th>ORGANISATIONAL PRACTICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Persist with closed innovation to support knowledge appreciation and integration</td>
</tr>
<tr>
<td>o Administer open innovation management strategy, including knowledge integration</td>
</tr>
<tr>
<td>o Defer to more common open innovation practices to minimise risk and lack of managerial competence</td>
</tr>
<tr>
<td>o Employ methods to identify and exploit new knowledge and new partners</td>
</tr>
<tr>
<td>o Intentional incorporation of learning to enhance relational skills</td>
</tr>
<tr>
<td>o Innovation champion to drive internal and external innovation</td>
</tr>
<tr>
<td>o Incentives to motivate employees</td>
</tr>
<tr>
<td>o Favour familiar partners: develop relationships with preferential partners due to established trust and relationship/open innovation efficacy</td>
</tr>
<tr>
<td>o Preference for informality in partner arrangements</td>
</tr>
<tr>
<td>o Close management of knowledge sharing with partners: selective revealing.</td>
</tr>
</tbody>
</table>

4.2 Chapter summary

Based on analysis of the open innovation and related innovation literature, together with that of the innovative SME, this study draws on key aspects to form the constructs of the conceptual framework. The framework proposed herein positions this study within the scholarly domain using the lexicon of the discipline and defines the boundaries to associate with current understanding (Bono & McNamara, 2011; Eisner, 1985). Subsequently, the framework provides a common language to inform the stages of this study, the boundaries, and the research method. In addition, it displays the strengths and weaknesses of the approach, referring to the limitations of any framework to adequately and accurately meet the needs of a study (Anfara & Mertz, 2006a). The framework guides comprehension of the data
During collection, analysis, and interpretation (Anfara & Mertz, 2006b; Leshem & Trafford, 2007; Smyth, 2004).

Development of the conceptual framework arose due to the absence of a specific open innovation theory suitable for study application. This is not unexpected with an emerging concept such as open innovation (Dodgson et al., 2006). According to Lichtenthaler (2011), open innovation in general is marked by a lack of theoretical and empirical work, although academic and practitioner interest is driving research growth. Gianiodis, Ellis and Secchi (2010) similarly found no unifying open innovation framework in their efforts to create an open innovation typology. The development of a framework is therefore consistent with other open innovation studies (e.g., Chiaroni et al., 2009; Hamaoka, 2008; Koellinger, 2008; Laursen & Salter, 2005; S. Lee et al., 2010; van de Vrande et al., 2009).

________________________

The framework is organic and continually develops through literature and research findings: refinement occurring as an outcome of empirical research (Miles & Huberman, 1994). The framework is integral to, and with, the research method used to gather the empirical data, the subject of Chapter 5, next.
Chapter Five

RESEARCH DESIGN

This chapter explains the research approach adopted for this study. The conceptual framework (Chapter 4) informs the approach and supports sense making of the data during collection, analysis, and interpretation (Leshem & Trafford, 2007). The desire to develop current understanding of open innovation in the context of innovative SMEs and their characteristics, a priori specification of constructs aids to build knowledge through a conceptual framework (Eisenhardt, 1989; Ridder, Hoon, & McCandless, 2009).

The research design links the research question and the conceptual framework with data collection and analysis (Yin, 2003b). The chapter commences by presenting the ontological stance of the author (section 5.1), and then introduces the two-stage research approach (Section 5.2). Description of the first stage, which is a pilot study, transpires in section 5.3. Section 5.4 provides details on the contextual setting of this study: the New Zealand engineering industry. Section 5.5 discusses Stage 2, the principal data collection method of multiple case studies. Section 5.6 explains the data collection and analysis to complete the chapter.

5.1 Ontological perspective

According to Creswell (1994), the theoretical perspective that underpins an organisational research project aims to reconcile a researcher’s assumptions about the world. The research design therefore reflects the researcher’s perspective and determines the framework of a particular project, the selection of methodology and the method or methods employed (Collis & Hussey, 2003; Creswell, 2003; Denzin & Lincoln, 2000; Mackenzie & Knipe, 2006). The author of this study - my personal philosophy - therefore determined the research design (Collis & Hussey, 2003).

Consequently, the adoption of an interpretive methodological approach relates to my epistemological perspective. While positivism and postpositivism paradigms are embedded in an objectivist epistemology and seeks to explain, the constructivist/interpretivist paradigm seeks to understand (Guba & Lincoln, 1994): understanding gained through interpretation in interpretivist research. Interpretation in the hermeneutics tradition is considered critical to deepen knowledge (D. E. Gray, 2004). New understanding then is generated when subjective experience is held up for “inspection” and by “taking it out of the world where it occurs”
Chapter 5: Research Design

(Denzin, 2002, p. 355). The ontological perspective then dictates the research design: adopted by this study, the research design adheres to the methodological fit recommendations of Edmondson and McManus (2007, p. 1160):

1. Having an open ended research question
2. Which requires the collection of qualitative data for interpretation for further meaning
3. Interviews and observations as the data collection methods
4. Few formal methods, usually new constructs
5. Data analysis goal of pattern identification
6. Thematic content analysis through an iterative process
7. A theoretical contribution that invites further work; a suggestive model of the phenomenon under study.

5.2 Gathering empirical data in two stages

As this study considers the implications of open innovation engagement to the characteristics of innovative SMEs, the research question is consistent with real world problems requiring field research (Edmondson & McManus, 2007; Stake, 2000b). As the aim is to understand the effects of open innovation on innovative SMEs’ characteristics as a social phenomenon, and the examining of the phenomenon in reality construed by the participants, the interpretivist approach is appropriate (Crotty, 1998; Siggelkow, 2007).

Edmondson and McManus’ (2007) recommend a hybrid quantitative/qualitative method when designing the research approach to best suit field research with the research tool selection appropriate for the purpose. The study therefore employed a two-stage approach for data collection:

1. Pilot study through application of a questionnaire
2. A multi-firm case study

Table 17 outlines the research steps undertaken.

5.2.1 Stage 1 - Pilot study

At the commencement of this study, the existence of open innovation and the extent of engagement were generally unknown in New Zealand. Consequently, use of a pilot study permitted a preliminary assessment of open innovation in the context of the New Zealand engineering industry. Through a series of interviews using a quantitative questionnaire, the pilot study fulfilled four purposes:
1. Ascertain industry suitability through confirming the existence of open innovation active firms.
3. From the open innovation active firms, identify suitable SME for case firms (Stage 2).
4. Test potential case study questions for application in Stage 2.

**Table 17: Research Design**

(Adapted from Rocks, Carson, & Gilmore, 2007; Stokes & Perry, 2007; Yin, 2003b)

**Exploratory pilot study**

<table>
<thead>
<tr>
<th>Design Tactic</th>
<th>Design Intent/Test</th>
<th>Phase of Research</th>
<th>Design Intent/Test</th>
<th>Design Tactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explore industry suitability and presence of open innovation</td>
<td>Viability of industry</td>
<td>Stage 1</td>
<td>Validity of sample for selection</td>
<td>Establish relevance of industry context through confirmation of open innovation activities Identify potential case firms</td>
</tr>
<tr>
<td>Congruence between research question/objectives and study design features</td>
<td>Reliability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop and refine case study protocol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Firm level explanatory case study**

<table>
<thead>
<tr>
<th>Design Tactic</th>
<th>Design Intent/Test</th>
<th>Phase of Research</th>
<th>Design Intent/Test</th>
<th>Design Tactic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replication logic</td>
<td>External validity</td>
<td>Stage 2</td>
<td>Transferability</td>
<td>Select case study database Use of specific procedures for coding</td>
</tr>
<tr>
<td>Define scope and boundaries for research</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple sources</td>
<td>Construct validity</td>
<td>Data collection</td>
<td>Confirmability</td>
<td>Confirmanbility audit examining the data and findings</td>
</tr>
<tr>
<td>Chain of evidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key informants drafts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within-case and cross-case pattern matching</td>
<td>Internal validity</td>
<td>Data analysis</td>
<td>Credibility/Trustworthiness</td>
<td>Triangulation</td>
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**5.2.2 Stage 2 - Case study strategy**

The principal research method for data collection relied on multiple case studies. Six SMEs identified from the pilot study agreed to become case study firms providing rich data.
Critical to retain authenticity between the research question and data, the case study approach provided the ability to conduct the research within the constructivist/interpretivist ontology. Selection of qualitative case study is appropriate as according to Kohlbacher (2005) “only qualitative methods are sensitive enough” (p. 9) when investigating little known phenomenon. In addition, qualitative case study is considered a suitable research strategy for use in explanatory studies (de Vaus, 2001; Kohlbacher, 2005; Yin, 2003b).

Multi-cases generate robust evidence through replication and provide better explanations than possible when studying a single case (Eisenhardt, 1991; Parkhe, 1993; Yin, 2003b). A single case tends to concentrate focus on the case itself, whereas multiple cases emphasise the phenomena under scrutiny (Thomas, 2011). Eisenhardt (2007) postulates that although theoretical sampling with multiple case studies can be an issue, using more than one case produces better theory with improved analytic strength; multi-cases therefore producing comparative and contrasting results to better understand open innovation in SMEs. Multi and single case studies have a strong background in open innovation due to the provision of detailed data through “full immersion” with firms in order to discern key themes pertinent to this study (Edmondson & McManus, 2007, p. 1162).

The presence of open innovation was initially revealed by Chesbrough from the case studies he and colleagues conducted in large and high technology firms during the mid-2000s (e.g., Chesbrough, 2003b; Chesbrough & Rosenbloom, 2002). The use of the strategy by open innovation scholars has developed understanding and appreciation of many facets of open innovation underscoring the suitability of application in this instance (e.g., Chesbrough, 2003b, 2003c; Chesbrough et al., 2006; Dodgson et al., 2006; Gassmann & Enkel, 2004; Hafkesbrink, Krause, & Westermaier, 2010; Huston & Sakkab, 2006; U. Lichtenthaler, 2010b; Srivardhana, 2006). Case studies, “are particularly helpful in identifying its [open innovation] moderating and contingent conditions” (Dodgson et al., 2006, p. 343) making selection appropriate to this study.

No precise guide dictates the quintessential number of cases in a multi-case study (Romano, 1989; Stokes & Perry, 2007). However, Eisenhardt advocates theoretical saturation should direct number choice; she states (1989, p. 545) that, “there is no ideal number of cases, a number between 4 and 10 cases usually works well.” Recommendations for suitable number of cases range from a minimum of two to four with a maximum of 10-12. Between four to eight considered most appropriate (Hedges, 1985; Stokes & Perry, 2007).
The research question required qualitative data collection consistent with the interpretivist paradigm. As Creswell contends (1994, p. 147) “qualitative research is interpretative research”. Selection of qualitative case study strategy is therefore congruent with this perspective with open question interviews comprising the main source of data collection (Mackenzie & Knipe, 2006; Yin, 2003a).

The research process included attending to the tests listed in Table 17, accounting for the requirements during data collection, case write-up, analysis, and discussion. The ensuing sections encompass the points raised in the Table and qualify the research process undertaken to meet research adequacy requirements.

5.3 Stage 1: Pilot study

The key objectives of Stage 1 were establishing the innovation activities of SMEs in the engineering industry and to identify innovative SMEs suitable to participate in Stage 2 case studies. The results from Stage 1 confirmed the presence of open innovation SME practitioners using the breadth and depth open innovation metric outlined by Laursen and Salter (2006).

Furthermore, Stage 1 addressed a well-known problem with organisational research in New Zealand. Chetty (1996) refers to the oversaturation of research within the small New Zealand business landscape creating problems with firms agreeing to research, resulting in frequently low response rates. As Stage 1 occurred in collaboration with the Heavy Engineering Research Association (HERA)\(^\text{17}\), HERA facilitated access to firms, and supported introduction to New Zealand firms agreeable to being research participants. In addition, the facilitation assisted to overcome otherwise normal constraints to interviewing, that of gaining interviewees’ cooperation and willingness to participate (Bouma, 2000).

Application of the survey occurred during a series of 25 face-to-face interviews during late 2010 and early 2011. The interviews took place with engineering firms around the North Island of New Zealand and lasted 60-120 minutes inclusive of a facilities tour. Firm size ranged from micro-SMEs (>10 employees) to large SMEs of 150+ employees, all leading industry firms with disparate specialties. Interviews were with the most senior person of the firm - the CEO, owner, or general manager as appropriate. As senior executives, they were fully conversant with their firm’s innovation activities, the majority directing innovation activities personally. Referred to as elite interviewing (Marshall & Rossman, 1999), their

\(^{17}\) HERA, a highly active trade organisation, drives major business-focused developments in the engineering industry.
familiarity with firms’ innovation activities permitted the eliciting of detailed information on their innovation strategies (Guba, 1990). This afforded understanding of firms’ open innovation involvement, the type of practices engaged, and frequency of open innovation endeavours to establish practice usage. In addition, the questionnaire served to determine firms’ sources for innovation. Rating these as high, medium, low or of no importance provided details according to Laursen and Salter’s (2006) breadth and depth measure of firm openness. Stage 2 repeated the same process and respondent interview protocol.

5.3.1 Interview questionnaire
The survey questionnaire used previously developed and tested information and questions from the following:
- Questions employed in the UK Community Innovation survey (CIS) survey: based on the OECD’s Oslo Manual to determine firms’ innovation activities.

5.3.2 Results
The pilot study served as a screening phase to establish whether the industry demonstrated open innovation-active firms. Due to the small response rate, the data from the questionnaire is not statistically significant; in addition, the sample selection was purposeful as favouring successful engineering SMEs. However, it does provide industry insights, the data from the survey summarised in Tables 18-20.

Table 18 details the type of innovation pursued. Product innovation dominates which differs from Laforet and Tann’s (2006) assertion that engineering firms are process-orientated, although this may be a matter of interpretation by the participants in this study. Other forms of innovation are also well represented.

Table 18: Innovation Activity of Surveyed Engineering SMEs

<table>
<thead>
<tr>
<th>Innovation type:</th>
<th>Period 2006-2010 (Total Sample: 25 SMEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product</td>
</tr>
<tr>
<td>Open Innovators (11)</td>
<td>11 firms</td>
</tr>
<tr>
<td>Closed Innovators (8)</td>
<td>8 firms</td>
</tr>
</tbody>
</table>
A number of SMEs reported no innovation activity during the period. One firm cited both the success of previous innovations and unfavourable market conditions to justify lack of innovations (Table 19).

### Table 19: SMEs Not Innovating

<table>
<thead>
<tr>
<th>Reason given:</th>
<th>Due to success of earlier innovation activity</th>
<th>Market conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms: 7*</td>
<td>4 firms</td>
<td>4 firms</td>
</tr>
</tbody>
</table>

### Table 20: Open Innovators

Firms reporting innovations during period in-conjunction with others

<table>
<thead>
<tr>
<th>Innovation:</th>
<th>Product</th>
<th>Process</th>
<th>Organisational/ Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally developed (closed)</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Developed in collaboration</td>
<td>11</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

Of the eleven open innovation practitioners, product innovations dominated activities (Table 20). While the firms collaborated on innovations, internal (closed) innovation continued to feature as a key innovation strategy. Presented in Tables 18, 19 and 20, the results indicate a diverse spread of firms with a propensity for closed innovation continuing as the primary innovation strategy. While there is a strong presence of non-innovating firms, the presence of open innovation active SMEs met the second objective: identification of suitable case study subject firms.

A bonus of the pilot study was the opportunity to interview senior industry experts. The experts provided additional information on the innovation inclination of the industry. They advised open innovation is a relatively recent development among industry firms. The consensus reinforced HERA advice that the majority of innovative engineering firms by preference pursue closed innovation.

### 5.4 Research setting

New Zealand is highly deregulated with an open economy (Porter, Sala-i-Martin, & Schwab, 2007). The current Global Competitiveness Report (2012) identifies New Zealand as an innovation-driven economy placing 23 out of 144 in competitiveness rankings. New Zealand features well in the IMF, OECD and the UN international innovation competitiveness index (2012) ranking fourteenth with an ICI score of 71.3, equal to the UK.
The OECD (2010a) positions New Zealand mid-range in the OECD for firms collaborating on innovation (i.e. open innovation). This is ahead of neighbouring Australia and the UK, but well behind Finland (first position) and slightly behind Denmark, the two being similar sized economies to New Zealand. While local collaboration within New Zealand is higher than open innovation on an international basis, when factoring in collaborating firms by R&D status, New Zealand drops from the chart. The implication is that local firms are more likely to collaborate on facets of innovation other than R&D (OECD, 2010a). This is iterated by Statistics New Zealand: drawing on the innovation survey (2012), 46% of businesses report innovation activity in 2011 while only 9% carry out R&D. Instead, three-quarters of innovating firms advise that opportunities for innovation arose from a combination of internal and external sources.

SMEs in New Zealand innovate to overcome the lack of proximity to other markets and to compete effectively within the country’s small arena, while the small population limits access to talent and skill diversity. Statistics New Zealand’s Innovation survey points to the advantages of New Zealand firms’ innovation activities as increased profitability (79%), increased numbers of markets (64%) and improved efficiency (75%). The results illuminate the importance of innovation on firm success (T. Jones, 2002).

A study of innovation in New Zealand’s manufacturing sector by Shangqin, McCann and Oxley (2009) explored whether New Zealand firms’ innovation activities had comparable issues and influences evident in other countries. Their study found the innovation approach of New Zealand manufacturing SMEs mirror those in the international innovation literature. While pursuit of innovation is evident to the same degree, success is not always realised, which they attribute to the prevalence of micro firms in New Zealand.

Micro firms dominate the New Zealand business landscape. Due to resource scarcities associated with the small nation, micro firms are rarely able to invest in or maintain R&D and other innovation endeavours (Shangqin et al., 2009). The inference is that the inability to afford R&D does not preclude the awareness of the need to innovate, however awareness of its importance does not readily translate to innovation activity and success. Another perspective is provided by Battisti, Deakins and Roxas (2009-2010). While their research of innovation and R&D in New Zealand argues that the dominance of small firms hampers innovation, size is not the key concern. Instead, the authors refer to growth-orientated firms’

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18 4.4 million at March 2013
significant innovation barriers are the lack of, or insufficient access, to adequate resources suggesting the suitability of open innovation to address innovation resource deficits.

*Engineering firms and innovation*

Engineering firms are recognised as specialist providers and often the locus of innovation activity for other organisations (Principe, 2000; van de Vrande et al., 2009). Ritter (1999) points out that the closed culture of engineering firms is contrary to exploiting external networks and the associated benefits. However, critical to their innovation success is linking with external knowledge centres, as is a commitment to innovation (Hoffman et al., 1998; Keizer, Dijkstra, & Halman, 2002), together with access to or presence of adequate resources (Hoffman et al., 1998). Furthermore, as generally project-based, to sustain business they frequently rely on historic expertise and internal technical resources; however, they often demonstrate cultural inertia due to this insular focus (Gann & Salter, 2000; Laforet & Tann, 2006). Generally training is ad hoc, which is suspected to relate to their reluctance to expose internal deficiencies or risk loss of control (Laforet & Tann, 2006).

Subsequently, engineering firms represent key sources of innovation while appearing to favour internal over externally orientated innovation activities, although this is changing (Ritter, 1999). Van de Vrande et al.’s (2009) survey, points to evidence of engineering firms adopting open innovation. As such, the industry appears suitable to explore open innovation in practice. Furthermore, as a suitable industry from which to draw, Laforet and Tann’s (2006) research of manufacturing SMEs demonstrated their similarity to SMEs in other industries.

*New Zealand Engineering SMEs*

HERA (2010) reports that the manufacturing industry, of which engineering is a facet, largely consists of SMEs with broad technical capabilities. Industry firms provide good quality products with some significant export successes. While 90% of manufacturing firms are small (0-20 employees), typical for New Zealand, the MED reports 55% rate in the top five of all New Zealand industries for innovation (Ministry of Economic Development, 2011). However, changes in the global economy and increasing international competition particularly threaten New Zealand firms. New Zealand’s economic isolation, small domestic economy, and dominance of micro and small-sized firms mean success is reliant upon innovation, service, and adding value.
Lewin (1983) states that the basics of engineering are problem solving to provide solutions: problems typified by complexity. Innovation is often born from necessity and has been a keen feature since early business in New Zealand with an innate need to improvise from available resources. Consequently, the relative isolation of New Zealand serves engineering firms as fostering the development of significant engineering competencies that firms then leverage for competition. In addition, the industry lacks the constraints of legacy technologies that can hamper new product development in other markets (HERA, 2010).

New Zealand is a relatively low cost producer in comparison to many other developed countries. However, China now severely challenges this historical cost advantage, the lower cost of Chinese work disrupting the industry with firms rallying to compete or find new markets. The advent of China attracting New Zealand-commissioned engineering work offers an unexpected bonus to local firms. Chinese fabricated units do not always meet New Zealand compliance, client specifications, or contain poorer materials. These factors require re-engineering of Chinese fabricated equipment and products by New Zealand firms. The challenges inherent in such re-engineering demands have generated new forms of innovative solutions to correct issues.

**Background - about the researcher**

Prior knowledge of SMEs and the engineering industry guided the study topic and served in constructing the conceptual framework and research design (Maxwell, 2005). The author’s New Zealand and UK SME business experience generated awareness of the resource struggles hampering SME efforts to innovate successfully. Involvement with the engineering sector led to recognising a demonstrative shift from being the domain of closed innovators towards opening up to collaborate with others. The shift appears driven by efforts to compensate for resource deficiencies and to increase innovation opportunities. Likewise, with increasing competition from offshore firms, the impetus to export, to build market opportunities, and to offset the small domestic market further compel engineering firms consideration of alternative innovation strategies. With the lack of resources especially pertinent in such a small economy, the question accordingly arose of how relevant is open innovation to the SME considering the unknown implications to engagement.

5.5 **Stage 2: Case Study Strategy**

The selection of case study in Stage 2 as the principal method of collecting data is consistent with Morse (1991). He suggests a research problem is ideally suited to a qualitative method when there is an evident lack of theory or research, available theory is
unsuitable, and when it is necessary to investigate a phenomenon to develop theory, an
opinion shared by others (e.g., Eisenhardt, 1989; Halinen & Tornroos, 2005). Ridder, Hoon
and McCandless (2009) advise the suitability of case studies to “identify and refine constructs
and their relationships” (p. 137).

Qualitative case studies provided the rich description required to answer the research
question. Furthermore, the case study method is suitable where there is a small sample base
such as evident in New Zealand (Chetty, 1996). The use of two methods sequentially where
the first method informs the second stage aligns with the recommendations of Greene,
Caracelli, and Graham (1989). Shangqin et al. (2009) used a similar two-stage strategy for
their research on innovation in New Zealand.

Six innovative SMEs formed the data set for the multi-case study. The following
subsections explain the selection process (subsection 5.5.1), and the steps taken to collect the
data from each firm (5.5.2). Discussion of the ethical considerations takes place in subsection
5.5.3. Section 5.6 details the data analysis.

5.5.1 Selecting the participants: case study selection criteria
The initial approach to each firm occurred during the HERA-facilitated interviews.
Consequently, the senior person or persons were already aware of this study and the
advantages of participating (Van de Ven & Rogers, 1988). Ten firms expressed interest in
participating as case firms: the firms then evaluated to determine suitability using criteria
developed by this study (Table 21). Firm selection relied upon literal and theoretical
replication to limit environmental variation, chosen deliberately as reflecting the necessary
experiences to afford understanding of the phenomenon under scrutiny (Denscombe, 2003;
Eisenhardt, 1989; Yin, 2003b). To support generalisability, firm selection related to study
constructs, defined in relation to the research question and conceptual framework
(Eisenhardt, 1989; Miles & Huberman, 1994).

In multi-case studies Yin (2004) stresses firm selection should be based on normalcy.
The six firms participating in the research are industry-recognised innovators and open
innovation practitioners. While each case firm is individually different, they are
representative of other innovative SMEs suffering innovation issues of resource shortages
while compensating through beneficial behaviour. This is consistent with the inherent nature
of innovative SMEs tending to demonstrate homogenous characteristics (Rothwell &
Dodgson, 1994; Rothwell & Zegveld, 1982; Vossen, 1998b; Welsh & White, 1981). Therefore,
the findings of this study may be supportive of replication and generalisability.
5.5.2 Final case firm selection

Of the ten HERA members meeting the above criteria, six engineering SMEs took part as case study firms. The choice of six falls within the range recommended by Stokes and Perry (2007) and Eisenhardt (1989). The remaining four firms were unable to be subjects due to their falling outside the selection criteria. The objective was not to maximise the number of cases, but to achieve saturation of information about the topic (Padgett, 1998, p. 52). Meeting the firms during Stage 1 identified SMEs who would be suitable to contribute valuable insights from their engagement in open innovation, therefore be illustrative of the phenomena (Robertson, 2012).

Table 21: Case Firm Selection Criteria

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<table>
<thead>
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<tbody>
<tr>
<td>1</td>
<td>Determination of SME size based on employee numbers established by the OECD.</td>
</tr>
<tr>
<td>2</td>
<td>The firm demonstrates innovation activity in the period 2006-2010 ascertained during Stage 1 screening.</td>
</tr>
<tr>
<td>3</td>
<td>Independent firms not reliant upon or part of a larger (parent) firm, therefore demonstrative of innovative SMEs' characteristics.</td>
</tr>
<tr>
<td>4</td>
<td>Agreeable to interviews with management and staff involved in innovation activities.</td>
</tr>
<tr>
<td>5</td>
<td>Firms located in geographical proximity to Auckland, a necessary criterion in order to meet the financial and time constraints of this study. As the upper half of New Zealand contains the country’s major industrial areas and majority of businesses, it was reasonable to expect to fulfil this last condition without compromising research value.</td>
</tr>
<tr>
<td>6</td>
<td>Collaboration with a range of external entities. Established in Stage 1, firms’ sources for innovation and depth of engagement used as the open innovation metric (Laursen &amp; Salter, 2006).</td>
</tr>
<tr>
<td>7</td>
<td>Engagement of three or more open innovation practices identified by van de Vrande et al. (2009). Meeting this criterion was critical to permit sufficient experience when discussing the implications of open innovation engagement.</td>
</tr>
</tbody>
</table>

5.5.3 Case study data collection

The interviews took place in 2011 at firms’ primary business locations with a minimum of two interviews per case, each lasting 60 – 120 minutes, inclusive of site tours: the number of interviews considered appropriate for the purpose (A. Larson, 1992; Perry, 1998a).

Interview format

The interviews with personnel at the SMEs used a semi-structured question guide. Based on Yin’s (2003b) case study protocol to ensure robustness, two sources supported development of the interview guide:

1. OECD’s Oslo Manual to provide overall insight to innovation research
2. Use of a validated instrument: van de Vrande et al.’s (2009) questionnaire applied during their research on open innovation in SMEs.

The questions from van de Vrande et al. (2009) study translated well for application in the interview guide. Some pre-testing of questions occurred during Stage 1 meetings, assisting with refinement in final application. Constant alignment of questions with the framework assisted consistency and continuity and to alleviate the risk of complexity, an inherent problem of the case study approach (Stokes & Perry, 2007).

Application of a standardised protocol at each interview attended to concerns regarding reliability and consistency (Yin, 2003b). The interview protocol outlined the philosophies, procedures, and definitions of this study to ensure consistency and to minimise confusion. Participants were encouraged to seek clarification on any term or question. Each case interview commenced with a discussion of related ethics and confirmation of formal consent.

The interview guide identified practitioner open innovation activities including the implications experienced from the practices employed and the organisational practices adopted to manage open innovation. The interview protocol itself used the funnel approach (Sternberg, Lamb, Esplin, & Baradaran, 1999). The funnel approach commences with wider issue-related questions narrowing down to specifics as the interview progresses. The approach encouraged rapport and encouraged a conversational manner using open ended questions to elicit retrieval of valuable free-call memory (Sternberg et al., 1999). Presentation of friendly and non-threatening questions furthered rapport and extraction of required information (Yin, 2003b).

Consequently, case study interviews commenced with an invitation to describe the individual’s and firm’s experiences of open innovation in general terms. Application of open-ended questions occurred as required, the format encouraging frank discussion and the ability to follow arising lines of thought (Carson, Gilmore, Perry, & Gronhaug, 2001; Stokes & Perry, 2007). Digital recording of interviews occurred if the respondent agreed (one person declined). Transcription of the recordings was undertaken by a professional firm for accuracy forming quality verbatim transcripts, further assisted by respondent validation (Thomas, 2011). Visits to firm sites enabled the collection of complementary and supplementary data through observations. The site tours permitted casual interaction with frontline employees in order to gain a deeper sense of the firm and its innovation activities and lent support to alternative perspectives (Yin, 2003b).
Self-assessment

A concern with interviews of this type is the reliance on respondents’ subjective responses, yet self-reporting can be problematic (J. H. Barnes, 2006). Barnes (2006) advises that due to selective perception and other mental heuristics individuals have a tendency to simplify. However, he suggests that subjectivity may be unavoidable and difficult to control. Reliance on subjective responses was alleviated in this study through seeking confirmatory evidence and multiple sources to corroborate responses (Larreche & Moinpour, 1983; Podsakoff & Organ, 1986).

Secondary data

The range of data conforms to Yin’s (2003b) list of six evidentiary sources with the collection of secondary data informing the overall picture of each case firm. Using information available in the public domain included documents collected from organisations such as company reports and marketing material. In addition, secondary data from websites and media reports provided support and understanding and enriched interview findings (Miles & Huberman, 1994).

Variations in secondary data occurred between case firms. Some SMEs have sophisticated and well presented websites and use social media extensively. Other case SMEs have websites simply listing basic details with little additional presence in the public arena. In the latter case, information was sought from the firm which was similar to that furnished by other case firms. In addition, sources such as information held by HERA supported comprehensive representation of each firm and consistency of secondary data.

Together the multiple sources increased confidence and hence data and interpretation validity and reduced dependence on interviews (Denscombe, 2003; Yin, 2003b). Participants’ receipt of interview transcripts increased accuracy and interpretation in analysis and write-up with each firm later receiving copies of their case study narrative for feedback. Interviewees advised of factual errors or inaccuracies and corroborated the data narrative, thus reinforcing data credibility.

5.5.4 Ethical considerations

In preparation for data collection, this study sought and received approval from the University of Auckland’s Ethics Committee. Two main ethical concerns relate to participants’ anonymity (firm and individual) and confidentiality of information. Included in the advice to the Ethics Committee was guidance on the conduct of the interview regarding use of a digital recording device and respondents’ right to refuse involvement at any stage during and after
the interview. In addition, the advice referred to respondents’ opportunity to receive a copy of the recording and transcripts.

Implementation of the necessary protocols for confidentiality of information resulted in the protection of firm and individual participants. These points comprised the primary purpose of the ethics application and subsequent approval. All participants received advice on the research and the ethics forms for completion before interviews took place with the advice revisited at the time of the interview to ensure understanding. All participants signed the consent letter assenting to the interview, recognising involvement was both voluntary and with informed consent.

5.6 Data Analysis

When it comes to analysis the view is that case data interpretation is less a science and more an art as reliant upon the narrative skill of the researcher (Fiss, 2009). However, application in this study of within-case and cross case analysis helped to distinguish patterns which in turn provided insights to support generalisability (Eisenhardt, 1989, 1991). Development of the write-ups built familiarity with each case as a sole entity thus permitting emergence and discernment of case-specific patterns.

According to Welch, Plakoyiannaki, Piekkari, and Paavilainen-Mantymaki (2013), the interpretive methodology views data as a “co-construct of meaning by the researcher and participant” (p. 251). The results in the analysis process to involve reading, re-reading, and reflecting on participant responses, as an interpretivist seeking to grasp the meanings (Gephart, 2004). Revisiting the data as collected resulted in the identification of common themes and patterns supportive of further enquiry and developed understanding of the phenomenon (Miles & Huberman, 1994). This allowed the case to tell the story, the gathering and considering of data consistent with the interpretivist ethos (Stake, 2000a).

This study adopted Miles and Huberman’s (1994) three stage analysis process: data reduction to select and simplify; data display to organise the data to support recognition of patterns and themes, and the third stage of drawing conclusions. Each step entailed iterative reviews of the data and returning to the conceptual framework to correspond data with the research question. Repeated consultation of the various constructs assisted consistency with research objectives while maintaining openness to alternative interpretations (Gilgun, 2011; Yin, 2003b). The conceptual framework guided data gathering and analysis to assess findings against the existent literature.
Application of the conceptual framework during data gathering and the analysis stages supported understanding, for instance:

- The eight practices (van de Vrande et al., 2009) guided recognition of each practice implications and the implications common across practices.
- The innovative SMEs' characteristics construct provided guidance on interpreting the data, leading to ascertaining the resource and behavioural impact of open innovation and the nuances thereof.
- Effects of engagement indicated by the literature assisted understanding the responses and facilitated further probing on organisational practice responses.

Field notes taken during data collection grounded the research and provided real time perspective that delayed analysis may have overlooked (Eisenhardt, 1989). The notes further supported the *in vivo* analysis steps, which included first level coding during initial reading of the interview transcripts. The initial coding highlighted data relative to the various constructs in the study framework. The second level focused on key words and concepts identified as pertinent from the literature (Farquhar, 2012). Data analysis consisted of examining, categorising, and recombining the evidence to address research objectives (Yin, 2003b).

### 5.6.1 Data reduction and discernment of patterns and themes

Two important functions occurred with writing up the case narratives. Firstly, the requirement for data reduction in order to tell the story of each firm focused data to information strictly pertinent to this study. This included frequent reflection and rendering the data into different matrices and mind maps to investigate alternative explanations (Miles & Huberman, 1994; Stokes & Perry, 2007). Reflexivity refers to the commitment of the researcher to reflect on their own bias, to actively reconsider the impressions, meanings and interpretations; to reorder and reassess data in conjunction with notes taken as a function of a reflective journal (Ary, Jacobs, & Raavieh, 2002; Stake, 2000a). Consequently, the case write-ups permitted capture of nuances within the context of the study while reducing data volume (Collis & Hussey, 2003).

Secondly, development of a descriptive narrative of the cases provided a wealth of details, the repeated revisiting of the transcripts improved accuracy in portraying the data and further revealing of patterns and themes (Fiss, 2009; Miles & Huberman, 1994). Combining primary and secondary data disclosed key words and phrases that served in later comparison with the conceptual framework (Denscombe, 2003). The comparative interplay between the framework - which embodies the literature - and analysis, disclosed insights to answer the research question, and of areas where the data provided novel or additional detail.
The process was supported by coding for patterns through careful clustering of the responses into themes and constructs (Fiss, 2009). Iterative mining of data at each step occurred manually with notations made of interesting and reoccurring patterns. The preference for manual data intervention (instead of a computer based program such as NVivo) resulted in intimate familiarity with the data and the distinguishing of consistencies and nuances. Prolonged immersion supported analysis, interpretation, and identification of themes leading to develop understanding of the implications of open innovation to the innovative SMEs’ characteristics (Eisenhardt, 1989, 1991; Padgett, 1998).

The individual case study narratives provided the foundation for cross-case analyses and further data reduction to refine results and assist generalisability (Eisenhardt, 1989; Miles & Huberman, 1994). Miles and Huberman advise cross case analysis helps, “deepen understanding and explanation” (p. 173). The application of the conceptual framework assisted the cross-case analysis (Eisenhardt, 1991). The steps taken during the within-case analysis furthered familiarity of each individual case by combining multiple sources of data, within case grouping for relationships, similarities, and differences to support the search for patterns and cumulative insights (Eisenhardt, 1989; Yin, 2003b).

Moreover, notations made during writing up revealed additional emergent themes and patterns (Miles & Huberman, 1994). The rolling analysis process converged with data collection, which required occasionally revisiting with respondents to clarify or seek additional information (Eisenhardt, 1989). The various data sources contributed to the case study write-ups to form a cohesive picture of the dynamics of open innovation in the SMEs in a repetitive process (Tellis, 1997). Tellis (1997) warns that the process is fraught with difficulty; especially loss of focus, however, awareness of these issues helped to moderate these concerns during analysis.

Another function of vigilance attended to internal validity concerns. Through consideration of rival outcomes or explanations of data and results during analysis and writing up stages, functions of the empirical design of this study, lent to data trustworthiness (Stokes & Perry, 2007; Yin, 2003a).

**Triangulation**

Creswell (1994) advises that qualitative studies typically involve bias, the values, and judgements of the researcher. Triangulation built the coherence of data, assisted data trustworthiness, dependability, and credibility through convergence of different sources of data, participant checking, and having rich thick descriptions (Creswell, 2003). Moreover,
drawing on multiple sources supplemented and extended the richness of the information (Collis & Hussey, 2003; Jick, 1979).

Adherence to a careful plan heightened strengths and diminished weaknesses, both paramount when in application of the case study approach. The research protocol and repetitive attention to case study concerns contributed to producing a comprehensive and sound study (Amaratunga & Baldry, 2001; Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2003b).

5.6.2 Drawing conclusions

As advised by Rudeson and Newton (2001) “generalisations are made on the basis of the particular data that have been observed and are tied to a conceptual framework which then leads to the elucidation of further research questions and implications for additional study” (p. 7). Hence, in a reflective, comparison process the research data were compared with current knowledge and also elucidated areas outside or lacking emphasis in the framework. Constantly cross-referencing the conceptual framework with empirical findings verified emerging ideas (Hak & Dul, 2010). The use of a conceptual framework to make sense of the data provides a “systematic study of particular phenomena” (May, 1993, p. 20) and is consistent with case study research in order to contribute to theory (Ridder et al., 2009).

However, this study proposes neither to test nor to build theory. The development of a conceptual framework employs constructs derived from the literature to illustrate what is believed to be the nature of open innovation in relation to innovative SMEs' characteristics. The conceptual framework, rendered as a figure, and the associated constructs are components that Sutton and Staw (1995) contend do not constitute theory as lacking the “why” (p. 376, authors' emphasis), although useful to demonstrate causal relationships. This iterates the aim of the study - to contribute to the literature on open innovation specifically in the SME context, providing insights to develop understanding (Ary et al., 2002). Understanding open innovation in the SME continues to highlight as lacking, suggesting further research is desirable (Brunswicker & Van de Vrande, Publishing October 2014; Spithoven et al., 2013; van de Vrande et al., 2009).

An additional objective of the study is to support open innovation adoption by practitioners. Van de Ven (1989) refers to the desire of business-orientated scholars to contribute to the business world in application of findings. As the author of this study is a businessperson and a scholar, the study aims to contribute to both theoretical and practical
domains. A research objective therefore, is to offer insight and work-in-progress understanding (Parkhe, 1993).

Chapter 6 next, presents the case SMEs’ narrative commencing with the smallest firm. The chapter considers the experiences of the six open innovation practitioners and the implications to engagement on their innovative SME characteristics.
Chapter Six
THE CASE STUDY FIRMS

This chapter presents the open innovation engagement experiences of the six case study firms. Stage 1 of the research identified candidate case study firms meeting the defined criteria; specifically, innovative SMEs actively participating in open innovation. During data collection, there was no eliciting of commercially sensitive information. However, the nature of the industry and topic led respondents to share firm-specific details. Therefore, anonymity of firm and individuals were prerequisites to facilitate the research and for ethics approval. Accordingly, the six firms and individuals are assigned labels and the descriptions limited to reduce identifiers.

Background

Older established SMEs of various sizes characterise the New Zealand engineering industry. The six firms are representative of the industry and range from micro-size (under 10 employees) represented by one firm; two small firms (10 – 25 staff), two in the medium sized category (30 – 60 employees). The last SME is the largest with just over 100 staff. Each of the individuals interviewed are directly involved in the innovation activities of their respective firms.

The engineering firms operate business-to-business (B2B) with other organisations as their customer. The 2008 global financial crisis and subsequent local and international recessions influenced the industry in general and specifically each of the firms within their areas of speciality. Consequently, the older firms (Firms A, B, C and D) have adjusted and redefined themselves to maximise efficiencies and develop their services to better meet changing market demands. Firms E and F relative industry newcomers yet are adjusting to accommodate changing economic conditions. The six SMEs attribute business sustainability and success to innovation, developing open innovation activities to complement internal initiatives and realise innovation objectives.

The two smallest firms (A and B) and Firm D services are primarily customisation work and specific engineering projects. Consequently, commercialisation of innovations is not a major objective of endeavours. Firm C offers similar customer-specific engineering services, however it is intentionally shifting to commercially orientated activities. Firm E offers a direct to market product: success is driving the development and enhancement of the offering to
realise further market opportunities. In regards to the largest case, Firm F, their standard provision undergoes tailoring to meet individual customer specifications.

**Case narrative structure**

The case descriptions commence with an overview of each case firm, the smallest first then each firm consecutively by size\(^{19}\). Following the overview is consideration of firm sources of innovation and description of each firm’s experience with open innovation. The experiences revolve around the key dimensions identified a priori and forming constructs of the conceptual framework.

### 6.1 Firm A: Micro SME (>10 staff)

**Overview**

The smallest SME is a multi-faceted specialist-engineering firm with considerable and well-recognised expertise developed over 40 years of operation. The firm serves within an important market niche offering a heavy forging plant, a large heat treatment service, machine shop, and metallurgical laboratory to provide a single location integrated facility. Customers gravitate to the firm attracted by their reputation for resolving tricky engineering problems others are unable to solve. Operating in a reactionary environment, the hard, the difficult, the under pressure jobs are therefore the ones most often worked upon.

Situated on the outskirts of New Zealand’s largest city, the rural setting lends an air of casualness echoed in the familiarity and friendliness of the staff. The rural location underscores the sense of informality in apparent contradiction to the innovativeness of the firm. The case interviews took place in the General Manager’s (GM) office amid surfaces covered with documents, engineering equipment, and computers. Interruptions were frequent as employees discussed work in progress issues with the GM. As well as interviewing both the GM and the Factory Manager (FM), an informal meeting with the staff took place in the lunchroom. Relaxed and forthcoming, the staff spoke of their experiences regarding the advantages and disadvantages of open innovation.

The GM is without artifice; his forthright manner encourages trust, preferring plain talking, and uncomplicated honesty. As an integral part of activities, he fills a multitude of roles from quoting on jobs through to overseeing and directly working on projects.

\(^{19}\) Firm size defined by the number of full time employees
Acknowledged as an industry expert, he embodies the innovative nature of the firm, recognised through NZ Business Excellence Awards nominations on several occasions.

The FM is second in charge; his responsibilities include scheduling work and operational activities. The firm operates with less than 10 staff, mostly well-experienced hands-on engineers, with apprentices supporting the senior engineers. Staff turnover is relatively low with some long tenured employees. The close-knit culture is evident in discussions of developments and innovation challenges that take place over “smoko” (morning and afternoon tea) in a collegial manner.

The firm has more physical capacity and scope required for current demand. The restrictions to growth, in the GM’s view, are attributable to some skill limitations represented by the low number and type of staff. He recognises the need to employ differently skilled engineers before securing new avenues of work that will offset the additional expense.

The GM is judicious in monetary endeavours funding developments from other income streams. A long established family business there are funds available without call on debt financing; the strength of the firm in this capacity helped manage the financial crisis of 2010. The crisis and other firm-external events resulted in the loss of key customers causing a restructuring. However, the firm has undergone several transitions to stay competitive through the years. Adopting new technology and equipment and continually developing their expertise keeps the firm abreast of market changes and re-energises the business. Although the changes are often subtle, cumulatively the offering is now radically different to Firm A’s original provision.

The firm has transformed from providing low skill-high volume services to higher skill-low volume. Driven by the transitioning overseas of the “easier” engineering work previously performed, the result is the ability to dedicate resources to more interesting and lucrative projects. The change also means fewer direct New Zealand competitors. Furthermore, there is an overall increase in professionalism with the advent of more sophisticated projects helping differentiate the firm from offshore competitors. The development of alternative practices and technological advancements in the industry however, means the firm - although sought after as highly specialised - is at risk as demand for such specialisation diminishes.

Firm A’s clients extend beyond the boundaries of the engineering industry to encompass many sectors. Their ability to perform when others are unable to solve a problem means that often price is not an issue; for the client finding a solution is paramount. Well-established
work practices, processes, and instituted systems ensure robust work ethics and close monitoring of activities. Overall, the structure, equipment, and facility provide a strong and distinctive offering reinforced by the SME’s hallmarks of flexibility and agility. While other firms offer one or more similar services, none provide Firm A’s overall machinery configuration, expertise, and experience. Furthermore, imaginative application by staff of the equipment is a competitive strength underpinning the firm’s ability to consistently resolve clients’ difficult problems, in the words of the GM, “the equipment lends itself to innovation”.

“With customers one way or another you do a lot of innovation… You’re doing your bit to help your customer and at the end of the day you help your customer, you help yourself” (GM). Since innovation is at the core of their offering, resources for innovation are, “freely available and considered part of the job” (GM). The firm considers time and expenditure on innovation always worthwhile and necessary for continual renewal. Constantly innovating services, improvements to techniques and manufacturing processes are core to the firm. Although innovation forms part of the business plans there is no specific budget allocation. The GM prefers to stay agile to take advantage of opportunities without reference to budgeting constraints.

The GM rates the firm as a first mover, introducing new products and techniques to the market. The success of innovative endeavours reinforces the GM’s reputation as an industry expert, in turn generating further work of this nature. There is a strong continuous improvement philosophy; all standard operating procedures are ‘live’ with constantly updated documentation. As the GM states, “innovation happens constantly every day, as part of natural in-built continuous improvement”.

6.1.1 Open innovation

Firm A regularly goes beyond closed innovation to consider external sources for solutions and opportunities. The GM recognises that survival necessitates looking externally to compensate for internal limitations: to access innovation-needed resources; increase knowledge, and up-skill staff. Acceptability is the word the GM uses, referring to the criticalness of adjusting and innovating to ensure on-going client acceptance. Generation and reinforcement of customer loyalty is a major incentive to open innovation as well as building “kudos” (GM). This refers to the enhancement of their reputation represented by the successful completion of open innovation projects. “I would like to think that is what has kept some of our customers coming back” (GM).
Firm A sees an overall decisive shift towards open innovation in the industry. Increasingly there is willingness to share knowledge among engineers and engineering firms at industry functions, partially in recognition of the shrinking market and that business existence requires collaboration at numerous levels. “It’s an open market and once upon a time it was harder for somebody to go behind another supplier but now with Google you’re kidding yourself, you really are. So you might as well be open and upfront” (GM). The firm’s perception of open innovation is as a complementary resource exchange and knowledge development. In the GM’s experience open innovation interactions challenge his own engineering assumptions causing him to reconsider, review and improve activities, “I have learnt something more, I’m that much the wiser”.

From experience, Firm A finds open innovation presents difficulties. The GM views open innovation is more often a longer-term investment than that of closed innovation, the value of internal initiatives more quickly realised. He advises, “external [open] innovation - time spent is consciously considered and more monitored. The same resource is not used for each: internal innovation tends to use more shop-floor resource where open innovation uses me as a resource almost exclusively”. The GM sums up the importance of open innovation to the firm as, “not always worthwhile dollar-wise, but from a mutual benefit point of view, definitely valuable”. When asked the internal innovation volume compared to open innovation, the GM expresses this as approximately 50:50. However, he warned, open innovation demands a higher resource commitment especially as arrangements depend greatly on the GM.

### 6.1.2 Sources for innovation

The GM explained the tenacity of the firm in identifying and utilising all means to achieve innovation success. Consequently, Firm A sources innovative ideas and collaborates with a range of entities. Figure 2 displays the types of entities and the depth of importance for innovation as per Laursen and Salter’s (2006) measures for gauging firms’ involvement in open innovation. As seen in Figure 2, prioritised is open innovation opportunities with customers, crucial to satisfying requirements and to constantly up skill. The GM states that the firm always pursues opportunities to innovate – particularly with a client. Moreover, other entities seek Firm A as an open innovation partner due to their reputation for results.

Essential to Firm A’s management of open innovation is upfront qualification of the other firm. The FM alludes to the challenge of ascertaining and discerning entities’ potential as sound partners, differentiating from others who may prove untrustworthy or unsuitable. The relational aspects of open innovation are particularly problematic, the key is, “qualifying
prospects upfront critical to success, identifying current and future value to minimise impact on resources” (FM). Although he finds partner familiarity minimises some impacts of open innovation activities.

**Figure 2: Firm A - Sources for Innovation**

The firm does not adapt its open innovation endeavours to suit different entities. Furthermore, while their tendency is to collaborate with familiar organisations, the firm does not restrict themselves to known entities. Firm A works with firms within and those reliant on the industry, and with competitors. Suppliers are the exception as the firm’s raw material requirements offer little reason for open innovation. However, on occasion when a supplier proposes an innovation, the firm will collaborate to realise the opportunity. Open innovation entities additionally include commercial laboratories and universities to develop innovative applications and processes. In addition, wide use of technical and trade press together with attendance at conferences and trade fairs maintain understanding of industry developments.

All employees are actively involved in innovation activities. The firm views this practice a normal activity due to the small number of staff. “Often we see ways to improve and innovate the jobs, this contributes to procedures, these are constantly evolving” (FM). Casual and social interactions among staff act as forums to bounce ideas around, solve issues, and discuss innovative solutions. One employee provided an example of Firm A’s effort to constantly innovate: “[we are] continually improving, for example 20 years with the same client. The product now is made very differently and much better quality than in the beginning. Prices, costs, constantly increasing so to maintain margin and keep quality we have to continually battle to find new and better ways internally and with others”.

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Interactions with a university are demanding a more structured approach to open innovation arrangements. The university claims ownership on all intellectual property developed during and as an outcome of any project, exacerbated by the absence of an intellectual property agreement. The GM voiced his concern that with the university owning the project’s intellectual property, why would he wish to liberally contribute his own without due recognition. The result is less openness and a greater desire to claim intellectual property contribution, resulting in friction an increasing prospect between the parties.

However, the GM grants that he is perhaps overgenerous in sharing his and the firm’s intellectual property, that this is standard practice. “We do it without even thinking about it, maybe if a new customer that I’ve never really dealt with before I have said ‘what’s in it for me?’. A lot of psychology goes in there”.

There is a high probability of communication difficulties when engaged in open innovation. When Firm A innovates with another engineering firm to solve a problem for the other firm’s customer a version of the “Chinese whisper”20 periodically arises. Firm A experiences this during conveyance and interpretation of information third hand. The misinterpretation can culminate into a delicate situation. The GM believes that it is preferable to hear the problems directly from the actual client, which the partner is reluctant to allow. The other firm may not have divulged to their client that they are collaborating with another party or fear Firm A will usurp the client and misrepresent the situation if permitted direct access. However, repeated interaction with the same partner builds familiarity and improves the firm’s relationship capability, overcoming such reticence.

Another point of difficulty with partners is the monitoring of open innovation activities in terms of agreed arrangements and deadlines: such monitoring considered beyond the resource ability of Firm A. The firm works on the premise that theirs is a small market, and the organisations with which it deals are reputable with poor and dishonest performers quickly known as such throughout the industry. The GM confesses – and the FM agrees - that the firm’s approach may be naïve and unsustainable and iterates timeliness for more formality in relationship arrangements.

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20 When numerous people share information from one individual to the next, errors accumulate as each person interprets the information. Often considered a metaphor for cumulative error and relates to the unreliability of surreptitious communication exchanges.
6.1.3 Open Innovation practices

Firm A determinedly looks to maximise the value from open innovation by employing the most suitable practices for their innovation objectives. Hence, with open innovation endeavours Firm A adopts practices that relate to the firm’s culture, restraints in staffing, financial ability, and other resource limitations. Under these criteria, the firm currently employs four open innovation practices: customer involvement, collaboration with the firm’s network and beyond, and external participation. Involving all employees is the only outbound practice employed by the firm. Absent are the practices of licensing-in and licensing-out. In addition, venturing is not applicable at this stage: the GM recognises that his time is already over extended, although considering future adoption of the practice. Conversely, rarely does the firm need to buy in R&D services. This practice is contrary to Firm A’s offering as a well-equipped engineering facility. Instead, the firm offers its facilities to a range of entities for the purpose of R&D including innovation testing by tertiary institutions.

The practice of licensing-out is under consideration, however the GM advises that as the firm currently lacks recognised IP their ability to license-out is limited. The GM also admits he is too close to assess the value of the firm’s intellectual property, he is keen to develop understanding in what he sees is a crucial source of revenue. Similarly the practice of venturing, explaining, “the people out there have the machines but not the vision, that’s something I want to explore when I have more time”. Investigation into the opportunities presented by additional open innovation practices is part of a new employee’s responsibilities.

Firm A is deeply involved with other New Zealand engineering firms, a local university and government organisation on a ground breaking open innovation project. Relating to the inbound practice of external participation, the group is developing leading edge research with strong export potential. Involvement with the group offers ample learning opportunities for future open innovation interactions and overall knowledge development for the firm. The experience adds to Firm A’s awareness that the relationship aspects of open innovation whether multi-party or a single firm interaction, are generally fraught and highly time demanding.

6.1.4 Open innovation engagement experiences

A micro-sized business, Firm A clearly has significant resource restraints especially staffing. However, long-term investment in equipment and sound finances compensates somewhat for resource deficiencies. This is important as, “open innovation heavily impacts
resources” (GM) referring to Firm A’s experience that costs present greater than the immediate or evident benefits.

Resource commitment for open innovation differs little between the various practices in the GM’s opinion. However, there are differences within initiatives as these are project dependent and relate to parties’ innovation objectives. Firm A refers to the resource cost incurred when drawing staff away from scheduled work in turn stressing existing BAU work. Firm A attempts to minimise disruption to BAU by factoring open innovation projects into work schedules. Scheduling and close monitoring of time and equipment partially addresses dividing scarce resources between BAU and open innovation. Treating open innovation as scheduled work helps ensure best resource allocation with resource expenditure generally documented. This is consistent with Firm A’s desire to try and “systemise different” (GM), despite the uniqueness of every open innovation project incurring different resource costs. The firm attempts to identify underlying similarities among projects to create a semblance of order to manage open innovation and reduce negative impacts from engagement.

If the firm lacks key physical innovation resources, investment in machinery only occurs if use is not unique to a specific event: otherwise the firm turns to another entity to supply such innovation resources.

Two types of open innovation occur in Firm A’s experience: urgent, rush projects and planned activities. Demand on resources for urgent ones is immediate, while factoring in the latter occurs over weeks depending on resource commitment and timelines. However, the strategy neither overcomes time lags created by open innovation projects nor the loss of regular business if the trials related to open innovation projects prove repeatedly unsuccessful.

Open innovation forces delays during machinery set-ups and when running innovation tests, usually of unknown duration. This includes others using Firm A’s facilities, an ideal use of the spare capacity as generally machinery is under-utilised - some running at only 20% of potential usage. Under-utilisation of equipment means innovation, whether closed or open, does not normally affect physical resources with the GM maintaining that the spare physical capacity alleviates open innovation impositions. However, as the firm is one of the last in New Zealand offering heat and forging, loss of equipment to open innovation projects limits BAU work in the same capacity with the inability to allocate equipment until testing completes.
However, Firm A’s employees disagree. They cite the lack of scheduled maintenance as an example. Often machinery will be trialling an innovative project; otherwise, the equipment is required to be available for BAU. Therefore, there is no allocated downtime for maintenance and servicing and they advise that without scheduled maintenance, machine efficacy is at risk. Yet, the employees admit that the variety and innovative use demanded of equipment by open innovation activities is worthwhile. Adapting machinery use and development of alternative usages offers opportunities to identify new applications for machinery, for example the development of innovative forging techniques. Reconfiguring equipment for open innovation further builds expertise, in turn increasing the firm’s service provision.

While the influence of open innovation is overall low in regards the firm’s physical resources, the impact on human resources is a different story. Employees are the greatest single cost to the business; close control of their hours is crucial. The firm has an unstated policy of promoting individual and organisational learning, which helps development of staff and improves work efficiencies. Open innovation experiences constantly up skill employees, the unaccustomed problems providing learning opportunities. Open innovation provides, “excitement and fun” (Engineer) with most employees considering open innovation personally rewarding. The diversity presented by other entities’ problems, which demand innovative solutions, provides stimulation therefore enjoyable additions to their roles. Another engineer is adamant of the importance to his job satisfaction, “the difficult one-off jobs are the most interesting, pushes me, innovating with others is the fun part”, often considered more attractive than routine work. Consequently, although keen to be involved, employees get exasperated when pulled off innovative activities to complete urgent, more mundane work. “This is frustrating for the guys, it has cost me good guys in the past” (GM) referring to some individuals’ difficulties with juggling innovation activities with routine projects.

Whereas the GM views open innovation activities do not require any overt adjustment to established systems and processes, some employees experience open innovation projects as an imposition. Employees refer to changes in the work routine imposed by open innovation projects as disruptive to job responsibilities and accustomed tasks, interrupting workflow. Some question the viability of open innovation, that it “doesn’t always mean the clients come back, innovation projects sometimes demand a lot of time but not paying or covering costs” (Engineer). What’s more, they advise, the subsequent innovation may solve what could have been on-going work, compromising further business in that capacity, “sometimes the
innovation may mean you’ve done yourself out of a job. But such is life” (GM). Furthermore, often the other entity primarily benefits from Firm A’s efforts rather than the firm reaping the full value of open innovation endeavours.

To reduce the impact of open innovation and to minimise disruption, the GM prefers to dedicate his own time rather than distract staff from BAU. Particularly in the instance of gratuitous open innovation work, additional people are involved only through careful selection. GM chooses employees that have “fire in their eyes” (GM), those keen to contribute their skills and build knowledge, thereby enhancing their own and the firm’s learning.

Open innovation projects distract the GM from active and potential routine business and can result in the inability of staff to access management when required. Employees refer to their frustration and desire to perform well thwarted if the GM’s expertise is unavailable, directly costing the business. Consequently, the GM’s preoccupation with open innovation projects adds pressure to the firm and at times forces job delays. Additionally, interactions with open innovation partners often mean the GM is physically absent, again adding further stress on BAU.

The FM expressed his chagrin that open innovation overly distracts the GM. He explained that the GM is attracted to the novelty to the detriment of BAU. Loss of focus risks jeopardising current and routine projects that would otherwise have the GM’s attention. Consequently, the FM views open innovation adds stress to the business. The GM is aware of his tendency to be distracted from BAU responsibilities. He also expressed concern that the extensive demands on his time of open innovation compromises other opportunities, that this is an unknown cost.

Another risk is open innovation endeavours not necessarily providing a return. Yet, the GM is emphatic that open innovation offers a greater gain than other organisational demands, “time spent in innovation, internal or external, generally I would like to think that the innovation time actually has a better return rate than quote time”. Consequently, although the GM prefers to spend time on innovation of all guises, he realises that this does not mitigate the need to continue chasing BAU work. He simply extends his work hours to meet all his responsibilities and believes that this is sufficient to meet obligations. From their feedback, staff may not necessarily agree.
Accordingly, and despite the firm’s extensive involvement with open innovation, the FM is not an advocate. He believes that it is timely to draw boundaries rather than continue to give away intellectual property and expertise. Whereas the GM considers freely sharing his knowledge reinforces and improves relationships and adds to his own learning.

The GM, in reference to his willingness to share his knowledge with other entities stated, “I operate a very, very open book.” He elaborates that he is generous with his ideas because, “if you kept close to your chest and then failed to do something with it, then there was no point keeping it close to your chest.” The informality of open innovation relationships reflects the GM’s desire to share and support others’ innovation objectives. In hindsight, this is not always a successful strategy, his inclination to work with all and freely share his knowledge he realises needs to adjust. Experience with the collaborative group emphasises timely reconsideration of how best manage future use of the intellectual property.

Until the group project the firm treated its intellectual property with nonchalance preferring to rely on trust and mutual respect. The dominant attitude tends towards sharing of knowledge and experience as a function of the business relationship. “People come to you because they feel they can trust you, they can… connect with you” (GM). Renown for his desire to attempt almost anything to help a client he often unhesitatingly shares hard gained knowledge. Sometimes to his and the firm’s cost, he confesses.

The employees agree that the firm to date has freely shared intellectual property. The only formal arrangements they are aware of are non-disclosure agreements occasionally initiated by clients. According to the GM, the lack of formal instruments has had likely financial implications due to lost revenue streams. An experience highlights the firm’s vulnerability through lack of protection. Sharing hard gained intellectual property with a collaborative partner resulted in the loss of a profitable income stream with the other party copying Firm A’s innovative process and offering it directly to the client themselves.

However, the GM considers arguing or defending the ownership of intellectual property restricts free flow exchange. The GM’s concern is that intellectual property developed for open innovation projects in isolation has no value, each entity’s contribution crucial to project realisation. The accumulative knowledge and exchange of ideas generates innovative solutions and contributes to endeavours to achieve an outcome not possible individually; free exchange of ideas and brainstorming essential to project success. Nevertheless, the issue remains of recognition and valuing the contribution of each party, therefore the appropriate allocation of reward.
The multiparty group is the firm’s first experience of formal contracts and the problems congruent with intellectual property sharing. Cumulatively the group’s intellectual property is developing a saleable product, however division of credit proving difficult to define. The FM views the issues as, “tussles over intellectual property - identifying boundaries and allocating appropriate recognition” which leads to the GM committing more time to manage the situation. The use of formal agreements and strict time measurement with each party’s contribution monitored now essential to ensure reciprocal value and reward for contribution. Disbursement of revenue relies on the university who will monitor and allocate income, which in turn depends on the university’s sales success. This requires extensive trust by group members who are not privy to contractual arrangements.

The multi-party open innovation collaboration has direct financial implications, particularly onerous for a small firm due to the requirement of sizeable upfront monetary contribution. The early commitment of funds strains financial resources resulting in the unavailability of finances for investment in projects offering more immediate returns. The knowledge of delay, or any return at all, for such a speculative venture accentuates the FM’s concerns. However, as the firm owns the plant and other physical assets the strain is manageable at this time, although the GM is aware of the opportunity costs. Yet, the attraction remains; the project is potentially highly lucrative with the additional income aimed to fuel future expansion.

Firm A reports of the high resource investment of open innovation arrangements. The requirement of managing multiple agendas, differing firm cultures, attitudes and objectives, and extensive delays impinge on the resources and routine activities. The majority of the demands are time-related, for instance, waiting for one of the other parties to perform their designated task. Regular and frank meetings help to address some issues, as is agreeing on a strong strategy. The GM states disagreements on direction and leadership are further difficulties, negating engagement effectiveness. Nonetheless, access to the knowledge and experience of others and the experience derived from open innovation projects are highly important to the GM and firm’s learning.

Open innovation requires a vast amount of time in Firm A’s experience. The GM’s time predominately to manage the process, the relationship arrangements, and interface aspects to ensure the firm gains value. The FM emphasises the GM’s concern that; “time must be the biggest issue”. The firm constantly assesses the time dedicated to open innovation projects, broad experience permitting them to rapidly recognise if overly time or
resource demanding. If apparent that resource expense is increasing, reassessment of the project becomes necessary to mitigate pressure on the firm.

While open innovation heavily influences labour and time in Firm A’s experience, the firm disregards the high cost in light of the overwhelming benefits ranging from developing organisational efficiencies, process improvements, and innovation realisation. Furthermore, an unexpected bonus is staff gratification from being involved assists retention. Another important contribution according to the GM is that the novelty promotes fresh thinking and receptivity to change. Therefore, open innovation benefits are not always evident in terms of income; knowledge development and firm reputation advantages particularly attractive features of open innovation. In the GM’s opinion, the tangible benefits of customer satisfaction and continuity in financial income due to on-going client loyalty reduces the impact of negative aspects. He states that open innovation and innovation in toto challenges the firm, its equipment, and especially the employees, constantly building expertise.

The FM highlights the group project illustrative of his concerns. He questions the ultimate and interim value of involvement, yet appreciates that the GM and firm directly benefit from the knowledge gained and the potential long-term reward may be considerable. However, although relatively negative about open innovation, the FM confesses that open innovation activities enhance learning, hence the firm’s expertise and underscores the uniqueness of their offering. For the GM, open innovation provides a direct personal benefit despite the added pressure on an already stressed and heavy workload, “there’s a bloody lot of heartache... But I would much rather be doing it than not because it gives you a sense of pride and achievement and identity.”

6.1.5 Summary

The GM qualifies his perspective of open innovation that, “there’s learning benefits, the cost to resources balanced by the opportunities that you receive and the time invested. I can take that learning and put it into our systems”. Consequently, in response to whether engagement is overall worthwhile, he maintains open innovation is critical and, “no way has it hampered our business or our growth” (GM). Firm A considers open innovation definitely contributes to innovation capabilities and realisation of innovation, while of average direct benefit to profitability. The transformation from closed to open innovation continues to prove valuable to the firm: transitioning to greater openness improving the firm’s offering and competitive position.
What tempers Firm A increasing open innovation endeavours is developing awareness of their intellectual property value and managing their knowledge resources. With the firm’s growing open innovation experience comes the realisation that freely sharing intellectual property is not as beneficial as previously considered. Additionally apparent is the necessity to improve measurement of the resources committed to open innovation.

However, the consensus is that ultimately, open innovation is worthwhile and foundational to the firm’s reputation and business continuance. Nonetheless, open innovation imposes on resources is undisputable in Firm A’s view. The overarching view the single greatest resource most affected by open innovation is time, directly imposing on the GM and indirectly on staff through delays. In general, Firm A considers the benefits predominant and negatives of lesser consequence with the caveat that this remains true while they have spare physical capacity. Parallel to the experience of open innovation as heavily resource demanding is the perception that open innovation versus the return on resources invested is difficult to quantify. Even so, the expectation is the continuance of existing practices and expansion to include licensing-out, and venturing opportunities, and increasing outsourcing of its facilities for other entities’ innovation endeavours.
6.2 Firm B: Small SME

Overview

A small mechanical engineering business, Firm B provides after-market modifications and customised solutions, exploiting a niche in a market that has primarily shifted offshore. Taking advantage of a niche is proving an effective strategy with the smallness of the market neutralising competitor threat. Having traded for 20 years at its current location in a small town’s industrial area, adjunct construction of new premises will improve facility configuration and overcome current physical constraints.

The firm has repeated success in developing new, significantly improved products, processes, and realising improvements in organisational functions. In the drive to continually improve, the firm proposes innovative developments to clients who often enthusiastically embrace ideas, working with Firm B to realise greater flexibility in output and cost reduction. “We try to drive prices down all the time. Building cheaper means happier clients which means more work, more R&D, more innovation to keep costs down. You see the cycle?” explains the Owner.

The success of their specialty attracts clients from throughout the country. Enthusiasm for finding solutions to client problems and offering ideas to improve use has resulted in numerous client-orientated practical and functional innovations attributable to the firm. In addition, the firm takes advantage of extensive experience of speciality projects to develop innovative improvements to internal processes. Subsequently, Firm B has undergone numerous refinements to dramatically improving their services.

Running the business is primarily the responsibility of the Owner supported by an operations manager and office manager. The Operations Manager (OM) complements the Owner’s managerial style contributing a different perspective and work practices. The OM is one of 15 staff, an increase from 12 employees three years ago. The growth in staff numbers reflects the firm’s success and consequent increasing demand for their customisation work. Firm B’s offering is highly labour intensive, the work often “one-off” customisations. Each employee develops expertise working on bespoke tasks; the expertise readily spread amongst staff to develop the firm’s overall knowledge.
The decision to become more manufacturing orientated in 2007 led to the adoption of Lean\textsuperscript{21} manufacturing: improving efficiencies through the development of processes that closely monitor all facets of the business. In addition, the Lean discipline encourages the creation of manuals documenting each project including developments, innovations, and overall work improvements. Visual documentation using photographs, drawings, and pictorial lists of components permits employees to fully appreciate project facets. Having project details results in time and cost reductions on similar projects and greater efficiencies. According to Firm B, the capture and accumulation of knowledge well recompenses the considerable effort required to maintain manuals.

The interviews took place in the firm’s lunchroom amongst kitchen facilities, with a white board and technical drawings jockeying for space. Throughout the interviews, the predominately male staff walked through to adjoining rooms in a courteous manner to minimise interruption.

There is justifiable pride in what the firm continues to achieve despite the firm’s small size and the smallness of the market niche. Faced with the demands of sustaining a small firm, the Owner heavily invests his time, energy, and knowledge into managing the business and willingly considers any opportunity supportive of the firm. However, as the key driver and manager of the business he is severely limited in time. In addition, hampering growth ambitions is the Owner’s imminent retirement with no family member claiming interest. He has the conundrum of growing the business sufficiently to survive, while desiring to realise opportunities to thrive, yet within a limited time.

6.2.1 Open innovation

Firm B has two areas crucial to business sustainability: efficiency of operation and continual product improvement. Open innovation is an outcome of the desire to maximise realisation in both areas. However, foundational to the firm is customer satisfaction: subsequently, customer retention. To maintain the reputation for expertise requires constant innovation and realisation of innovative solutions. The firm’s ratio of internal to open innovation is approximately 50:50 with resources invested of similar weighting. Short specific runs mean that often innovations developed during one project are not directly transferable to another unless the firm secures a similar project. The client drives much of the innovation expressly through requirements, or through the firm’s identification of improvements for the customer.

\textsuperscript{21} From the Lean website (www.lean.org) lean at its core maximises customer value while minimising waste: “lean creates more value for customers with fewer resources”
With continuous renewal fundamental to endeavours, Firm B constantly searches for new knowledge to develop their provision. Principally, innovation is necessary to meet customer demands and overcome challenges with equipment modifications. The OM finds that open innovation offers many opportunities in conjunction with other entities to develop his and the firm’s learning, improving processes and organisational innovations. According to the firm, open innovation provides the resources simply not available internally and the ability to access required knowledge to achieve innovation objectives. The use of external expertise and access to another’s R&D operations are important advantages of open innovation and complements internal activities. The initiatives improve and occasionally revolutionise internal methods: the increase in knowledge coming directly from open innovation endeavours and indirectly through exposure to others’ work styles and processes.

Primarily product innovations occur within the firm’s boundaries whereas process and organisational improvements happen through open innovation engagement. The Owner sums up the need to seek outside sources to support innovation as, “delivering this [innovation], we need knowledge, we don’t have the time, or the knowledge. We could probably acquire in house eventually, but takes too long”. Open innovation also minimises the risk of over investing in the business, the Owner draws on external sources to continually innovate the firm’s offering and support effective use of resources.

**6.2.2 Sources for innovation**

According to the Owner, Firm B is “always looking for ideas and for better ways of doing things”. However, the firm is selective with whom it engages. Firm B’s preference is to work deeply with a few entities, focusing on organisations that immediately offer innovation benefits. The firm constantly searches for entities keen to collaborate and proactive. Entities do not include firms external to the industry, R&D laboratories, and tertiary institutions as detailed in Figure 3.

The Owner and OM’s techniques differ when seeking external sources for innovation. The Owner favours known business and personal contacts. The OM instead searches extensively to identify suitable entities with the resources to realise innovation objectives, “we do it [innovate] in-house if we can do, but we can only go so far… sometimes we try but then find someone who can do it more efficiently than us, so we work together” (OM). He advises that it, “takes a long time” to find the right people for open innovation with his selection criteria relating to innovation need-fulfilment. A further stipulation for the OM is the importance of flexibility in the other entity, flexibility providing fertile ground to develop
innovations collaboratively. The OM is concerned with, “finding the right people to start with – takes a long time to find the right people”.

Figure 3: Firm B - Sources for innovation

The OM generally starts by asking around the firm’s network for referrals, he “keeps fishing around and asking, eventually you find someone... a bit of a word of mouth thing”. If the network fails to supply a suitable entity, he ventures further - often turning to the Internet to locate potential partners. Known for his radical and lateral thinking, he draws on corresponding manufacturing concepts to secure novel approaches. He gave the example of approaching a local manufacturer that makes equipment for the trotting industry. He investigated application of their manufacturing technique to a challenge experienced by Firm B, unfortunately ultimately proving unsuitable.

Nevertheless, Firm B prefers to innovate in the first instance with familiar entities. Drawing on an established relationship means common understanding and appreciation of each party’s priorities, communication styles, and work methods: collaborating with known entities translates to simpler and less time demanding interactions for the firm. “You mainly end up dealing with people you know” (Owner). The Owner frankly admits that he operates with people he likes and trusts - notwithstanding that he sees this appears, “a bit provincial. But that’s what I prefer” and help avoid unpleasantness. The OM relates to the problem of unpleasantness and partnership difficulties to emphasise that relationships are time demanding and require appreciation of divergent work styles to support engagement.
Consequently, the degree of partner familiarity, the firm finds open innovation arrangements are often fraught with communication and priority issues: issues that demand preventative vigilance with frequent interaction necessary to confirm understanding. In order to operate effectively, timelines and activities are linear so that each party has adequate time to complete their input adequately, “development takes a long time…. they have things to do, you can’t rush them, very slow process, have to nudge them on all the time” (Owner).

In the firm’s experience, suppliers in general are not overly proactive. However, some suppliers offer innovative opportunities to which the firm readily responds. In the Owner’s words, he welcomes “anything that will improve or help efficiency, especially labour”. The firm aims for mutual benefit and exchange, and shared innovation objectives. The expectation is that expressing this upfront overcomes the need for contractual arrangements between Firm B and the other entity. Firm arrangements therefore lack formality regardless of the familiarity or unfamiliarity of the entity.

Vital also to the firm is the need to identify the other entity’s limitations to pre-empt issues and address potential problems. The OM views the interactions with others during open innovation to be, “entertaining… keep it as light as possible so they want to work with you. If you are more approachable they are more accommodating, want to help you. Big sticks don’t work, just makes it more difficult.” He alluded to keeping things between parties amicable and interesting develops trust and builds the relationship. He confessed that time required for open innovation process especially relationship management is continuous and critical.

6.2.3 Open innovation practices

Firm B engages in four practices: customer interaction, collaborating with external network, outsourcing R&D. In addition, the outbound practice of involving all staff in innovation: well recognised is the revealing of innovation opportunities through intimate involvement in daily work. Consequently, the firm encourages staff to suggest and trial ideas with regular meetings a forum for sharing innovative suggestions: employees offer up insights to improve client work and process efficiencies. Even though some have difficulty contributing, employees continue as a prime innovative source.

The other three open innovation practices are critical to bringing in needed innovation resources with customer involvement dominating innovation initiatives. The drive to meet customer requirements develops the firm’s knowledge of client product usage and issues with current units, in turn motivating innovative solutions. The Owner advised that the firm often
improves equipment functionality for customers through knowledge sharing, collaborating with other entities at times to realise the innovation. Importantly the need to increase efficiencies and manage costs also prompts innovation, “anything we can do to make the job easier we’ll do” (Owner) with ease of work equating to lower cost. Importantly, Firm B’s successful innovative provisions enhance client relationships and client loyalty.

Use of another’s facilities for R&D to develop innovations reduces the requirement to commit scarce funds to one-off equipment and expertise. The ability to call on another’s facilities can realise an innovation with greater rapidity and at less cost. There is also the additional bonus of access to others’ knowledge and expertise in turn assisting knowledge development of Firm B. Although valuing others’ expertise, they themselves do not consider possessing any intellectual property of commercial viability for licensing-out. The perspective is that innovations generated by the firm are client and project specific therefore lack wider relevance.

6.2.4 Open innovation engagement experiences

Juggling routine demands with the necessity of developing innovative solutions requires continuous decisions on optimum resource usage: an unrelenting challenge common to SMEs. Ardent monitoring of resource usage is essential to minimise waste and maximise output and a function of Lean. Furthermore, until recently, Firm B has not committed financial capital to procure equipment for open innovation activities. This is changing with some capital allocated to open innovation projects. However, consideration of any financial outlay relies on the value continuing beyond immediate application.

Firm B manages its physical resources closely through using dedicated fully equipped bays, which has dramatically improved work efficiencies. Allocation of a project to a bay improves workflow and limits disruptions. The firm’s planning and scheduling includes allocating each job with task specific activities and the appropriate resources contained within a bay. Open innovation activities usually relate to a specific project with any innovation therefore within the designated bay. Isolation of each project helps monitor resource usage and minimise any interruption that may occur with internal and external innovation delays. Should a project delay be extensive the physical components can be broken into modules and stored elsewhere until resolution. Reallocation then to another project of bay and staff then is possible.

Customisation work is labour-intensive making labour the highest cost to the business. Time sheets monitor this cost with Firm B constantly reviewing operations, particularly any
improvement in staff deployment and operational efficiencies. While open innovation can be disruptive to staff routines, generally, the firm finds the stimulation and novelty offers employees a break from routine and assists retention. However, adjustment of employee habits is a constant challenge.

While the work is fundamentally innovative, staff preference is for routine and for innovation generated internally. The Owner expressed frustration that this is not always an effective method to reach solutions. In reality, he has often found it easier to achieve innovations in collaboration with another entity than force through internal change. Employees often need convincing and some show a lack of initiative, both preventative to staff trialling concepts and adopting innovations sourced through open innovation. Accordingly, the firm has developed techniques to overcome staff resistance, although changing routines is a constant challenge.

Change can take considerable time when introducing innovative adaptations or improvements to routines. One practice found effective to address reluctance is the application of visual tools, showing workflows and work practices including application of innovative developments acquired from external sources. The organisational practice supports adoption of improved routines and acceptance of introduced innovations from open innovation. Another is addressing staff reluctance through internally developing prototypes and working models. Although incurring costs and delays the practice is worthwhile to clearly demonstrate the innovation limiting complications and misunderstandings. However, it requires employment of highly skilled people and the right equipment, additional costs for the SME, yet essential to achieving favourable open innovation outcomes.

A major constraint to Firm B’s open innovation endeavours is the lack of management time. The onus on both Owner and OM to manage open innovation relationships heavily depends on time availability amongst BAU responsibilities. Amongst time demands is the need to continuously monitor the other party: monitoring critical to ensure the necessary actions are propelling the project forward. The firm advises that a key to success is connecting with the right person at the other organisation making a dramatic difference to the other entities willingness to innovate, reduces issues, and improves results.

Firm B finds that others in an open innovation arrangement may not appreciate that there is some urgency, or the other entity discovers that the innovation is not directly relevant to their objectives and so lacks priority. The Owner of Firm B manages potential discrepancies by frankly asking the other party for their expected time line. If the response
does not meet requirements he looks elsewhere or he doubles the time required as, “it always takes longer when collaborating with someone else”. From experience, factoring in extra time affords greater accuracy when assessing overall project duration. Subsequently, the firm purposely extends timelines to compensate for open innovation through familiarity with partners not meeting commitments or providing unrealistic deadlines, which are then not adhered.

Firm B monitors external and internal delays through detailed worksheets. Management reviews the worksheets to furnish the necessary actions in order to compensate accordingly and build greater efficiencies into the system. However, this often increases pressure on internal resources. Incorporation of delays into overall work schedule is a product of Lean manufacturing activities and assists developing transparency of project costs.

Notwithstanding experiences of communication issues and delays, legal instruments are rarely utilised for open innovation projects. Firm B considers the use of contracts unnecessary and an additional expense in terms of time and money; however there are contracts for large jobs. The OM takes a slightly different perspective. He suggests that the services offered are not straightforward so imitating or attempting to replicate are commercially unviable. He views the difficulty and expense of copying the firm’s activities negates the need for legal protection. “What we are doing isn’t easy anyway. If they [the open innovation partner] want a crack at it, well, good luck to them and see if they can make any money out of it” (OM). Another concern regarding open innovation is the opportunity cost incurred in extensive innovation development processes. For example, income losses from missed BAU work when a lengthy open innovation project monopolises Firm B’s scarce resources, particularly labour.

However, organisational processes benefit considerably from open innovation according to both the GM and OM. Constant and cumulative process improvements result from engagement. The firm assimilating the learning gained during interactions with collaborative partners has led to a multiplicity of improvements. Notwithstanding some internal hindrances at times, overall one of the firm’s competitive edges is its ability to remake itself to meet changes in the industry supported by open innovation.

6.2.5 Summary

Open innovation activities provide the crucial inflow of knowledge and resources in order for Firm B to continue the provision of their services. The ability to tap into others’ experience and facilities helps minimise costs and achieve innovations that the firm would
otherwise be unable to realise. For Firm B two of the greatest constraints with open innovation are the reluctance of staff to adopt, the other is time, time required to identify, develop, and manage open innovation relationships, and time to manage internal acceptance. In addition, there is pressure to continually develop relationships and relationship efficacy. Deference to familiar partners reduces the extensive relationship demands. However, the firm will search elsewhere if known entities lack the required innovation resources.

Both the Owner and the OM are adamant that open innovation is critical to realise Firm B’s innovation objectives and to sustain the business; the negative resource issues they see as secondary to the benefits of engagement. The detrimental aspects are negligible in comparison to securing internally absent resources and achieve innovation, the firm instead developing compensatory methods to manage disadvantageous effects. When it comes to the tensions of meeting both management responsibilities and open innovation demands the OM laughingly responded that he, “just simply works harder and longer” in order to meet objectives. Looking to the future, Firm B will continue to maintain, possibly even increase open innovation activities as proving effective to achieving innovation objectives.
6.3 Firm C: Small SME

Overview

Firm C is a small highly ambitious company offering precision engineering services, the firm presents as an innovative future-oriented business. Recognising the advantages of targeting a niche market, the firm’s radical innovativeness and attention to detail resulted in attracting the attention of multi-national enterprises and government organisations. Consequently, despite their small size, international prestigious brands populate their client list. Firm C has a history of meeting precision engineering challenges since 1960 with numerous certifications recognising their uncompromising commitment to quality and accuracy.

The founder earlier established an innovation legacy years to position Firm C as an industry leader. Firm C’s pioneering developments support periodic reinvention to meet changing market conditions facilitated by the continuing vision of management. The firm’s specific skill sets, and configuration of equipment contribute to determine the success of firm’s engineering competencies. A function of rejuvenation, the ambitious expansion into specific componentry during the 1970s secured a large international organisation as a client. The ability of Firm C to meet the high standards of this client led to further opportunities and established the firm as a benchmark of excellence. From Firm C’s experience, few other New Zealand firms have the ability or wherewithal to meet the exacting compliance requirements stipulated by these major international firms.

The firm’s innovations extend beyond developing client-orientated provisions. Firm C has a range of in-process and upcoming innovative projects, which they intend to offer to the greater business environment. To date, six patents represent their innovation initiatives. Patenting is an expensive exercise for a cash-strapped small business, however the firm justifies the cost due to the commercially sensitive nature of the innovations. Furthermore, they view patenting is necessary to permit licensing-out and sale of the firm’s intellectual property. The firm considers licensing-out key to securing income for reinvestment in further innovative developments. As the GM states, the firm is “trying to raise a bundle of cash without selling our souls to do some real cool s**t projects” otherwise hampered by resource limitations.

Success of its innovation activities translates to their moving away from the short-run precision work that built its reputation. The success of the innovations is generating growth-orientated strife with the increasing demand for their services requiring process alterations to
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overcome bottlenecks and cope with larger volumes. The growth profile of the business has attracted support from the New Zealand Government to address bottlenecks in the production system hampering up scaling. Additionally, the repercussions of a sizeable bad debt limited infrastructure investment until recently, the business working its way out difficulties through exemplary effort.

The small management team work closely, complementing each other’s activities and supportive of overall performance. Sited on the industrial outskirts of a large city, the engineering workshop and production facility dwell in two buildings. There is strict adherence to functionality of layout for optimum workflow and to comply with international safe operating standards. Traditionally Firm C currently employs 27 full time staff, predominately academically trained at tertiary level. The majority of employees are in manufacturing; the next largest group is in quality assurance, reflecting the firm’s dedication to this crucial aspect of the business. Quality assurance, continuous improvement, and benchmarking best practice are hallmarks of Firm C.

As a family business, the General Manager (GM) is highly responsible and dedicated to evolving the firm’s success. However, the GM - the son of the original founder - expressed some diffidence about his managerial skills, concerned he may not currently be fully adequate to guide the next phase of growth. Recognising his need to up-skill, he is investigating options to change the business model and personally improve his management expertise to better realise the firm’s potential. Part of his concern regards the firm’s naiveté in a number of innovation-related areas, although he shared that naiveté is not always a fault. The success of innovation initiatives he attributes on occasion to, “we didn’t know it can’t be done”. However, from an engineering perspective the firm is conscious of numerous blind spots potentially limiting ambitions.

Not surprisingly, the firm rates itself an active innovator. It has introduced products and services both new to the firm and new to the industry over the last three years. There is an annual innovation budget with time reserved to pursue innovation-based opportunities, although there is no specific R&D department. In addition, continuous development of new processes and innovative improvements iterate innovation locates at the centre of activities. The GM rates the firm as a first mover amongst its peers: there is an active policy to research and gather knowledge through industry and other media publications, attendance at trade shows and conferences.
The firm appreciates that introduction and development of innovation is not straightforward. Often innovating causes other issues as, “it shotguns across a whole load of things” (GM) referring to the changes that inherently accompany innovation - changes not always appreciated by staff. Nevertheless, the consensus is that innovation is imperative for the firm. Innovation keeps the firm ahead of competitors, provides new and improved processes, increases efficiency, and maintains its prestigious reputation.

6.3.1 Open innovation

Closed innovation accounts for 40% of the firm’s innovation efforts, “you still rely on closed [innovation]” (FM), with the remaining 60% dedicated to open innovation endeavours to stimulate and support internal innovation activities. Open innovation provides access to knowledge to, “build up a wall of information” (GM), building knowledge the main open innovation driver. “We’re out there looking for methods of excellence... find out what they’re doing differently to what we’re doing” (GM). Firm C recognises that their greatest limitations relate to knowledge-deficits and other innovation-critical resources not available internally. “We are very active at realising that we can’t do everything so we may as well specialise with what we are doing and work closely with other people, collaborate and there will be more collaboration to come. [We] want to go into businesses and observe” (GM) with the aim to evaluate different thinking, approaches, and operating methods for potential internal application.

The Factory Manager (FM) partially apportions the firm’s shift to open innovation to the difficulty of finding the right people. Two factors impinge on this handicap: loss of the government supported apprentice scheme, and people moving into technology industries instead of manufacturing. Consequently, “we’re having to bring in knowledge, or find it ourselves – you can’t rely on the knowledge within the company otherwise you’ve almost got your blinkers on then to new ideas. We try to find partners or people who share their knowledge to get extra ideas on projects” (FM). He elaborates that, “we can’t be expected to know everything - no one knows everything”.

An example of the drive to secure appropriate knowledge is the decision to streamline the factory based on the GM’s recent overseas excursion. He met with potential clients and prospective open innovation partners, site tours providing opportunities to inspect different facility layouts and work processes. Knowledge of operational variations gathered during the trip is instrumental to the firm trialling reconfigurations to increase efficiency and resource usage. The Factory Manager (FM) advises that the GM could assess, “what was working for
bigger, more efficient companies and what wasn’t, so that we can look to not make mistakes when we set up manufacturing areas”.

6.3.2 Sources for innovation

With innovation knowledge accumulation a key driver for open innovation, the firm calls on whatever source, wherever and whenever available. “I have ideas that come from the Internet, talking a lot to the likes of NZTE\(^{22}\), watch videos from the Society of Manufacturing Engineers in the USA, and things like that. A lot of people have been down that road [of ignoring chances], we don’t want to make the same mistakes,” (FM). Hence, Firm C is always open to innovation and enhancements emphasising that these originate from anywhere. Nonetheless, to take advantage of any opportunity, “you have to be humble to learn”, explaining the GM’s appreciation of the development of knowledge arising from experiences with other entities. Therefore, Firm C looks to a variety of organisations and sources for innovation (Figure 4). The preference is for overseas partners to limit immediate intellectual property exposure to local competitors as well as greater novelty of innovative ideas.

However, the firm does interact with parties within New Zealand. In addition, Firm C views financers and venture capitalists help better pursue innovation opportunities. Rarely does the firm collaborate with tertiary institutions, from the firm’s perspective, academia and business conflict with, “[an] utter lack of connection between the two” (GM). In spite of this, currently the firm is part of an innovation group that includes a university.

The firm undertakes considerable research before collaborations. The key innovators at Firm C have several different approaches when sourcing entities for innovation. GM defaults to known contacts and asks directly, or for suitable referrals. The FM favour firms with websites; he will not make contact until he has researched the entity on the Internet. Additionally he has strong relationships with previous colleagues with which he works closely in the first instance. He then compares results of different search methods to establish the best entity to approach.

The firm also joins one or more of the many online engineering forums to draw on diversity of expertise. During interactions, the firm finds it unnecessary to divulge much intellectual property in order to receive answers. Instead, they use leading questions then proffer a range of possible solutions. Others hearing the questions and options provide

\(^{22}\) NZTE: New Zealand Trade and Enterprise, a government organisation.
feedback and share viewpoints. The flow of ideas is multi-directional; Firm C is not intentionally Machiavellian. Instead, they contribute to discussions and offer their thoughts to the benefit of others.

Figure 4: Firm C - Sources for innovation

Consequently, while the firm in the first instance preferences known partners for innovation, they are willing to search widely for alternative sources. As an example of the firm’s commitment to obtain knowledge wherever held, the GM described how the firm approached NASA for innovation-required information. Nine times NASA declined the firm’s request for information. Finally, NASA capitulated and asked why they wanted the information. Once the firm explained, NASA sent everything the firm had requested with the bonus that, “now we’ve got some contacts at NASA” (GM). Another example is the firm developing a very close relationship with a USA company. The two parties happily exchange information during open innovation activities, each party fully privy to developments.

Open innovation partners then contribute to Firm C innovation knowledge bank. As innovations develop there is an exchange of ideas, “a lot of bouncing around, it means it [innovation] happens a lot quicker, because they might come back and say hey we tried that two years ago, it didn’t work, so we actually focus very quickly” (GM). Consequently, the reciprocity of open innovation results in each party asking and receiving assistance as required. In the experience of Firm C, there is constant reinforcement of mutual benefit, “all
learning from each other in a good relationship” (FM). However, the firm receives constant reinforcement of the importance of closed innovation activities comes from open innovation experiences. Endeavours strongly emphasise closed innovation to qualify and maximise open innovation engagement.

A lack of formality dominates Firm C’s open innovation relationships although not for much longer. According to the GM, “this is an issue, a lot are informal, some formality needs to be brought in… we are a little naïve”. An experience two years earlier with an American university resulted in free revealing of Firm C’s concept to enable collaboration. The university exploited the idea to realise huge financial success. The firm is now more cautious using non-disclosure agreements to limit exposure.

6.3.3 Open innovation practices

The open innovation activities of Firm C demonstrate six, potentially seven of the eight practices. Practices range from of all staff inclusion to collaborating with other entities, and out sourcing R&D. The firm also engages in venturing and external participation activities. The only practice not present is licensing-in of intellectual property while prospects for licensing-out are currently under scrutiny. The GM confessed that there was an earlier attempt to license out their technology that proved unfortunate due to their practice ignorance. However, the plan is to reengage with this practice to realise the value of their patents.

The key practice of employee involvement is paramount to innovation activities to both identify and offer suggestions for innovation. The firm solicits staff for innovative ideas, process improvements, and developments; however, in actuality ideas are rarely forthcoming. With inbound practices, the firm develops innovations particularly with inter-industry firms and always with customers. Firms external to the industry and suppliers are of lesser importance, and rarely does the firm collaborate with competitors. A further inbound practice, that of external participation, is under development. Involvement in spinning out a new venture with an overseas firm to realise an innovation is stimulating the firm’s enthusiasm about similar practice opportunities. Likewise, the knowledge advantages of participating in a group project with other innovation-focused firms are highly valuable: the firm’s involvement already proving of value.

The use of another’s R&D facilities is an inbound practice of importance to the firm, using the resources of one of its major clients to develop innovative concepts for the same customer. It also provides R&D services to others, explaining that this is a major function of
their business. The external provision of R&D services is extremely valuable beyond the income generated. Additional benefits include brand enhancement and up-skilling of staff through exposure.

6.3.4 Open innovation engagement experiences

“We could do the innovation in-house, but there will be a lot of mistakes” (FM). The firm’s rapid growth accentuates their resource lack and the need for open innovation to meet the shortfall. However, Firm C realised through experience of open innovation affects that existing resources require effective management to fully benefit, the shortage of open innovation skills reinforcing difficulties. Subsequently, development of necessary management abilities is now imperative to improve success and employ best use of resources for future open innovation endeavours.

Open innovation seldom influences the firm’s physical resources. Physical resources are well utilised by open innovation projects and access to other entities’ resources complements Firm C’s equipment. The firm has some slack in physical resources further supporting closed and open innovation projects. In addition to accessing other’s specialist machinery as a function of open innovation, the firm benefits from cost reductions; innovations concluded from open innovation endeavours improve capacity without requiring investment in extra equipment. However, Firm C judiciously buys equipment for specific open innovation purposes if the return justifies expenditure.

Human resources are the most affected by, and derive the greatest benefit from, open innovation engagement. Managers are innovatively active including collaboration amongst themselves to build on and seize opportunities. However, particular issues experienced include having sufficient time for open innovation endeavours and difficulties with staff adoption of results. Some employees are more innovation-orientated, the differences between individuals’ innovation propensities quite marked according to management. Different work ethics, attitude, and appreciation of innovation lie at the heart of cultural division; for instance, some employees are more skilled in the identification and scoping of innovations whereas others view innovation as disruptive and contrary to routine.

Innovation resistance is therefore evident in Firm C. The firm experiences staff reluctance with adopting innovations introduced as outcomes of open innovation. Representative of the NIH syndrome, resistance embodies in the prevalence of myopic engineers reluctant to consider innovations generated from or with outsiders. The prerequisite to alter staff bad habits the GM considers an important part of the GM’s
function as the firm moves forward; yet doing so requires further investment of his already scarce and divided time. Yet, change is key to meet innovation objectives and to gain maximum value from open innovation activities.

Firm C attributes the very flat management structure to achieving more effective work processes delivered by open innovation activities. However, the firm appreciates that changes to the firm and its culture are necessary for growth. For instance, the lack of recognition of the individuals driving innovation is an area under consideration. The firm believes it is timely to formally acknowledge staff who introduce and champion open innovation endeavours through promotion or similar. Recognition in this form will change the company structure, the revised structure a major step in firm growth and important to drive innovation performance.

To address internal issues including adoption reticence and to assist assimilation of open innovation, the firm employs a range of organisational practices. Innovation champions drive open innovation through the firm and influence adoption - even surreptitiously if required. “There’s a team of us you could say are innovative that balances the people that come to work that aren’t” (GM). Another method has key people set up and run simulations utilising the open innovation sourced concept, beta testing to perfect adaption and integration. Testing regularly conducts outside of normal business hours to prevent workflow interruption, which allows the testing of various configurations in seclusion. Adapting systems first thereby demonstrates to staff the efficacy of the new arrangement. Firm C found taking this additional step effective to neutralise resistance, “the guys on the floor have no opportunity to bad mouth it prior to it even happening. We’re actually proving by doing” (GM). Experiencing the introduced innovation in action can excite staff as they observe the benefits for themselves.

The firm experiences management time one of the major casualties of open innovation. From the managing internal issues such as the innovation introduction process, which requires extensive commitment of additional hours by the innovation champions, through to partner identification, relationship development and arrangement, open innovation imposes intense time demands. Management copes by working longer hours, “for the few key people it costs them to be doing it, obviously extra time… it’s planning for the time and allowing for that time” (GM). The FM similarly advises, “if we don’t invest that time, we’re only ever going to be so good. It’s an extra burden but I don’t have the time during the day to do this stuff. That’s what out of hours is for. It’s worth spending that extra time on it”. For
instance, the firm’s success with open innovation endeavours requires the GM to employ methods to increase effective management of open innovation complexities. He plans to divest duties, particularly relinquishing more routine tasks to focus on innovation opportunities and develop potential partners.

The GM is categorical that open innovation depends on the relational aspect, “it comes down to relationships are key”, and “we converse. It’s a trust thing I suppose and an openness, and honesty” (GM). Relationships do not develop without serious commitment and long-term investment from Firm C’s experience.

Effective open innovation relationships require maximum transparency in all facets of the relationship and open innovation endeavours. The GM summed up the key to successful open innovation relationships as, “just being honest and straight up”, and to aim for consistency and integrity in all communications. However, relationship management is, “all a bit loose, discussion at the moment is that we need to organise” (GM). Relationships require investment of management time to identify, develop, and maintain partnerships. However, the FM does not count the time invested as costly, “it is personal growth as well... what cost can you put on education? It increases your sanity”. Similarly, the GM invests considerable effort in developing relationships finding it laborious at times, “quite tiring. I would rather be fishing than dealing with people.... but being able to talk to these people is a privilege”.

Owing to the different time zones, the majority of the communication between parties takes place after hours yet acknowledged as critical to build effective connections while demanding long and late hours. The GM finds the commitment worthwhile as it develops a closer personal connection, in some circumstances friendships as they share information on families, hobbies, and holiday plans. The various forms of involvement further develop firm relationship learning, the interactions constantly improving relationship skills.

There are neglected areas in the relationship structure. Monitoring partner performance and post collaboration review of partnerships are ignored due to lack of time and capability. Reviews are particularly desirable in the firm’s opinion, “we don’t actually have enough resources to do that. That’s part of what we want to start doing.... Hand things over that I can spend time analysing that sort of thing properly and formally” (GM). Presently, reliance is on “gut feel” (GM) that partners will perform and that selection is suitable until proven otherwise. If delays occur due to partner default, employees work overtime to compensate and meet deadlines. The open innovation objective achieved by
management intervention to simply “do what is required to achieve the desired outcome” (FM).

Although not directly attributable to open innovation activities, the division of funds across various demands - innovative and non-innovative - limits availability to meet firm objectives and open innovation initiatives. Insufficient funds remain the biggest handicap the firm faces in its growth and innovation-orientated aspirations. They suggest that improvements in relationships with overseas partnerships would occur if they could develop associations in person. Travel expenses, accommodation, gifts, and loss of management time due to absences cumulate in high costs to the small firm. The GM described tight finances restricting the duration of a USA trip to two days. The American firm was impressed that the GM was prepared to travel so far for such a short period. They then made every effort to maximise the value of the GM’s visit, together achieving more than otherwise expected, especially in terms of knowledge development and exchange.

Critical to the firm is the opportunity to build knowledge resources and access information divergent to their own through open innovation. Parallel to amassing open innovation-sourced knowledge is that the wealth of information requires careful management. Organisational processes are currently limited in terms of capturing the integral components of open innovation project outcomes. The firm anticipates a customer relationship management (CRM) system will help. Additional investment extending the CRM programme to capture knowledge as well as systems improvements.

Unexpected by Firm C is the requirement of the firm to demonstrate leading edge practices - to be an innovation and business exemplar - to attract and reassure partners. Fulfilling the expectation found necessary to qualify for and realise projects by open innovation partners and clients alike. The expectation beneficially influences firm resources while exacerbates the stress on others. Constant improved use of machinery is one positive, the pressure on staff to maximise performance less so. Consequently, Firm C mandates vigilance for opportunities to constantly improve performance, processes, and systems to optimise the business. Such efforts are worthwhile. The firm attracts new clients because of successful endeavours. The more open innovation projects the firm engages the greater the number of additional opportunities congruent with continual augmentation of their reputation as a sound open innovation partner.
6.3.5 Summary

Open innovation equates to survival and realisation of growth for Firm C: “it has actually allowed us to stay alive through three years of tough business. We’ve got opportunities because of that [type of] innovation, dreamed of but wasn’t possible” (GM). Therefore, Firm C does not perceive the time and other resources invested in open innovation as a cost, rather a function of business expansion. Experiencing consistent benefits and issues with open innovation regardless of the type of practice, the main benefits translate to greater firm and individual knowledge. The knowledge propagates throughout the firm to enrich innovation and BAU activities, and instrumental to achieving firm growth.

The improvement of Firm C’s reputation is an unexpected yet substantial benefit of open innovation. Part of the firm’s challenge with open innovation is that what others call innovative, Firm C calls business as usual. Better appreciation of their innovation abilities expected to result in better realisation of opportunities and of the potential of their technology and industry developments. Appreciation of their innovation abilities considered contributory to further improvements in achieving innovation objectives through open innovation.

Therefore Firm C views open innovation is, “good for us, good for business. It’s good for morale, we’re doing well and being talked about, and the quality of the work is improving so we are getting better jobs with higher value” (FM). Firm C’s rapid growth requires effective management of the various internal resource aspects of open innovation to reduce negative consequences. While physical resources lie on the positive side of the equation, organisational resources straddle advantageous and disadvantageous effects. Human resources however dramatically benefit, yet suffer the greatest negative implications. Employees’ reluctance to adopt and adapt to developments resultant from open innovation activities is a strong behavioural barrier. Another is the increased pressure on management time open innovation demands, as are relational expectations. These add stress to already intense schedules and divert attention from BAU. Nonetheless, repeatedly highlighted as valuable outcomes of open innovation is the opportunity to grow organisational knowledge through exposure to others’ activities, the acquisition of innovation resources, and gaining different perspectives.

The success of the firm’s efforts is evident in the queue of work on its books - an enviable position in the current economic climate. Increase in open innovation activities directly supports the business with wider application and adoption of other practices.
expected. Appreciation is that acceleration of open innovation activities is necessary to meet growth projections; however, respected too is that success rests on effective open innovation management of current resources and development of relational aspects.
6.4 Firm D: Medium-size SME

Overview

Firm D is a heavy mechanical engineering service firm based in a relatively remote area. Commencing life as a specialised machine shop in the mid 1990s, the firm now offers a full range of engineering services: component manufacturing, maintenance, and re-engineering services including machining, balancing, fabrication, fitting, design, and project management. Recognition of Firm D’s heavy engineering expertise and ability to provide total mechanical engineering solutions attracts a diverse customer base, the firm providing engineering excellence to clients throughout New Zealand and the South Pacific. The solutions often improve on the performance of the initial OEM\(^{23}\) realising welcome improvements for Firm D’s customers. Achievement of this level of performance is a source of differentiation and pride for the firm and depends upon innovation.

Firm D is a “one-off” provider meaning the workload is unpredictable with volumes varying dramatically from project to project and year-to-year depending on client requirements. Operating with some of the largest machining equipment in the country, the purpose built workshops are highly flexible with sufficient diversity to react quickly to client plant breakdowns. This reactive work comprises a considerable volume of the firm’s business. Breakdown crises demand rapid response; the firm is configuration designed to rapidly alter internal processes and staff activities to accommodate urgent jobs. Consequently, the configuration of the workshops is based on a process innovation premise. The facilities are a functional part of the firm’s capability; the configuration and layout of equipment provide an innovative workflow design, one that is both highly effective and expensive to emulate. However, the result is physical and human resources constantly under pressure.

As a medium sized SME, sufficient management is available to run different divisions. Although marginally peopled, the divisions include factory, sales and marketing, and quality control with the majority of staff on the operational side of the business. There is an active governance board led by the founder, which is driving a strong growth trajectory and ambitious revenue targets. Representative of the firm’s growth directive is the recent appointment of a new general manager to replace the founder. The GM’s decree is consolidation of the business structure and financial base to support development. Innovation is at the heart of this growth and recognised as necessary to the achievement of ambitious objectives. Monitoring of resources particularly finances is critical, balancing the

\(^{23}\) Original equipment manufacture
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constrained resources of the SME while maintaining BAU, growth intentions, and innovation initiatives require intense management of the tension between conflicting functions and resource demands.

Innovation is integral to Firm D to continually improve services and achieve objectives, others in the industry describing the firm innovative and astute. Representative of the firm’s commitment to innovation is the winning of awards for the provision of innovative solutions in products and services. For example, the firm’s consistently high standard of performance, due to innovation, resulted in Exporter of the Year. The firm prides itself on outstanding work with morale high among evidentially dedicated staff.

6.4.1 Open innovation

The ratio of internal innovation to open innovation is approximately 50:50 with resource usage heavier with open innovation. While demanding more resources, open innovation is essential to operations and the provision of client-required results. “A lot is hard to measure in dollar terms… trading knowledge. How do you quantify that?” (Sales and Marketing Manager (SMM)). The Quality Assurance Manager (QAM) agrees, he considers open innovation an effective way to conduct business, “you actually have access to a lot of other resources that really aren’t costing you a lot in physical terms, it’s that intangible stuff like the added stress levels and resource, stresses on resources. But people being people, everyone’s pretty flexible and we just take it in our stride”: the firm determined to make things happen from “top management down to the guy sweeping the floor” (QAM).

However, the QAM questions how well Firm D currently manages open innovation, even whether management of open innovation is truly possible. He believes that the firm needs to address some outstanding issues to better actualise open innovation success. He is adamant that open innovation is important, “I think the collaborative side of things is essential to grow the business”. He refers to the benefits of open innovation as “delayed gratification”, referring to the need to invest time and resources upfront before any assurance of value.

To complement the highly skilled and experienced workforce of 80 people, the firm is in the process of adopting Lean. Lean is one of several initiatives adopted in pursuit of continuous development and improvement. The Lean process supports management of open innovation activities, improving on past efforts more so, “than we would’ve if we weren’t going down that track” (QAM). The reflective process of Lean highlights deficiencies across the firm, across activities and network interactions. Firm D finds Lean assists to identify
processes that require upgrading to meet innovation objectives and partnership arrangements. Lean emphases eliminating waste, highlighting in particular time management, which is considered key to improve efficiencies. Better use of scheduling is additionally under scrutiny. Getting the mechanics of timing correct at Firm D’s end is something the firm can control with open innovation, more so, “than what the others are doing” (QAM).

Open innovation advantages are often intangible in Firm D’s experience, yet unquestionably of value. Open innovation is, “more than just measuring it on the bottom line, it goes far greater than that” (SMM). He says a firm can stay internally focused and maintain a sound capability. However, he believes the dominance of closed innovation damages the engineering industry, “engineering industry in New Zealand is capable of a lot... not realising the benefits because of that very closed thinking.... It’s a stifler [sic] of growth”. He is adamant that it is time for the industry to look beyond firm boundaries to forge open innovation relationships with others to improve innovation realisation.

The new GM has a different perspective. Tasked with achieving growth targets by the board, his imperative is to produce financial results to reinvest in growth, partially restricted by the location. Referring to staffing restraints, he explained, “it’s hard to get that type of person in [town]. Any collaboration has to be done but the problem for us is that because we’re only a small firm, we have the issue that unless it’s moneymaking we can’t afford to let people go away and be innovative unless it produces something at the end of the day. Unless we know its going to produce money.... you’ve got to almost be assured before you start”. However, he views the investment in relationships is important, although he stresses, “you’ve still got a definite end game in place”. His concern is radical innovation - he views open innovation as radical - is not presently cost effective. Unfortunately but necessarily at this stage, he must weigh every opportunity against the financial risk. To satisfy requirements open innovation must be results-orientated to ensure return on invested resources, project-specific, and to satisfy client requirements.

He offered an example of a risk considered too great leading to the rejection of an open innovation opportunity with an offshore firm. Risk analysis of open innovation then is a priority to ensure focus remains on growth: traditionally engineers are risk-adverse. He advised that the risk assessment of every opportunity and project is required to move the firm forward without jeopardising scarce resources.
Engineers tend to regard problems requiring innovative solutions as a challenge to address internally whether the necessary skills are available or not, that to ask for external help reflects poorly on their ability. The GM warned this attitude is almost one of arrogance and costly in firms unprepared to admit outside assistance is required. Consequently, although expressing concerns in terms of risk, the GM is an advocate of open innovation. He believes achievement of a strong base will result in a very different conversation on open innovation in a year’s time, viewing such opportunities in a more positive light.

### 6.4.2 Sources for innovation

Firm D sources innovation knowledge from an array of sources including attendance at conferences, industry journals, and regularly innovates with clients, suppliers, and other organisations. In recognition that the future is about collaboration, the firm recently formed an innovation group to further realise open innovation opportunities. It has strong industry links for open innovation endeavours that supplement internal innovation activities; the firm calls upon its network to realise innovation opportunities and address resource shortfalls.

Firm D’s choice (Figure 5) indicates the depth and breadth of sources for innovation. Entities encompass, “potentially even those competitive to us, depending on how the job is approached... An opportunity to say, let’s not compete, let’s collaborate. In order to be successful at collaboration, there cannot be too much competition” (SMM). The firm finds from experience that primary to collaborating with a competitor is each organisation differing in their innovation objectives. Attention to arrangements and keen management of the open innovation relationship are necessary to minimise exposure, while transparency is critical to all project facets.

Effective open innovation relationships require corresponding yet differing goals between parties. Too similar and the result in the firm’s experience is competition. If parties’ agendas conflict, the relationship will be ineffective and highly risky, “if they’ve got the same goals as us, it then becomes very hard to collaborate to the point where it’s no longer possible” (SMM). The exception to this occurs when the innovative opportunity is so large that one firm cannot achieve it alone, collaborating more likely resulting in success. Differences and opportunism then are set aside as parties unify to achieve mutually beneficial outcomes.

Another important source for innovation are specialists. The firm’s open innovation engagement with specialists has been advantageous; accumulating knowledge from
interactions improving customer outcomes, “to be able to collaborate with others and specialists is a real advantage for us” (SMM).

**Figure 5: Firm D – Sources for innovation**

The SMM and his team invest considerable energy assessing and developing worthwhile open innovation relationships: partner selection criteria commence with an assessment of the entity’s resources to establish suitability for Firm D’s innovation purposes. “There is quite a process… we decide, does it match with what we need? Then we’ll actually try and build that relationship, sometimes it doesn’t work, and sometimes they don’t want to. It’s complicated often by the fact that they may not be close” (SMM). It is not a one-sided approach, each party must want to profit from the arrangement. Although demanding, the effort is worthwhile, “even though it costs us time and money, because long-term, that’s where we see the benefits coming from, establishing those networks, having those relationships” (SMM).

Firm D actively explores for potential partners especially during attendance at overseas conferences. Activities are, “pressed into what we do day-to-day... it all comes down to a resource issue and how much time we have available” (SMM). Relationship development for open innovation is highly demanding he advises, “it’s an investment... it takes a long time initially to develop collaborative opportunities because there’s trust and there’s a whole range of things that need to be dealt with... some of the knowledge, that’s our intellectual property and that’s our competitive edge. It’s not a quick process”. Furthermore, he warns, “as much
as you want to collaborate with others, you have to remember your own company first”, regardless of others’ expectations.

The SMM expanded on the difficulties of developing open innovation relationships. “There’s a large trust requirement - you really have to be able to see tangible benefit, and sometimes it’s very hard to see that tangible benefit early on so there’s a bit of faith required”. They find trust builds over time and importantly, contributes to address differences in disparate cultures. While firms might appear to be similar organisations, confusion develops if each party seems to speak the same jargon yet with different intent. However, continued interaction reveals communication nuances and improves understanding - learning the firm then applies to future collaborations.

Known partners are therefore the first choice for open innovation, “we’ll go to these people because we’ve got a relationship rather than go shopping around” (SMM). From Firm D’s experience, using a trusted network of partners reduces negative ramifications and risk exposure that may eventuate when engaging unknown entities, even if offering greater suitability. However, management deem themselves fortunate that their experiences to date have been fruitful open innovation relationships. Support for selection success a function of the partner criteria that includes choosing entities that build rather than detract from Firm D’s reputation.

### 6.4.3 Open innovation practices

Firm D engages in four open innovation practices: collaborating with customers, with organisations within and outside the industry, external participation, and all staff involvement. Encouragement of employee input on innovation is very important to the firm. Management regularly shares innovation ideas among themselves; recently the firm extended the initiative to everyone in the firm. Staff readily adopted the concept, particularly the engineering team, seizing the opportunity to support innovation activities and improve activities. Incentives encourage participation, for instance vouchers for use at the local lunch bar. Exploration and assessment of the suggestions by the continuous improvement team saw, “a huge majority of the ideas implemented, and there was a big change and definitely a saving of time” (SMM).

Another outbound practice, additional to the recognised eight, is the provision of R&D services to clients and other firms. The provision of R&D rewards the firm financially, gains in learning from the innovation experience, and from the knowledge shared by the other party to facilitate the R&D. Furthermore, employees relish the variety.
Licensing-out intellectual property is one practice not employed. Management’s view is that there is nothing specifically of value for the firm to offer with management doubting the saleability of the firm’s intellectual property - even whether it exists as the value inherent in the firm’s innovations relate to advances in project specific developments.

The QAM questions whether the firm’s output is valuable or simply sound engineering practice. He believes distinguishing between the two is difficult when engineering frequently has innovation as its basis “I don’t think we’ve ever been in a position where we’ve had intellectual property that we’ve needed to safeguard” (QAM). Furthermore, licensing-in is not currently relevant under their current business model. Nor is there engagement in venturing, which relates to the current financial restraints. Advice is that improvement in finances may change this, however focus presently is organic growth as a single entity.

6.4.4 Open innovation engagement experiences

Firm D has sufficient staff to assign a project manager to each open innovation project. The project manager constantly assesses and measures resource usage throughout an open innovation endeavour to ensure best possible return from initiatives. The project manager is responsible for the overall process and gauges success at each stage. If the project, “crosses the threshold from successful to unsuccessful, we’re acting on it” (SMM) pre-emptively acting to mitigate problems and possible delays.

Firm D finds open innovation heavily influences internal resources, “a burden in resources as well as managing that process. So the resource burden, you have to think of those” (SMM). From the firm’s involvement with open innovation, there is a definite lag between identification and development of open innovation relationships, and realisation of results.

To realise customer deadlines Firm D supports open innovation partners - although a rare occurrence - through the provision of staff or other resources. Such offsite opportunities and through exposure to alternative work practices advantageously builds employees’ expertise and offers greater variety to staff. However, the practice directly strains the business and existing resources: “often it’s about modifying our resources so that we can overcome limitations from this external resource” (QAM). Should a project suffer from the inability to deliver on time Firm D will communicate to the client the completion difficulties. Some customers will revise original delivery expectations to incorporate changes, reducing the stress on Firm D. In other incidences, deadlines are concrete. If non-negotiable, Firm D will run
double shifts to deliver on time to compensate for partner delays, yet, “of course there’s a cost to that, sometimes the customer is happy to absorb some of them” (SMM).

Firm D’s physical resources run at approximately 90% capacity, however equipment usage and demand are unpredictable. Gaps in usage occur when work better suited to some equipment and not others leaves machines and related staff inactive. Management of the uncertainty in conjunction with open innovation activities can therefore be challenging. The inability to concisely plan workflow and allocate machinery causes scheduling complexities, accentuated when unexpected delays occur.

Standard operating timing changes increase to compensate for the open innovation process. Situations develop when unforeseen problems and BAU commitments impose on partner agreed timelines. Issues can result in confusion and unexpected interruptions as one party grapples with their part of the work, the result is one firm delays the other thereby creating tension and compromising project delivery deadlines. The risks and issues compound if the partner is slow or fails to clearly convey the reasons that led to problems. However, Firm D mainly engages with open innovation partners early in a project, reducing the affect of such difficulties.

A function of the firm’s increasing open innovation engagement is their participation in multiparty open innovation projects. Multiparty collaborations offer Firm D access to novelty in knowledge accumulation and the opportunity to realise radical innovations beyond the scope of the firm. However, engagement with multiple parties significantly increases the existing complex demands of open innovation arrangements. Multi-parties require far greater involvement particularly in terms of management time and relational ability. The SMM advised that multi-party collaborations impose complexity in terms of communication and understanding of issues across parties.

The investment of time is one of the major affects of open innovation they explain, particularly during initial relationship development stages to ascertain level of compatibility. Consequently, open innovation relationships demand extensive time commitments by Firm D’s management. The resultant additional work to manage communication aspects and meeting attendances all costs to BAU due to managers’ unavailability.

Yet, the open innovation benefit of enhancing learning is emphasised by Firm D. Access to others’ knowledge and knowledge spillovers increases in-house expertise, in turn constantly develops services. However, realising that spillovers occur in both directions, Firm
D appreciates open innovation endeavours necessitate sharing knowledge with others and requires judicious revealing to limit exposing hard won developments. For instance, experiences from open innovation partners viewing Firm D’s processes remarking, “we didn’t even think about doing it that way.... They might go away and copy us. You just have to be sensible about what information you disclose” (SMM).

However, such exposure highlights another management concern - controlling the extent to which workers share information with third parties during open innovation projects. Firm D recognises that people talk, particularly in a shared and collegial manner when working together. The firm adopts the philosophy that broadcasting achievements via employees results in the open innovation partner further appreciating the firm’s capabilities. Nonetheless, if the information is particularly sensitive the firm ensures employees are explicitly aware of the need for non-disclosure, although due to the nature of the work the information is usually fragmented further reducing the risk of exposure.

Usually open innovation arrangements do not include formal instruments in initial stages, often not at all. “The best collaboration comes about when formal agreements are not required” (SMM), the SMM preferring formalities occur as an after thought. As the firm does not divulge any firm-held knowledge until project engagement, the need for protection is disputable, he believes. Primarily Firm D instigates open innovation therefore arranges to retain the rights to any intellectual property development. In Firm D’s opinion, leaders in technology will always have others attempting to copy them; imitators will not prevent Firm D continuing with open innovation.

From the QAM’s view, one of the major issues Firm D has with open innovation is managing internal relationships. “Its extremely hard... what one person sees as a significant opportunity to collaborate externally, the next person [here] will see it as a threat that will expose our trade secrets... aligning everyone’s thinking in the organisation to the degree that you can actually move forward on the collaborative process”. Generally, the management team meet to discuss an open innovation opportunity, collectively deciding actions based on financial viability. If financial viability is not an issue, consideration of the moral or ethics of the opportunity are next. Sound respect for each other’s opinions encourages discussion with engineers’ tendency to speak frankly assisting direct communication.

6.4.5 Summary

In Firm D’s evaluation the positives of open innovation offset the negative issues, while admitting open innovation is implicit with risk, “we’re selective about it, whether it always
pays off is hard to measure” (SMM). Exposure to new ideas and novel processes is a definite benefit of open innovation projects from Firm D’s perspective. Open innovation directly benefits the firm’s innovation efforts though access to others’ expertise and physical resources: commanding reasons to pursue open innovation opportunities in Firm D’s opinion. The SMM sums up that open innovation is, “an enabler of growth” and proven worthwhile.

Nevertheless, the firm recognises the existence of numerous problems with open innovation. Main issues relate to effective open innovation relationship management and the dependency on internal resources. In particular, reliance on management time and skill regarding partners, arrangements and project realisation. Further, there is financial risk, which may compromise reinvestment in other facets of firm activities. Therefore, if showing any sign of financial risk, the firm immediately revisits an open innovation project to consider alternative options. Erosion of the firm’s reputation should an open innovation project go awry is another issue. However, this has not been their experience to date, the firm enjoying the reputational benefits of successful open innovation projects.

Firm D considers innovation critical to advancing the firm’s capability, and the most effective way for the SME to achieve innovation objectives. Especially, that open innovation facilitates their ability to enhance value for their customers. Open innovation, therefore is instrumental in extending their capability and providing opportunities to enrich employees’ skill sets, the development in expertise continuously improving Firm D’s services. Fundamentally, “there’s quite a wide economic benefit” (SMM). Consequently, Firm D perseveres with open innovation as it continues to make a valuable contribution to effective innovation performance.
6.5 Firm E: Medium size SME

Overview

Since its establishment in the late 1980s, Firm E’s dynamic nature and early market success have resulted in rapid growth. Firm E’s competencies are integral to its innovative products and project management services. The firm exploits opportunities represented by its revolutionary design-and-build systems to successfully enter markets throughout the world. Proprietary designs facilitate the products ability to withstand stresses beyond normal tolerances. In addition, the innovative use of quality materials provides flexibility and choice for customers with sustainability a core advantage.

The revolutionary nature of the firm’s products and services mean the innovative products are outside current construction parameters. This requires the firm to deliver education programmes to relevant parties on the virtues of the firm’s products. Such efforts are necessary to enable adoption and the adjustment of local compliance standards. Deeply involved in industry development, Firm E is, “removing barriers to innovation through driving national standards” (CEO).

The firm has over 80 staff, one-third residing in New Zealand. The employees divide across teams, each team dedicated to different aspects of the business: servicing customers, technology enhancement, certification demands, and R&D. Additionally, it employs a national team of experts to support activities. The technology-driven facility is highly systemised for greatest efficiency.

Previously a finalist for Entrepreneur of the Year, the CEO is recognised in Deloitte’s Fast 50, a gauge of well performing and exceptional company leaders. The kudos reflects in the quality of the firm’s output and the high level of success. Collectively the impression is of a tightly run organisation with a flat management structure – a big small firm seriously dedicated to realising opportunities in worldwide markets. Benchmarking international standards, the firm will not stay long within the SME size bracket.

“All innovation should be customer-led” (CEO). These words sum up the locus of the firm’s development drivers. Often the first to introduce innovations into the market, the firm employs staff dedicated to maintain the competitive edge through innovation. The teams proactively search for innovation opportunities, systematically seek out, and incorporate client requirements - actions fundamental to innovation initiatives. Support for innovation includes an international platform to create new modules, new technology, and new product
versions. Consequently, exploring for innovation opportunities is not a random activity; it is a purposeful and driven imperative.

The firm combines specialists in electronic, hydraulic, and mechanical engineering in manufacturing the product range. The diverse range of experts covers the product spectrum to support innovation activities with innovation permeating through the firm. The expertise contingent with such a knowledge base provides a variety of perspectives to all facets. The configuration offers, “a wide range that is not always complementary... we’re trying to pull it together”, advised the Commercial Manager (CM).

The firm exploits all facets of technology. Extensive use of the Internet supports internationalisation and communication to stakeholders. YouTube videos of activities, posts on Facebook, Twitter, and other social media demonstrate product examples to develop application understanding. Websites promote the range of products and services and advise of software updates for customers and licensees. Innovations in software extend to users to consistently guarantee Firm E maintains a leadership position through effective client support. Internet sites and social media channels educate and encourage interaction between the firm, clients, suppliers, and licensees.

Complementary to the extensive use of technology is the drive for continual improvement and value creation. The firm is constantly reassessing its products and services in conjunction with clients, adjusting its range and components to better meet requirements and to accommodate user feedback. Firm E’s recurrent theme is one of unrelenting and emphatic focus on customers’ needs, to meet or exceed requirements. The customer centricity results in continual and cumulative innovations to product and service offerings. Firm E measures present and future success on product receptivity, the firm’s reoccurring satisfaction of customers a significant market differentiator.

Subsequently, Firm E is under constant pressure to produce new and improved products and services to meet client demands and maintain its respected status. Continual improvements emerging during manufacture, installation, and the experience of users advance product extensions. Consequently, on-going development of intellectual property emerges through adherence to the improvement philosophy and continual benchmarking. “Genuine leadership versus just staying in the game” is the CEO’s summation of the firm’s overall innovation imperative drawing on closed and open innovation initiatives. Consequently, Firm E has an annual innovation budget and allocates time to implement innovative offerings. Unsurprisingly then the mandate for the R&D department is to drive innovative
developments, a function also of the design team. However, the focus is not blue sky or radical innovations. The primary consideration for innovation rests on commercialisation prospects.

6.5.1 Open innovation

The CEO views open innovation “essential to business” to build technological competencies, engagement in open innovation therefore occurs on a regular basis: the lack of internal capability driving engagement. Hence, open innovation is critical to the acquisition of innovation-required resources to overcome internal deficits and realise commercial opportunities. The CM highlighted open innovation crucial to resolve engineering system complexities and access alternative approaches to examine issues. However, particularly stressed by the CM is the pertinence of open innovation to design improvements through acquisition of external knowledge.

The appropriation of external knowledge then is essential for the firm and a driver of engagement in open innovation. “Knowledge is the basis of open innovation” (CEO). An example provided relates to identification of a market gap by Firm E, one that requires expertise not available internally. The objective: to satisfy the market as cost-effectively and expeditiously as possible leveraging the experience of open innovation partners to achieve. The partner incentive may take the form of a share in the intellectual property or a percentage of the product margin.

The firm considers the two streams of closed and open innovation operate in tandem as contributing to achieve an overall superior innovation provision. Firm E’s innovation ratio is 80:20 in favour of internal innovation. The CM differs; he considers the ratio to be 60% internal, open innovation 40%. The difference likely due to interpretation, “there’s a number of ways by which we internalise innovation, essentially we take the external innovation, and we internalise it. Then, in turn we’re taking some of our innovation and we’re externalising it” (CM) pointing out that deciphering where closed and open innovation diverge is not always possible.

The firm also advised how open innovation initiatives require a return to “the rule book”, observance of traditional engineering and scientific routines preferable to doing things completely different. An excess of newness, the CM stated, can occasionally be contrary to achieving results, with some level of conventional activities better facilitating open innovation.
6.5.2 Sources for innovation

The firm constantly surveys a variety of sources for innovation opportunities with a preference to be proactive than reactive. Accordingly, the firm has a portfolio of potential partners in readiness for open innovation initiatives. Of the various entities that comprise the firm’s innovation sources (Figure 6), customers take priority. Other key sources for innovation include attendance and exhibiting at international trade shows. In addition, the firm respects suppliers as providers of incremental innovations for manufacturing improvements and cost reduction, helping Firm E achieve greater efficiencies during early development stages.

The CEO’s view of the role of any open innovation partnership is, “the external party to do something that you don’t have the time, money or expertise in house to do”. If possible, Firm E favours partnering New Zealand firms. This is not always practical if the resources required are absent among local entities or if collaborating with New Zealand entities will incur higher costs, selection then turns to more suitable and cost effective offshore entities.

Development of revolutionary products and product extensions transpire with New Zealand universities. The universities’ innovation programmes are often product-specific and outside the directive of the firm’s core business, thereby adding to the range rather than directly influence current product development. Involvement with university programmes then does not distract staff from internal firm-specific projects. However, there are specific challenges. Frequently there are issues operating with universities. The CEO states that there is a tendency to, “pursue academic interests without commercial context and commercial judgement”. The universities continue on trajectories without consideration of suitability or viability for commercial application, requiring the firm’s close management of the situation. The CM also referred to the disjuncture between commercial reality and academic requirements. He adds that the overly protective nature of tertiary institutions in terms of intellectual property often hampers relationships and opportunities. Furthermore, he points to the necessity of research programmes to be three-years for PhD studies, whereas the firm requires research results within six months: market opportunities otherwise lost.
Identifying potential open innovation entities is, “quite haphazard” (CM). Finding entities are primarily the domain of the CEO as, “these people he literally stumbles across, or they stumble across him” (CM). The CEO’s entrepreneurial spirit and opportunistic manner found to attract potential open innovation parties. Regardless of his success with finding suitable entities, the CEO has a pragmatic attitude to partnership opportunities. He views any project, employee, or party requires terms of reference and terms of engagement to maximise potential and minimise risk.

There is a vetting process. Before entering into any discussion, potential parties to open innovation undergo a qualification procedure. The firm conducts a preliminary assessment in light of the specific open innovation purpose. In the CM’s words, entities are to offer, “all round philosophical congruence at its highest level”. Before proceeding further, Firm E clarifies project objectives to establish clarity and transparency in arrangements, finding clear articulation of objectives and requirements of the relationship standardises arrangements somewhat and improves relationship management. The objectives then form the basis for the open innovation relationship. From the firm’s experience, establishing the purpose before commencing negotiations quickly exposes inappropriate partners or any misalignment between parties. Alignment with innovation objectives and firm expectations therefore dictate partner selection.
Another stage is face-to-face meetings regardless of geographical location. The CEO admits, “these can be brutal”, with parties erring on the side of frankness to ascertain suitability and pre-empt issues. Firm E dominates the relationship from the beginning by setting the agenda, the design, and operating parameters to achieve the desired open innovation outcome. As the firm dictates the agenda, assumption of responsibility rests with them and how well they determined the right partner and project path. Each project thus adds knowledge to the firm’s relationship management ability in a continual learning process for improved future application.

According to the firm, different types of projects demand different approaches, and so different partners: on some projects, the other firm is the partner; on other projects, the same firm presents as a competitor. Consequently, relationships with the same entity changes: The role played by the other firm depends on their offering, the locality, and availability of materials. For instance, with inter-industry collaboration overlaps can occur, the overlaps often project-specific limiting conflict. Other projects with the same firm may have no product or service overlap, hence offer no grounds for conflict. Regardless, Firm E maintains vigilance to reduce risks to their intellectual property.

The firm frequently engages in multi-party open innovation arrangements advising these are, “less combative, but vastly more political” (CM). The tension created by multiple entities and their varying roles dramatically increases open innovation mechanics and complexity. Multi-party collaboration also requires greater attention and cohesion with clear objectives and issues. Establishment of arrangements with multi-parties occurs early with regular negotiations common to identify reciprocity in terms of contribution and priorities, “[multi-parties are] a lot more genuine collaboration than just two parties” the CM believes.

From Firm D’s experience, agreement on commercial terms is a crucial aspect to ensure a functional relationship. Each open innovation initiative demands a case-by-case approach, hence is not prescriptive. The essential is to specify the commercial application, detail each firm’s project responsibilities, the how, why and by when. The deadline is, “the marker in the sand” (CM) otherwise, “people will always expand the time of the task”. Complexities compound with overseas partners with the inclusion of cultural differences. Altogether, the open innovation partner dimension and relationship management costs are extensive for the SME, financially and in terms of management resources.
6.5.3 Open Innovation practices

Firm E embodies the eight open innovation practices. Prioritised is working with clients to achieve a consistent level of customer satisfaction; clients are both major contributors of innovative concepts and the cause of initiatives. The firm realises a close physical presence with customers through the practice of licensing-out to local manufacturers. There is the added benefit of country-localised firms bringing fresh perspectives to Firm E, the clients and licensees frequently complementing New Zealand-based activities.

In order to meet client demands the firm relies on the innovation contribution of inter-industry firms. In particular, Firm E turns to suppliers to assist with design improvements, product performance, and reliability to better meet requirements. Similarly, licensing-in assists the firm to shorten costly developments and increase speed to market. Licensing-in therefore supports the firm to maintain its competitive edge and constant improvement philosophy.

The firm realises much of its expansion through licensing-out to overseas organisations. Collaboration with licensees often results in innovate products and process refinements as outcomes of implementing the intellectual property in that locality. The licensees work with Firm E on developments to meet local requirements, compliance issues, and cultural nuances. Innovations suggested by licensees and local customers may be developed as necessary to meet regulations, yet can be advantageous to the firm’s overall provision. Processes are continually improved and new features introduced through this open innovation practice; intellectual property developed and exchanged to improve customers’ experiences.

Investment in other ventures occurs in the related practices of venturing and external participation. The firm has externally participated through technology investment in other firms representative of the inbound practice. It also adds innovative products and services through acquisition. The CM gave as an example a business whose innovation services are important to Firm E. To ensure continuation of arrangements, the firm invested in the business to maintain output. In addition, the outbound practice of all staff involvement is critical to innovation activities. Employees are the backbone of the firm’s innovation successes and thus its reputation: management’s expectation is that everyone will offer innovative suggestions. Firm E draws on staff throughout the firm to contribute innovative ideas, product developments, and improvements in manufacturing and organisational processes that cumulatively advance the firm’s offering.
6.5.4 Open innovation engagement experiences

The CM is complimentary of open innovation. Innovation inputs from external parties contribute to and build on internal activities to continuously develop the firm’s strong knowledge base. The knowledge then furthers innovation objectives and product development. Open innovation activities provide Firm E numerous opportunities to learn through engagement.

The CM is clear on the importance of open innovation over any investment of physical equipment. The CM advises the firm is, “a bit light on plant at the moment” increasing the dependency on others to meet the physical resource shortfall as, “we’d rather invest in further innovation than capital equipment”. However, engagement has implications. Open innovation is necessary to meet innovation objectives, yet delays occur between engagement and the generation of income from resultant innovations. “It’s a constant tension” the CM remarked, “understanding the cost of not doing, as opposed to the cost of doing” demanding close scrutiny of opportunities and the costs thereof.

“The greatest impact is to human resources, not physical resources, materials are essentially immaterial in comparison to the costs to labour - it’s to do with the personnel” (CM). The human resource aspect of open innovation influences the ability and extent of the firm’s open innovation engagement. He advised that with an offshore open innovation project Firm E may provide engineers to supervise onsite development of the technology to assist licensee assimilation, improve immediacy and relevancy of results. “External collaboration process is typically always different to your internal one” (CM), explaining other entities’ requirement for direct support. New Zealand’s geographic location means trips are inevitably lengthy to visit major markets. The loss of staff for the duration adds pressure to remaining employees. Furthermore, the absence of personnel overseas has financial and management implications. Removing key people from the business for extended periods impacts BAU with difficulties of delegating absent employees’ responsibilities due to the firm’s tight human resources.

According to Firm E, open innovation introduces complexities beyond the demands of closed innovation. Behavioural aspects illustrate the complexity of open innovation projects, the individuals from each party bringing different expectations and personal nuances. “In terms of the person that’s involved is the one that dictates what behaviours and habits they bring…. Sometimes we have to push back, you call them to account, and this is the way we do things” (CM). Consequently, from the firm’s experience the type of individuals
representing the other party can exacerbate differences, as can misalignment in operational and cultural structures. Therefore, arrangements and outcomes often depend on the individual. In addition, there is an accentuation of individual’s attitudes, willingness to accommodate terms, and relationship styles with distinct country-orientated cultural differences, reinforcing communication and relationship difficulties. Alternatively, compatibility between individuals facilitates projects through to successful completion with greater ease.

The human resource aspect is further emphasised in interorganisational relationships. Firm E finds that the interface between firms during open innovation projects can be combative, “it’s actually two philosophical approaches that you’re bringing together” (CM). Cohesion can require revisiting objectives, changes and compromises from one or both parties, which then influences internal mechanisms and demands adjustment to working styles and processes. These adjustments then flow into employees’ work routines, which then present further issues with change resistance. However, there is little option but to adapt. Open innovation necessary due to Firm E’s low employee numbers, “encourages third party collaboration, purely because there isn’t the knowledge, the time, or the capital” (CM).

From the CM’s perspective, open innovation is a scenario of give and take. There is a constant requirement for each partner to exchange the role of leader, alternatively to surrender control during project stages as the respective expertise of each entity comes into demand. He sums up the asymmetrical nature of open innovation arrangements explaining that, “no external collaboration on innovation actually occurs in a true equal party environment”.

The firm is cognisant that open innovation requires a huge time investment. Open innovation constantly imposes on management, “time commitments [on open innovations] can be expensive – if you let them,” the CEO firmly stated. The lack of discipline in project management results in time inefficiencies with free reign of endeavours costly. Close control considered critical for momentum and to achieve the best use of resources. Even with controls in place, frequently time lags inevitably develop during open innovation endeavours for numerous reasons such as equipment malfunction. Time lost on project problems is a major issue, especially when needing to incorporate other forms of interruptions. One method the firm uses to accommodate foreseeable and unforeseeable delays is automatic extension of timelines when engaged in open innovation, at times forcing rescheduling and alterations to commercial trajectories. Partial resolution of time difficulties is driven by
government and investor funding, the additional monies, “encourages proactivity in addressing time lags, and critical to R&D” (CEO) hence essential to the firm’s engagement in open innovation.

Repeatedly time appears as a critical facet to open innovation arrangements. Commitment of time is necessary to establish and manage endeavours, “typically, the cost comes internally in actual managing in real time the parties. In terms of we’ve got Party A’s designers and Party B’s designers [who] have never worked together before. So, it takes either somebody from our organisation like me, to actually nursemaid that through, and it gets a bit lumpy” (CM). The CM explained that interceding in projects in this manner is very time consuming, and requires daily monitoring to accomplish objectives.

Moreover, open innovation is, “administratively more complex”, specifically with management of intellectual property. Firm E’s view is that establishment of intellectual property ownership in commercial terms is crucial for open innovation activities. Furthermore, clear identification of each party’s contribution is foundational to arrangements and to render correct acknowledgement of resulting intellectual property. Consequently, the firm operates all open innovation engagements on a formal basis to mitigate risks, for instance non-disclosure agreements are standard. Employee contracts contain similar intellectual property clauses to those incorporated in external partnership agreements. However, with all open innovation activities Firm E retains or on completion owns the intellectual property. This may translate into other parties receiving manufacturing rights.

Yet, the CEO is relatively ambivalent about intellectual property illustrated by his comment that, “does intellectual property really matter? Intellectual property protection is not the key – commercialisation is”. To hold a patent does not automatically translate to success. Rather, he says, the ability to commercialise the intellectual property determines the value. His view is that a strong market presence creates new platforms and offers competitive positioning advantages beyond the benefits of patenting.

The CEO may occasionally seize the initiative to engage in open innovation, leaving the debate on commercial terms to lag. The CM warned that this results in a debacle between parties and the delay of the project until the establishment of commercial terms. Subsequently, the CM developed a framework to operate open innovation interactions to alleviate potential fallouts. He explained, “we kiwis are a very trusting lot, and we believe that at the end of the day we will do the right thing. That’s not necessarily the case, particularly if it’s collaborating with people offshore. Different cultures, that’s a space which
New Zealand organisations probably need to draw a little bit of savvy”. He has found that enthusiasm can often be the key driver of an open innovation project: with the perception that the imposition of structure and operational terms are detrimental to receptivity and openness of the relationship. However, the CM perseveres with directives to ensure project effectiveness, to protect the firm’s intellectual property, and to lessen the burden on firm resources.

Yet, the advantageous experiences gained from open innovation continue to serve the firm long after completion of a project. Knowledge and learning happen “intuitively” (CM) as a function of open innovation with internal innovation influenced by open innovation experiences. “[It] transfers into your own design methodology which we bring back in-house” (CM). Comments and suggestions can arise haphazardly as a result of open innovation such as “hey look this is a really good thing that we learnt”. The CEO is adamant that the purpose of open innovation is the accumulation of knowledge and spreading this throughout the business furthers innovation activities. Incorporation of the knowledge assisted by, “at the end of this [open innovation endeavour], actually sit down as a team and understand the things that we have learned, and understand how that could improve our stuff” (CM). Retrospective consideration of open innovation activities often greatly benefits the firm and employees. Reviewing projects reinforces appreciation of the benefits gained from open innovation initiates and the value of the time invested.

“[Open innovation] is critical to financial performance”, (CEO). Open innovation is not costly according to the CEO. The firm has established processes to minimise negative resource implications and extensive experience has led to the development of mechanisms to mitigate concerns. For example, the development of heads of agreements to detail projects, partner vetting, and the firm’s retention of the intellectual property resulting from open innovation endeavours.

6.5.5 Summary

“We couldn’t have done what we’ve done without collaborating” is the CM’s summation of the value of open innovation to the firm. The firm actively and regularly pursues open innovation to realise innovation objectives. Open innovation benefits the firm, “you become a little bit more worldly in what you do and how you do it and why you do it” (CM). Furthermore, open innovation builds the firm’s reputation as, “the company that breaks all the rules” (CM). Further the CM refers to the pain experienced during internal innovation is not experienced as drastically during open innovation as risks and knowledge are shared. Especially the involvement of different thinking and approaches alters the
dynamics of innovation and differentiates open innovation from the organisational difficulties of closed innovation.

Open innovation initiatives, “influence what we do here”, the up skilling of employees well recognised as an outcome, propelling Firm E’s learning to achieve greater innovation outcomes, “it’s helping us to grow up” (CM). Open innovation contributes to the firm’s “genuine innovation” (CM) while recognising the detriments to engagement on human resources. As well, Firm E is clear that success is often dependent upon partner choice. Particularly there is reference to management resource effects in terms of relationship management, the identification, development, refining of arrangements, and the monitoring of partners. From the firm’s experience, open innovation has concerning implications if controls and procedures are absent. Thus, management of open innovation calls for, “controls twice as robust as innovating in-house…. if you lose, you could potentially lose money faster” (CEO).

Firm E views open innovation as operationally fundamental to overcome resource limitations. The lack in personnel necessitates bringing in external resources for innovation to compensate; access to such resources at times critical to project delivery. However, the firm constantly refines key aspects of open innovation and arrangement criteria to reduce detrimental implications. The establishment of a clear purpose for open innovation before commencing partner engagement proving to be highly effective: the clarity also establishes sound working structures that reduce risk. Despite the challenges presented by the time dimension and the dependence on management resources, the firm is certain of the value of open innovation. The firm intends open innovation initiatives to continue at the same level, most likely increasing the near future.
6.6 Firm F: Larger-size SME (100+ staff)

Overview

Recognised as a global leader, Firm F provides leading-edge products and services. The firm rapidly grew after a few early stumbles and product refinements to realise considerable export success, meeting the stringent demands of European markets. Compliance with international requirements helps drive innovation and product revisions. Often first to market, the firm attributes much of its success to industry leading innovations. The customer expectation is that the firm’s products will continually improve to address feedback and remedy any shortcomings providing impetus to the firm’s innovation activities. On a strong growth trajectory, Firm F is presently focused on increasing efficiencies and maximising international opportunities.

Consequently, a robust re-investment policy is in place to fund further expansion. Support for growth is through the firm’s commitment to and maintenance of internationally recognised accreditation and quality assurance programmes. Adherence to safety and compliance to international requirements together with innovative products and services add up to a commercially sensitive and valuable offering. Admission to the modern, purpose built facility requires prior notification with restricted access preventing unauthorised entry. Once inside the structure is light, airy, and principally open plan, the layout designed to simplify interaction among individuals and between departments. Firm F is a seriously professional, intensely busy, and highly disciplined business keenly focused on maximising the return on shareholder investment.

The shareholders are operationally involved in the firm and comprise the majority of the board. Complementing the strong governance, the board members and senior managers have extensive experience of industrial engineering and commercial astuteness. The firm has just over 100 staff, the majority employed on the factory floor. Three divisions manage the range of products and services including one whose focus is after-market services for clients: after-market increasingly in demand to support and maintain installations. The operational side employs a significant number of mechanical and other types of engineers making up the backbone of the manufacturing plant. A separate division focuses on sales, peopled by experienced business managers with excellent reputations and most successful on the firm’s behalf.

The design and innovation side received a boost recently with the firm establishing an R&D team. A dedicated team became necessary to address the gaps in the firm’s offering
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revealed by the rapid growth and increasing awareness of market opportunities. The innovation/R&D team is energetic, active, and respected inside and outside of the firm. Populated primarily by people under thirty, older experienced staff act as mentors, an approach found effective for the development of innovative solutions and process improvements. In the firm’s experience employing younger people - tertiary graduates - is advantageous as they tend to be less constrained in their thinking, often coming up with wild ideas that justify further exploration.

The R&D team’s central task is supporting the firm’s strategy of constant renewal and continuous innovation to products and services. An important facet is the tailoring of products and upgrades to existing facilities to individual client requirements. However, the current rationalising of the product range aligns with increased focus on efficiency measures to support expansion objectives. Designing standardised models wherever possible, the firm appreciates that some client-specific tailoring of products will continue.

In the R&D Director’s (R&DD) experience Firm F is the most innovative he has ever worked: the drive to innovate originating from the top. The entrepreneurial Managing Director displays a keen interest in the firm’s innovation activities and is renown as highly innovative in his own right. Innovation is key to meet client-specific requirements, product enhancements, and financial demands. “If you’re not finding a need to continually innovate, then you’ve probably got a problem because they’re [customers] not demanding anything of you” (R&DD). The firm’s significant investment in innovation and R&D to the R&DD’s knowledge is greater than that found in most New Zealand firms.

In addition to investing in an R&D team, Firm F has an annual innovation budget and documented plan for innovation activities. The firm’s use of the Stage Gate process\(^\text{24}\) facilitates and enhances business plans and product development. “A lot of the innovation that I talk about comes about as a result of problems that we have out in the field”, according to the Factory Manager (FM). His innovation focus differs then from the R&D team. The team on the factory floor prioritises issues that occur during manufacture usually marked by a pressing urgency for resolution to meet deadlines. Problem resolution results in, “theoretically less problems to solve” (FM) minimising future issues through pre-emptive action.

\(^{24}\) Developed by Robert Cooper (2001, 2005a, 2005b), organisations apply the method to the product development process using pre-determined steps.
6.6.1 Open innovation

The firm’s attitude towards open innovation is, “without it we wouldn’t be growing at all. It’s a painful process for sure, painful but critical... we need it for the outside skills” explained the R&DD. Firm F engages with others to supplement the firm’s innovation resources in distinct areas. However, internal innovation is the primary innovation activity with the ratio of closed innovation to open innovation approximately 80:20 respectively. However, the dedication of resources is greater with open innovation, the suspicion is that resource usage is around 30% for open innovation activity as, “it invariably costs more to do it outside” (R&DD). From his experience, open innovation is difficult and often fraught with problems. “How to make that collaborative approach easier is a difficult question”, the R&DD remarked, in order to reduce the investment of effort and resource demands.

The FM expressed much reticence regarding open innovation. He is, “reasonably loathe” to work with external partners due to his somewhat negative experience with earlier projects. While agreeing to the necessity of open innovation to address limitations in knowledge and other resource gaps, in his opinion defaulting to outsiders should not be an automatic response. Even though the FM is hesitant about open innovation, he admits that open innovation provides a number of benefits and that, “it definitely helps a lot... if we didn’t have some [open innovation] then you never grow”.

6.6.2 Sources for innovation

The extensive search and the depth of involvement demonstrate Firm F’s utilisation of every source in pursuit of innovation (Figure 7). The firm does not limit interactions; instead, it conducts open innovation with a variety of organisations within and outside the industry to realise innovation objectives. However, customers take priority together with the internal team, the two deemed the key innovation drivers. R&D laboratories are another important external source with other organisations trailing. For example, the firm finds supplier firms simply unsuitable for innovation initiatives. Instead, the firm turns most often to specialists to address gaps in Firm F’s skills and knowledge. Open innovation engagement with these organisations enables the firm to compensate for internal resource deficits.

Other sources for innovation include working closely with government organisations with the firm the recipient of grants to support growth and innovation. In addition, Firm F frequently collaborates with universities and other research organisations, less so with government research institutions (CRI)s. The R&DD cautioned that CRI*s recent

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25 CRI: Crown Research Institute(s), New Zealand Government organisations.
introduction of strong directives to protect activities means that they “actually steal your intellectual property and do whatever they will with it unless you fight vigorously”. In addition, he is reluctant to collaborate with CRIs as, “generally very difficult to keep on target because of the nature of the people”. Similarly, he finds that tertiary and other government organisations even those with commercial divisions require frequent interaction and involvement as, “collaboration is quite difficult”. He alludes to a gap between the realities of business and academic pursuits which are often at odds with the firm’s objectives. His preference is to collaborate with other firms offering similar innovation resources held by universities and government bodies, while not presenting the same impediments. However, from the Operation Director’s (OD) perspective, university partnerships work well for the firm as often the institutions introduce advantageous novel innovations.

**Figure 7: Firm F – Sources for innovation**

![Diagram showing sources of innovation for Firm F]

Trade fairs, conferences, trade press, and other forms of knowledge dissemination are additionally very important to Firm F. Firm F has a policy of knowledge collection from national and international events for market research. Employees regularly attend conferences and trade shows to maintain knowledge of industry activities for inspiration and to source potential open innovation partners.

Firm F assesses potential open innovation partners using a selection criterion that is, “complicated” (OD). The criteria include capability, reputation, and employee qualifications. Equally, the potential partner assesses the firm to identify areas of reciprocity. In addition,
customers act as referees recommending the firm to others and vice versa, recommendations assisting establishment of trust between parties in initial stages. Nonetheless, despite wide enquiry most often partners are firms familiar to Firm F. “They tend to be like-minded to us. They’re there for business, they’re not out to steal your ideas, and they don’t have the resources to do anything useful [to compete]” (R&DD). A critical motivation for open innovation is Firm F’s requirement to maintain their edge on competitors - not to collaborate with them. The OD is adamant that competitors keep their distance, “we compete with our competitors. We don’t co-operate with them. We don’t have anything to do with them”. Other Firm F managers are not quite as adamant.

The R&DD illustrates some of the firm’s experiences with open innovation relationships to highlight areas of difficulties. A European licensee presented particular problems and relationship complexities to the point the R&DD questioned, “whether they’re friend or foe”. Further complexities arise with cultural and behavioural issues, which vary tremendously between countries and between partners. Obsession with compliance is the attribute of one culture for example, another is preoccupation with minuscule details that do not influence the product but do hinder installation and delivery. However, “whilst it’s frustrating and creates difficulties with relationships... the result is that there is a learning cycle and an iteration.... You end up that you can sell into that market” (R&DD), explaining that paramount to success is managing the relationships and sensitivity to cultural distinctions.

In addition, notwithstanding extensive efforts to engage with the most suitable partners, the firm finds open innovation relationships can be unsuccessful. A recent experience with a new partner exposed a misfit with problems between the two firms leading to multiple intellectual property and personality issues. So fraught was the relationship that it was terminated, at a cost to Firm F. Firm F then chose a company with which the firm is familiar, “we’ve historically gone with them, and they’re actually similar, similar mix of people” (R&DD). The FM also gave an example; he described an open innovation project that “was riddled with errors, not the way we want to do things. There was a significant amount of negative energy about the whole concept. So we [in the factory] try not to utilise external resources if we can”.

Normally arrangements between Firm F and open innovation partners are formalised through application of a confidentiality agreement or licensee contract to protect the firm’s intellectual property. According to the R&DD, intellectual property is of significance only in
deployment, “there’s no value with it sitting on the shelf”. In his opinion, overly protective mechanisms or processes can limit intellectual property usage and therefore its value. However, the firm is judicious in revealing intellectual property, releasing only sufficient detail for the partner to perform. In addition, the firm most often takes the lead in interactions and dictates the terms of open innovation relationships to limit problems and intellectual property exposure. Moreover, of importance is the information flow between open innovation parties, that there is acceptable clarity and understanding of requirements. The firm’s organisational practices for open innovation reflect refinements developed through experience of difficulties, the application of hindsight proving valuable to new open innovation endeavours.

Once the parties agree on terms, there is no monitoring of the partner to ensure compliance. Reviews are not always necessary; the FM emphasising that if open innovation becomes necessary, “we’ll use people that we know. We make sure that they understand what we want…. we’ve found out the hard way, we ensure we get verbal feedback, that requirements are absolutely understood”. Hence, repetitive use of familiar entities with shared experience of open innovation reduces breaches of intellectual property and miscommunication.

6.6.3 Open innovation practices

Firm F participates in all eight open innovation practices, engaging in both the more common forms of open innovation practices as well as the higher-level ones of venturing and licensing. The practice of customer involvement dominates practice engagement. This is unsurprising with customers’ considerable contribution to the customisation process. Licensees are likewise critical to open innovation activities for similar reasons. The sale of intellectual property through licensing-out is an integral function for the firm and warrants their presence in international markets. Licensees exist around the globe to meet market demand and exchange innovation advancements to the betterment of Firm F, its customers, and licensees. The licensees’ application of intellectual property develops the manufacturing process and output; the innovative developments then feed into Firm F’s initiatives. Firm F reciprocally shares the innovations with other licensees. Conversely, the firm has licensed-in intellectual property to expedite product and process improvements.

External participation through equity involvement in a Canadian firm is one episode of this inbound practice. However, such commitment is uncommon. Investment in the reverse direction also exists. The firm has spun out new ventures to meet developing areas of the market. Not completely isolated, the ventures act as separate firms with separate identities
and branding, while remaining under Firm F’s governance. However, the firm rarely outsources R&D services; although the inference is this may occur in the near future to fully utilise the plant and the firm’s expertise.

The firm considers the outbound practices of all staff involvement highly important. Demonstrated by the presence of a dedicated innovation team, Firm F actively encourages - expects - all staff to contribute including potential innovations arising from customer and licensee feedback, insights from engineers and salespeople.

6.6.4 Open innovation engagement experiences

From the firm’s experience, open innovation requires a different approach to closed innovation. Open innovation demands more comprehensive and more formal processes; consequently, dramatically increases investment of a greater percentage of resources. Whether it is the challenge of managing personalities within collaborating parties, contending with differing agendas, or aligning objectives, the difficulties are a necessary part of open innovation according to Firm F, “it really comes down to the internal resource here, to manage those [open innovation demands]” (R&DD). For instance, the firm finds innovation champions necessary to drive open innovation arrangements to incorporate results internally, and ensure instigation of legal protocols. These rely on management to instigate, whereas such activities are not required for closed innovation.

In addition, the firm employs project managers, allocating one to each project to coordinate efforts. Firm F measures the results of each project and the efforts of the project manager to ascertain project management success. There is also some lengthy relocation of employees to install product innovations on client sites. The individuals draw from the project team not from factory staff, the imposition of stress on others in the project team inevitable to compensate for the loss.

Consequently, the firm appreciates open innovation is resource demanding. The FM, as responsible for the factory and equipment, often finds open innovation an imposition. He advises that open innovation can play havoc with factory resources and routines, “mainly because you schedule your resources to do the jobs in hand. The [open innovation] tasks are over and above that, so it’s trying to squeeze them in”. The factory adheres to tight schedules; consequently the unavailability of plant and staff for BAU activities due to involvement in open innovation projects results in time delays, which are, “a given really” (R&DD). Open innovation therefore causes consternation between factory employees and other staff. For example, delays to allocated work while R&D runs open innovation tests can
lead to the factory missing deadlines. The R&DD elaborates, “things generally take longer in open innovation development and so a piece of equipment might be tied up in the workshop…. Invariably you end up tying up machinery for longer than expected”. The FM responds that, “you are not going to meet one of those targets” iterating the open innovation schedule impositions to BAU.

The FM sums up his concerns with open innovation as weighing heavily on, “time and people, the main elements from my perspective. [Open Innovation is] time consuming” he said, specifically his and the R&DD’s time and skill. He views a conflict between BAU and open innovation projects, “the biggest problem is taking people off jobs that have committed timelines. Because we’re so tight with resources, and because our timelines are so fine, it doesn’t take much to bump them”.

Likewise, the OD views the pressure on time is the biggest area of concern. Employees are already busy, open innovation simply adds to the stress. He alluded to the constant tension between BAU and open innovation endeavours that leads to delays as employees contend with competing priorities. Similarly, reviewing current and past arrangements and ensuring application of best practices are limited by the availability of time. “We can put that off till later” (FM) is a common reaction to the suggestion of reviews although “later” rarely happens, limiting improvement of open innovation protocols for future initiatives.

However, the FM’s opinion of open innovation is not all negative. He acknowledges a key benefit of open innovation is the firm and employees’ enhanced learning. More often there is, “more brainpower working on it…. come up with the right solution quicker, you also learn from that”. Designs and projects benefit from application of the knowledge acquired from open innovation projects. The OD advises, “we learn from them, they’ll learn from us”, stressing the importance of the learning aspect of open innovation.

Another area highlighted is that the firm’s core value links indelibly to its intellectual property, in turn the income earned from sharing its intellectual property. This practice dramatically increases the risk of intellectual property breaches if selection of open innovation partner is flawed or poorly managed. Fortunately, the highly designed nature of the firm’s products thwarts imitation according to the R&DD as does their providing in fragments the intellectual property and supporting mechanics to prevent full comprehension. These efforts limit the extent to which a party may benefit if there is an attempt to usurp the intellectual property. In addition, protection of intellectual property is through legal instruments
although, “I sometimes wonder whether they’re worth the paper they’re written on” (R&DD).

The FM has concerns with intellectual property issues and conveying requirements, “to spend the amount of time to bring them up to understand what you need…. It can be quite a challenging task”. The OD perspective differs, he advises that they consider the licensees and open innovation partners are trustworthy, “we probably accept them at their word… reputable organisations… wouldn’t blatantly breach the contract”.

Corresponding to relationship management and intellectual property protection concerns is employees’ abilities to interface in a commercially appropriate manner with other parties. Commercial astuteness is absent in some employees advised Firm F, which becomes evident during open innovation. Unable to differentiate between what is acceptable and what is inappropriate to discuss can be problematic. The R&DD explained that, “[engineers] don’t see the commercial implications of a comment… Flippant comments that aren’t necessarily true can be spun out of control”. The R&DD elaborated that technical people desire to be truthful, yet their naïveté means they do not always appreciate the consequences of their comments. The comments when taken out of context lead to misunderstandings that require “damage control” (R&DD) and the intervention of management to limit ramifications.

Conversely, the FM refers to open innovation information, “walks around in people’s heads”. This presents several challenges: difficulties in accessing and distributing the knowledge gained from open innovation projects; secondly, extracting the knowledge for open innovation partners. He justifies the reticence of employees to share with others is, “part of what makes them [the individual] valuable to the organisation”, protecting their knowledge in effort to assure their continued value to the firm.

6.6.5 Summary

There are some department differences on the benefits and even interest in open innovation engagement. The R&D team perceives it as critical to fulfil innovation objectives regardless of the additional issues created by application, “no pain, no gain” (R&DD). From their and the OD’s perspective the difficulties simply demand close management. However, the FM would prefer to avoid open innovation altogether if possible, “I guess I am mindful of the time it takes, and the limited resources…. It requires more resources... we are struggling to meet the load that we’ve got” (FM).
Although some personnel are more convinced than others of the value of open innovation, there is uniform agreement that it has a positive impact on the firm. In particular, the R&D views open innovation as crucial to meet innovation knowledge deficits and innovation objectives. Due to Firm F’s intense growth trajectory, internal resources remain restrained, tightly controlled, and carefully allocated. Engagement in open innovation facilitates access to needed innovation resources to meet Firm F’s innovation requirements. Although the firm acknowledges open innovation imposes additional stress on scarce internal resources on, among others, management and worker routines.

While Firm F appreciates there are issues associated with open innovation; there is also full realisation that perseverance is definitely worthwhile. Open innovation helps realise innovation objectives, therefore the firm’s growth strategy. Consequently, open innovation is most likely to increase under expansion ambitions to compensate for innovation deficits and to accelerate development through utilising others’ resources.

Chapter 7 next, considers the case firms’ practitioner experiences of open innovation. The chapter assesses the implications of engagement, analysing the effect to the characteristics of the innovative SME.
Chapter Seven

SMEs’ OPEN INNOVATION PRACTICE IMPLICATIONS

This chapter presents the result of the case study analysis. The analysis follows the sequence of the conceptual framework; consequently, this chapter commences with establishing case firms’ open innovation practice engagement (section 7.1). Section 7.2 compares the literature-derived effects listed in the conceptual framework with case firms’ data to establish the range of effects case firms’ experience. Section 7.3 presents the effects in relation to innovative SMEs’ characteristics by, firstly, consideration of the innovative SME characteristic effects that span practices. Secondly, the effects observed by case firms specific to each practice, the relationship complexities case firms’ experience, and additional effects experienced beyond those identified in the conceptual framework.

Section 7.4 discusses the enhancement of organisational learning from case firms’ open innovation engagement. Section 7.5 identifies case SMEs management of open innovation and associated effects through the adoption of organisational practices; lastly, the chapter provides details on findings additional to the research question and objectives (section 7.6). The findings include an extra characteristic of innovative SMEs not apparent in the literature. Also considered is case SMEs continuation of closed innovation to support open innovation endeavours and the size variations apparent in case SMEs. The last part of the section reviews the innovative SMEs’ characteristics that appear to support or are unaffected by open innovation. Section 7.7 summaries the chapter.

7.1 Practice engagement

This study qualifies SMEs’ open innovation engagement as manifest through the eight practices of van de Vrande et al. (2009), which embody equity and non-equity arrangements, formal and informal activities. Analysis of the case firms data show all case firms employ three practices:

- Customer involvement to fulfill customer requirements
- External networking, collaborating with others to compensate for resource deficits; often driven by realisation of customer requirements
- Employee involvement: encouragement of all staff to contribute to enhance innovation results.
The findings support the popularity of the three practices as found by van de Vrande et al. (2009). The next most adopted (five firms) is the practice of external participation. As identified by van de Vrande et al. (2009), external participation is a higher-level practice and costly to SMEs. Yet, while prior research indicates the larger case firms will engage the practice, three of the smaller SMEs also engage in the practice. This apparently contradicts van de Vrande et al’s (2009) assertion that external participation is the domain of the larger SME. The smaller case SMEs innovation and growth ambitions directing early adoption of this resource-demanding practice.

Regarding the other practices: outsourcing R&D is the next most common activity (four case firms), the SMEs finding the practice highly cost effective as suggested by Gavin (1993). Half the case firms engage in venturing and licensing-out. While licensing-out is evident in the larger SMEs, the firms rarely employ the practice due to steep resource costs. However, one smaller SME engages the practice, despite cost, to exploit the value of their innovations. Finally, only two case firms practice licensing-in, however find the practice helpful to more immediately achieve innovation objectives.

7.2 Literature-derived effects specific to practices

From the conceptual framework, we expect case SMEs to experience certain effects from open innovation practice engagement. From the findings, beneficial effects listed in the conceptual framework are all or primarily supported by case SMEs (Table 22). The detrimental effects consistent with the framework include the reliance on management, dependence on relational ability, stress on internal resources, and partner-related issues. However, while the case SMEs support many of the detrimental effects identified in the conceptual framework, case firms did not agree with all. The effects not supported are (Table 23):

- Evidence of negative behaviour with customer involvement: Case SMEs closeness to their customer and appreciation of firm survival depends on customer satisfaction overrides possible negative behaviour. Similarly, case firms do not support other negative effects considered consistent with customer involvement. This does not discount the detriments exist in case firms, simply that meeting customer requirements override the influence of any negative effect.

- Disintegration of internal innovation: Engineering firms’ existence depends upon development of innovative solutions to customer problems. Consequently, case firms engage in both open innovation and closed innovation finding the strategies complementary and necessary to achieve innovation objectives.
Table 22: Effects specific to practice: Beneficial

<table>
<thead>
<tr>
<th>Beneficial</th>
<th>Customer</th>
<th>Network</th>
<th>Participation</th>
<th>Outsourcing</th>
<th>Licensing-in</th>
<th>Employee</th>
<th>Licensing-out</th>
<th>Venturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of knowledge and other innovation-required resources</td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not relevant</td>
</tr>
<tr>
<td>Augmentation of organisational learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased revenue sources</td>
<td>Some support</td>
<td>Supported</td>
<td>Some support</td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td>Some support</td>
</tr>
<tr>
<td>Brand and reputation enhancement</td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td>Not relevant</td>
<td>Supported</td>
<td>Irrelevant</td>
</tr>
</tbody>
</table>

Table 23: Effects specific to practice: Detrimental (italics = effects not supported by the case firms)

<table>
<thead>
<tr>
<th>Detrimental: Internally located</th>
<th>Customer</th>
<th>Network</th>
<th>Participation</th>
<th>Outsourcing</th>
<th>Licensing-in</th>
<th>Employee</th>
<th>Licensing-out</th>
<th>Venturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade off between BAU and open innovation</td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Some support</td>
</tr>
<tr>
<td>Disintegration of internal innovation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not supported</td>
</tr>
<tr>
<td>Reliance on adequacy of management time, expertise, and relational skills</td>
<td></td>
<td></td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependence and stress on internal resources</td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td>Some support</td>
<td></td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>Increased costs</td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td>Not supported</td>
<td>Supported</td>
<td>Some support</td>
<td>Supported</td>
</tr>
<tr>
<td>Business structure inadequacies</td>
<td>Not supported</td>
<td></td>
<td></td>
<td>Supported</td>
<td></td>
<td></td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>Detrimental:</td>
<td>Internally located</td>
<td>Customer</td>
<td>Network</td>
<td>Outsourcing</td>
<td>Licensing-in</td>
<td>Licensing-out</td>
<td>Employee</td>
<td>Venturing</td>
</tr>
<tr>
<td>-------------</td>
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<td>-------------</td>
<td>--------------</td>
<td>--------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Behavioural issues (NHH, NSH, OUIH, lack of motivation)</td>
<td>Not supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Some support</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
</tr>
<tr>
<td>Difficulties with knowledge management</td>
<td>Some support</td>
<td>Majority support</td>
<td>Majority support</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Some support</td>
<td>Irrelevant</td>
</tr>
<tr>
<td>Tendency to informality with arrangements, inability to afford intellectual property protection</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Preference for known entities</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Irrelevant</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Partner and outcome delays impacting R&amp;D and internal resources</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Externally located</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulties with interpreting customer requirements and ideas, relational risks</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Costs and uncertainty in partner identification, qualification and establishment of suitability</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Interfirm relationship complexities</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Dependence on firm network to compensate for innovation inadequacies</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Inability to control partner actions</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
<tr>
<td>Financial consequence if customer/ partner relationship deteriorates</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
<td>Supported</td>
</tr>
</tbody>
</table>
o Outsourcing R&D increasing firm costs: case firms state use of the practice is more cost-effective than purchasing the expertise and equipment themselves.

o Lack of formal mechanisms: according to case SMEs, three practices unequivocally demand formal legal mechanisms to permit application. Case firms employ such intellectual property protection instruments to enable adoption and to exploit innovation opportunities; in these instances, negating the innovative SMEs' characteristic tendency towards informality.

o Although case firms favour familiar entities to reduce risks and impositions on management, the SMEs actively search out and engage with all possible open innovation entities relative to resource requirements.

Consequently, while the findings reinforce some effects, support for all effects identified in the conceptual framework is not apparent in case SMEs. Furthermore, as evident in Table 22 and in particular Table 23, the data suggest effects are practice-specific or experienced across practices, rather than divisible between inbound and outbound modes.

7.3 Practice implications to the characteristics of innovative SMEs

Having established in 7.2 the effects from case SMEs' open innovation experiences, this section explores how the effects impose on innovative SMEs' characteristics. The following subsections therefore examine:

o The effects experienced consistently across practices, divided between resources and behaviour - key features of innovative SMEs' characteristics (subsection 7.3.1)

o Effects attributable to certain practices (subsection 7.3.2)

o Consideration of the effects attributable to the external relationships the findings point to these effects spanning practices (subsection 7.3.3)

7.3.1 Effects on innovative SMEs' characteristics across practices

The case firms present strong evidence of many effects occurring regularly and common across practices. Presentation of the findings divides open innovation implications between the innovative SMEs' characteristics key features of resources and behaviour.

Resources

o Appreciated from the conceptual framework, access to resources is a significant benefit of open innovation. Case firms confirm this. Resource acquisition dominates the benefits of open innovation engagement, particularly knowledge acquisition:

26 As outlined in Chapter 3, sub section 3.3.4
“you can’t rely on the knowledge within the company otherwise you’re almost got your blinkers on then to new ideas. We try to find partners or people who share their knowledge to get extra ideas” (Firm C).

- A characteristic appearing in the conceptual framework is the trade-off between BAU and open innovation. Especially the imposition on management to juggle multiple and conflicting BAU and open innovation responsibilities, “it’s painful process for sure – painful but critical, no pain, no gain” (Firm F). Management compensates by working “harder and longer hours” (Firm C).

- The conceptual framework lists dependence and stress on internal resources an effect of open innovation. The case firms agree; they experience open innovation as costly and heavily dependent on already burdened resources. For example:

  - Partner delays burden internal resources to compensate, further stressing financial and human resources, “even though it costs us time and money, that’s where we see the benefits coming from” (Firm D), “If you lose, you can potentially lose money faster” (Firm E).

  - Another internal resource stressed is that of knowledge. Management of firm-held knowledge continually requires attention. Case SMEs questioning the extent of intellectual property revealing to afford open innovation endeavours, a quandary appreciated by West (2006). Once acquired, assimilation and retention are often problematic with SMEs constantly pondering effective knowledge practices (Luoma et al., 2010a).

  - Case firms report little impact on physical resources generally from open innovation endeavours. The findings suggest some minor impact in terms of equipment unavailability during open innovation testing and development, similarly the unavailability of experienced staff when dedicated to open innovation projects. In case firms’ opinions, the benefits of skill development and improved equipment usage considered more than compensatory for any inconvenience.

  - Organisational resources primarily benefit from open innovation according to case firms. Open innovation facilitated organisational learning opportunities enhances internal practices and processes. Case SMEs explain that any “organisational problems, they are not as important as other issues” (Firm E).

  - However, while the conceptual framework identifies an innovative SMEs’ characteristic is the inability to exploit external sources of knowledge, the case firms do not support this. Case firms instead take active measures to develop and exploit
external sources for innovation, the measures a basic function of the firms’ managerial and organisational practices.

Behaviour

The conceptual framework refers to innovative SMEs’ characteristics of agility, fast learning, and flexibility as advantageous innovation behaviour. The case firms demonstrate such innovation-supportive behaviour. However, negative behaviour resulting from open innovation endeavours contradicts the advantageous behaviour characteristics and inhibits open innovation value-realisation. For example, to counter the negative behaviour of staff requires managerial intervention. The conceptual framework lists further behavioural effects, which case firms fully support:

- The existence of the NIH syndrome limiting or preventing open innovation: the characteristic of change resistance and the accompanying threat to routines demonstrated by case SME staff.
- The majority of the case SME managers demonstrate evidence of NSH and OUH.

Managers question the value of firm-developed innovations as unique to firm innovation efforts and customer purpose, therefore lack further application. This is consistent with van de Vrande et al. (2009) finding such behaviour hinders realisation of potentially valuable revenue sources, the behaviour comparable to the innovative SME characteristic of technical myopia.

The negative behaviour appears contrary to innovative SMEs' characteristics of fast learning and adaptation of routines while aligning with the negative characteristics of change resistance and threatened routines. Case firms manage the conflict between these characteristics and other open innovation contradictory effects by adopting various organisational practices.

7.3.2 Effects specific to a practice

While many effects span open innovation practice, data from case SMEs suggest that some practices have specific implications to innovative SMEs' characteristics. For instance, the regularly adopted practice of customer involvement generates the most benefits for case firms resulting in customer satisfaction and retention. Conversely, the practice of network collaboration presents the greatest effects and challenges for case SMEs. Other practice specific effects on characteristics are:
**Customer involvement**

“With customers one way or another you do a lot of innovation” (Firm A). Attending to customer satisfaction and consequent retention causes the practice to be paramount in case SMEs, subsequently the one most pursued. Reinforced are the beneficial behaviours of SME flexibility and agility in responding to customers. However, the characteristic of customer dependency and financial implications of customer loss underscore the case firms’ vulnerability. The dependency therefore compels realisation of customers’ innovation requirements without question and mandate customer satisfaction for business continuity. Consequently, case firms value the contribution of open innovation to client retention as found by Piller and Ihl (2009). Although the practice can be a cost imposition to case firms, cost recovery occurs on a project basis, or from on-going client loyalty.

**Network collaboration**

The use of external sources for innovation is an innovative SMEs’ characteristic (Freel, 2003; Laforet & Tann, 2006). Overall, case SMEs response to the practice is positive and often adopted to meet customer innovation requirements. Exposure to others’ activities improves case firms’ organisational processes and enhances learning, acknowledged and purposeful open innovation outcomes embraced by case SMEs. However, while the practice addresses resource shortcomings, it present substantial detriments with the partner-related dimensions highly time consuming and heavily dependent on managerial ability. Case firms support the effects detailed in the conceptual framework advising the practice is very costly to internal resources, “even though it costs us time and money, because long term, that’s where we see the benefits coming from, establishing those networks, having those relationships” (Firm D).

Furthermore, as per the conceptual framework, the case firms affirm the practice accentuates negative employee behaviour requiring management to develop compensatory methods. Yet, firms find many employees relish involvement in open innovation endeavours, involvement supporting employee retention. Nonetheless, some employees appear openly reluctant and view introduced innovations with suspicion (Chesbrough & Crowther, 2006; Hadjimanolis, 2003; Luoma et al., 2010a). The same issues arise with other practices, especially outsourcing R&D and licensing-in.

**External Participation**

The two larger case SMEs have engaged this practice. Furthermore, three smaller case firms are participating in groups to realise radical innovations. The upfront monetary
investment and the extensive demands on managerial time and relational ability are painful impositions on the smaller resource-strapped SMEs. Moreover, the managerial demands of multi-party collaboration are dramatically steeper than those expected by case firms. However, as indicated by the conceptual framework, the immediate benefits are the dramatic increase of participants’ knowledge through cumulative exchange and contribution of innovative ideas. Furthermore, if success, the return will be substantial financially. Nevertheless, the practice is associated with high risk and the investment return long term at best. The case firms support prior research regarding external participation as higher level and demanding than the more common practices (U. Lichtenthaler, 2010b; van de Vrande et al., 2009).

**Employee involvement**

The conceptual framework allies the practice with behaviour benefits and problems. In the first instance, case SMEs view all staff innovation input is axiomatic. Likewise, support the practice as presenting advantageous and disadvantageous effects behaviour implications. A clear benefit is firm improvement through staff innovation contributions. Detrimental effects relate to disinterest among staff and their disregarding innovation-input opportunities. Each case firm manages the attitudes differently; some simply ignore reluctant staff and focus on innovation-orientated employees, others make concerted efforts e.g. Firm D’s reward system.

**Licensing-out**

The conceptual framework identifies the practice as providing financial benefits. The case firms who engage in the practice support the financial rewards after meeting initial costs. An added benefit for case firms is realisation of international expansion. In addition, firms report licensees’ modifications to meet local demand develop valuable intellectual property and further enhance organisational learning. In addition, the SMEs report licensing-in and licensing-out offer cost advantages to achieve firm and innovation objectives.

**7.3.3 Relationship complexities**

As identified in the conceptual framework, reliance on external entities results in unfavourable consequences to internal resources. The case firms agree. Supportive of the conceptual framework, case firm managers encounter difficulties throughout relationship stages. These include impositions on management time and ability to manage open innovation, partner delays, dysfunctional relationships, and complexities of arrangements heavily influence human resources. Similarly, the case firms iterate the characteristics of weak external contacts and interface difficulties exacerbate the effects. Furthermore, lack of
management time results in few, if any post-project assessments, limiting the potential for organisational learning for application to future endeavours.

The conceptual framework lists relationship issues as a well-recognised area of open innovation engagement detriments. The case firms agree, emphasising external entities present as the single greatest problem area. The issues emphasise innovative SMEs’ characteristics deficits in managerial skills, tendency to informality, and insufficient staff especially limiting the availability of sufficient relational ability. However, the case firms add identifying and connecting with receptive individuals representing the external partner an important feature to open innovation relationship efficacy not apparent in the literature.

Management of open innovation partners, “burden resources as well as managing that process... there’s trust and whole range of things that need to be dealt with, it is not a quick process” (Firm D). To reduce relationship and resource risks associated with open innovation case SMEs preference familiar entities - a recognised innovative SME characteristic. Case firms agree that deference to known partners limits relationship risks; however, familiar entities may not always possess the required resources. Consequently, in order to maximise engagement benefits they survey widely for suitable entities and novelty of innovation offering, as per this beneficial characteristic. This then argues against the SME characteristic of defaulting to known entities.

The deliberate searching for potential partners outside of firm networks addresses an apparent oversight of van de Vrande et al. (2009) regarding SMEs intentional cultivation of partners regardless of network familiarity. This practice also minimises intellectual property protection issues, “the best collaboration comes about when formal agreements are not required” (Firm D). Moreover, case firms report experiences with open innovation develop relational ability, repetitive experiences building relationship competency.

7.3.4 Additional effects

In addition to the effects identified in the conceptual framework, the case firms experience others not apparent in the literature. Table 24 lists the case firms’ additional effects experienced specific to three practices including the ninth practice offered by half the case SMEs: the provision of R&D service. Apparent in Table 24 is the benefit to organisational resources through client retention, reduction in costs due to access to other organisations’ equipment and enhancement of organisational learning through the provision of R&D services.
### Table 24: Additional Open Innovation Effects on Innovative SMEs’ Characteristics\(^{27}\)

<table>
<thead>
<tr>
<th></th>
<th>Customer involvement</th>
<th>Network collaboration</th>
<th>Additional Practice of R&amp;D service offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical resources</td>
<td>Improved equipment usage</td>
<td>Unavailability of equipment stresses BAU</td>
<td>Unavailability of equipment stresses BAU</td>
</tr>
<tr>
<td>Organisational resources</td>
<td>Financial resource benefits through client retention</td>
<td>Access to others’ equipment reduces financial impositions</td>
<td>Innovative use of equipment equates to organisational learning</td>
</tr>
<tr>
<td>Behaviour</td>
<td>(Irrelevant)</td>
<td>Some staff dislike interruption to routine</td>
<td>Benefits financial resources</td>
</tr>
</tbody>
</table>

#### 7.3.5 Summary of practice effects

The conceptual framework refers to open innovation benefiting some innovative SMEs’ characteristics while other characteristics are detrimental. The benefits of engagement dominate case firms’ appreciation of open innovation leading to repetitive engagement. According to case SMEs, the value represented by open innovation engagement justifies the investment of effort and internal resource costs, “a lot is hard to measure in dollar terms… trading knowledge. How do you quantify that?” (Firm D).

- While some open innovation practices present specific implications to the innovative SMEs’ characteristics, many key beneficial and detrimental effects span practices.
- Human resources benefit the greatest from open innovation particularly in knowledge development and organisational learning; conversely, experience the greatest pain.
- The case firms support the conceptual framework that open innovation involves impositions on managerial resources and the characteristic of skill deficits.
- Behavioural difficulties prove contrary to the characteristic feature of beneficial behavioural attributes.
- Application of higher-level practices relies on SMEs having sufficient finances to afford intellectual property and legal services.
- External entity issues dominate concerns. Finding, and qualifying partner suitability, relationship complexities and necessary relational abilities all weigh heavily on management.
- Awareness of the effects from open innovation endeavours drives further practice adoption. From engaging in the common practices, case firms develop understanding of open innovation, the experiences together with firm objectives and

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\(^{27}\) Italics denote negatives
sufficient resource holdings dictate adoption of the higher-level practices. These findings are congruent with existent research (S. Lee et al., 2010; van de Vrande et al., 2009).

However, factors such as the importance of customer satisfaction suffuse within case SMEs and override many detrimental effects. This finding agrees with Piller and Ihl (2009) that customer centricity equates to firm survival. The closeness of staff and low hierarchal structures mean management and employees are intimately aware that firm survival depends on achieving results for their customer; often satisfaction relies on open innovation engagement with other entities.

### 7.4 Organisational learning

The conceptual framework features organisational learning as a beneficial effect of open innovation. The case firms accentuate organisational learning is a significant benefit, “it’s learning by doing” (Firm E). “Seeing how others do it, seeing it for yourself. Then take that and say, how can we make it work better” (Firm C). The case firms simply visiting potential partners’ premises and viewing facilities can result in dramatically enhanced organisational learning. The substantial benefits have case firms pursuing open innovation precisely to access the learning opportunities. The enhancement of organisational routines relates to the innovative SME behavioural characteristics of flexibility and fast learning capability, and their exploitation of external opportunities. Furthermore, advancement of the firm through exposure to others’ work practices supports organisational development and improvements to open innovation (Dodgson, 1993; Transfield et al., 2000).

#### 7.4.1 Organisational learning and relationship competencies

Case SMEs advise open innovation endeavours provide two forms of organisational learning: the experience itself of open innovation; second, the exposure to external entities work practices and facilities. Enhancement of organisational learning builds case firms knowledge developing organisational processes and structures. Moreover, managerial relational ability develops from repeated experiences of open innovation, the learning then applied to future open innovation interactions (Figure 8).
7.4.2 The cyclic interrelationship of open innovation with SME internal activities

An unanticipated finding is the case firms’ strenuous emphasis regarding the significance of organisational learning as an outcome of, and facilitated by, open innovation. Emphatically stressed by case SMEs as a major benefit and often the sole motivation to open innovation, empirical results suggest a strong association between open innovation, organisational learning, and organisational practices. Organisational learning development occurs through exposure to others’ work activities and routines, and as a function of the experience of open innovation, reciprocally improving organisational practices.

As illustrated in Figure 9, open innovation experiences build engagement competencies, furthering organisational learning opportunities. The SMEs then apply the organisational learning to improve organisational practices in a cyclic process to manage open innovation and to benefit of the firm overall. Subsequently, the case firms recognise the enhancement of organisational learning from open innovation results in open innovation being doubly attractive as offering two significant benefits:

1. Resource acquisition to realise innovation objectives
2. Enhancement of organisational learning beyond normal, organic development.
Figure 9: The Interrelated Cyclical Relationship

7.5 Organisational practices: SME responses to open innovation

The conceptual framework distinguishes various organisational practices adopted to manage the effects of open innovation. Of these organisational practices, case firms support the majority (subsection 7.5.1). However, the case firms report of additional organisational practices to those identified in the conceptual framework (7.5.2).

7.5.1 Organisational practice support

Case firms respond similarly to open innovation by employing various organisational practices. The findings suggest that all case firms adopt the organisational practices identified in the literature in order to optimise open innovation engagement (Table 25). Some organisational practices require the support of additional organisational practices. For example, case SMEs using incentives to encourage staff innovation participation found the activity to be highly successful. The success of employee generated suggestions led development of a further practice - an innovation team to manage the volume of innovative ideas.
Table 25: Organisational Practices in Case SMEs

<table>
<thead>
<tr>
<th>Conceptual framework Practices</th>
<th>Case Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persist with internal innovation to support open innovation knowledge appreciation and integration</td>
<td>All case firms engage in closed and open innovation as complementary. Both required as knowledge generators to gain most from innovation endeavours.</td>
</tr>
<tr>
<td>Administer open innovation management strategy including knowledge integration</td>
<td>SMEs introduce specific practices that support integration of open innovation, e.g. the pre-testing and adapting of routines before instigation, found to be important in half SMEs to address change resistance and NIH syndrome.</td>
</tr>
<tr>
<td>Defer to more common open innovation practices</td>
<td>Generally, smaller SMEs reduce risk through adherence to common open innovation practices. Larger SMEs with sufficient resources and expertise engage in all levels of open innovation practices.</td>
</tr>
<tr>
<td>Employ methods to identify, and exploit new knowledge and new open innovation partners</td>
<td>Considered a function of management responsibilities. SMEs use various strategies including the internet and calling on firm network, the last a recognised innovative SME characteristic.</td>
</tr>
<tr>
<td>Intentional incorporation of open innovation relationship learning to enhance relational skills</td>
<td>The practice an important function of management.</td>
</tr>
<tr>
<td>Innovation champion supporting internal adoption of open innovation</td>
<td>Management consciously adopts practices to overcome NIH syndrome and change resistance to open innovation.</td>
</tr>
<tr>
<td>Incentives to motivate employees</td>
<td>Purposeful solicitation of staff for innovation suggestions, use of innovation idea boards, casual group discussion, operation of incentive programmes. Smaller SMEs use collegial manner to gain staff “buy in”.</td>
</tr>
<tr>
<td>Favour familiar partners</td>
<td>None limit themselves strictly to familiar entities. However, the practice reduces stress on management and financial resources.</td>
</tr>
<tr>
<td>Preference for informality in partner arrangements</td>
<td>The cost and expertise required deemed too high or irrelevant in smaller SMEs. However, the large SMEs consider legal instruments standard.</td>
</tr>
<tr>
<td>Close management of knowledge sharing with partners: selective revealing</td>
<td>A perennial difficulty for SMEs. Some defer to legal protection; others cite preference for familiar partners assists managing the dilemma. All case firms struggle with open innovation knowledge management.</td>
</tr>
</tbody>
</table>

7.5.2 Case firm additional organisational practices

Case firms employ additional organisational practices not apparent from the literature. Table 26 lists the additional organisational practices case firms adopt to address the effects of open innovation engagement.
<table>
<thead>
<tr>
<th>Practice</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management extending work hours to meet BAU and open innovation responsibilities</td>
<td>The firm meets the demands of open innovation and BAU. For the individual, personal satisfaction competes with increased stress.</td>
</tr>
<tr>
<td>Software programmes for knowledge management</td>
<td>Supports capturing of open innovation knowledge value.</td>
</tr>
<tr>
<td>Formal organisational systems (Lean, Stage Gate)</td>
<td>Case SMEs employ formal systems directly and indirectly assisting development and assimilation of open innovation.</td>
</tr>
<tr>
<td>Formal and informal development of open innovation partner criteria</td>
<td>Criteria establishment supports search strategies and limits inaccurate selection.</td>
</tr>
<tr>
<td>Preference open innovation-keen staff</td>
<td>Smaller SMEs tend to favour staff enthusiastic about innovation, ignoring those less so to focus on routine work.</td>
</tr>
<tr>
<td>Knowledge sharing advice with staff on intellectual property secrecy aspects</td>
<td>Larger SMEs no longer experience staff closeness with customer, therefore, are required to make specific efforts to ensure staff awareness of sensitive information.</td>
</tr>
<tr>
<td>Intentional efforts made to investigate, analyse and incorporate other organisations’ work practices</td>
<td>Deliberately seek opportunities for organisational learning and organisational practice development through open innovation.</td>
</tr>
<tr>
<td>Scheduling open innovation projects, factor additional time into schedules</td>
<td>The likelihood of partner delays compensated by factoring in additional time in project scheduling.</td>
</tr>
<tr>
<td>Monitoring resource usage</td>
<td>With varying degrees of success, case SMEs use a range of methods to audit open innovation resource expenditure.</td>
</tr>
<tr>
<td>Separate open innovation project specific areas to reduce impact on BAU</td>
<td>Isolating open innovation endeavours reduces interference with BAU and supports monitoring of resources associated with open innovation.</td>
</tr>
<tr>
<td>Employment of open innovation project managers</td>
<td>Larger case SMEs closely manage arrangements through project managers. The smaller SMEs unable to afford such luxury in human resources manage projects on a piecemeal basis.</td>
</tr>
</tbody>
</table>

The application of some practices contributes to improve organisational receptivity to open innovation: the case firms noting a distinct difference between staff (many demonstrating resistance to open innovation) and management attitudes to innovation (who universally consider open innovation beneficial). Identification of the supplementary organisational practices suggests innovative SMEs actively manage open innovation to optimise endeavours. However, while case firms recognise the benefits of the organisational practice of post-project analysis, the majority do not undertake such reflections blaming the...
lack of time. Likewise, the SMEs admit this limits fully appreciating the organisational learning from endeavours.

7.5.3 Summary of organisational practices

As identified in the conceptual framework, case SMEs develop organisational practices to improve the return from open innovation. Case firms introduce process improvements and practices to progress cultural receptivity, to support assimilation of introduced innovations resulting from open innovation and the organisational learning from engagement. The organisational practices developed and refined through further open innovation endeavours.

7.6 Additional findings

In addition to the conceptual framework, data from case firms offers additional insights on open innovation in SME practitioners. Firstly, an innovative SMEs' characteristic directly relating to open innovation (7.6.1); a ninth open innovation practice (7.6.2); the complementarity of open and closed innovation in case firms; and the variations in the open innovation experiences of case firms relative to size (7.6.4). Finally, the characteristics found supportive of open innovation endeavours (7.6.5) and a closer consideration of the engineering SME in terms of open innovation and other industries (7.6.6).

7.6.1 Supplementary innovative SME characteristic

In addition to the characteristics listed in the conceptual framework, case firms advise of a characteristic important to open innovation: closeness to customer. The lack of bureaucracy, close communication, and small employee numbers mean firms are intimately familiar with their customers, their individual requirements, and relationship nuances. The closeness assists to expedite innovation.

7.6.2 Additional open innovation practice

Complementary to van de Vrande et al.'s (2009) practice of outsourcing R&D, engineering case SMEs provide their facilities and expertise to other entities for innovation. This ninth practice of offering R&D outsourcing services benefits engineering case SMEs’ financial resources and organisational learning from service experiences. Negatives relate to physical and human resources: the unavailability of project-dedicated machinery and staff imposes on BAU and for an unknown duration stressing deadlines.

7.6.3 Complementary nature of open and closed innovation

Lichtenthaler (2010) warns open innovation adoption risks the demise of closed innovation as firms focus instead on external opportunities. However, the findings herein are
consistent with others who advise closed innovation complements open (e.g. de Faria et al., 2010; Poot et al., 2009; Schroll & Mild, 2011). The case firms consider continuance of closed innovation critical, evidenced by at least half of all innovation initiatives occurring internally. Case SMEs emphasise the importance of internal innovation to recognise open innovation opportunities and to maximise gain from open innovation (Dahlander & Gann, 2010; Vanhaverbeke et al., 2007).

### 7.6.4 SME size category variations

Earlier studies found open innovation manifests differently within the SME size category (e.g., Bianchi, Cavaliere, Chiaroni, Frattini, & Chiesa, 2011; Chiaroni et al., 2009; Hoffman et al., 1998; van de Vrande et al., 2009). Prior research suggests that larger SMEs demonstrate greater formality and division between management and manufacturing staff and have more resources at their disposal to support open innovation (Laforet & Tann, 2006). Although not a construct of the conceptual framework, discernable from this research are indications of variations in the implications of open innovation within the different sizes of the SMEs (Table 27).

<table>
<thead>
<tr>
<th>Case firms</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smaller SMEs</td>
<td>Prefer to avoid legalities between partners. Viewed as unnecessary demand on financial and human resources; legalities Impeding “friendly” relationships</td>
</tr>
<tr>
<td>Smaller SMEs</td>
<td>Rarely experience casual intellectual property breaches by staff due to close internal communication.</td>
</tr>
<tr>
<td>Smaller SMEs</td>
<td>Greater propensity for OUH and NSH</td>
</tr>
<tr>
<td>Smaller SMEs</td>
<td>Deferment to common, less risky open innovation practices relative to firm resource holding, objectives, and competencies</td>
</tr>
<tr>
<td>Larger SMEs</td>
<td>Formal instruments standard with availability of sufficient funds</td>
</tr>
<tr>
<td>Larger SMEs</td>
<td>Larger SMEs have adequate staff and other resources to dedicate to open innovation. However, strains remaining human resources to compensate.</td>
</tr>
</tbody>
</table>

Most evident from findings (Table 27) is the ability of larger case SMEs to draw on greater resources to afford and manage a range of open innovation practices. Conversely, the smaller case SMEs informality of relationships assist to negate the costly legal arrangements adopted by larger SMEs. Furthermore, smaller case SMEs attribute successful open innovation engagement to the absence of bureaucracy. Correspondingly, of note is the
apparent rarity of negative open innovation behaviour in larger firms. While the larger SMEs acknowledge the possible existence of such behaviour, the expectation is that employees will meet their responsibilities without questioning the source of innovations, reflecting the presence of greater bureaucracy in larger SMEs.

**7.6.5 Innovative SMEs' characteristics advancing open innovation**

While the research considers the effects of open innovation to innovative SMEs' characteristics, case firms advise some characteristics are uninfluenced or advantageous to engagement. For instance, case SMEs lack of bureaucracy fosters firm agility to rapidly respond to open innovation opportunities, while entrepreneurial tendencies increase receptivity to open innovation. In smaller SMEs, closeness of staff and sound internal communication enhance open innovation integration. Consistent with the framework, features such as brand enhancement - while not strictly related to innovative SMEs' characteristics - supports open innovation endeavours (Chesbrough & Crowther, 2006; Cosh & Zhang, 2011). Furthermore, the findings suggest brand enhancement reduces stress on management resources as firm reputation improves attractiveness as an open innovation partner (Luoma et al., 2010a).

**7.6.6 The engineering SME**

As identified in prior studies, the engineering industry is a key source of innovation and specialist providers supportive of other organisations’ innovation activities (Principe, 2000; van de Vrande et al., 2009). This study found likewise, the innovative efforts of the case SMEs critical to realise customers and other entities’ innovative requirements, demonstrated by case SMEs provision of R&D services. While Laforet and Tann’s (2006) research shows engineering SMEs favour process innovation over product, a finding supported by Stage 2 of this research, the group collaboration and other innovation activities suggest efforts are expended in developing product innovations through open innovation. However, as found by Ritter (1999), the tendency is for closed innovation in the first instance, turning to open innovation when internal resource shortages limit innovation realisation.

Furthermore, the findings show behavioural barriers restrict appreciation of open innovation benefits, for example the reluctance of some engineers to turn externally for assistance by Firms B, D, and E. Similarly, in terms of OUH and NSH, half the case firms neglect the potentiality of additional income streams presented by their internally developed innovations.
While these negative behaviours may be attributed to the self-reliance of engineering personnel when conducting innovation, other studies indicate few differences between innovative SMEs regardless of industry (Laforet & Tann, 2006; U. Lichtenthaler, 2008). The findings suggest that experience of open innovation may be similar in other industry SMEs.

7.7 Chapter summary

The case SMEs view open innovation as *sine qua non* to acquiring innovation-required resources to realise innovation objectives. Findings suggest engagement results in such resource-specific benefits. However, there are indications of detrimental implications to innovative SMEs' characteristics. Yet, according to case SMEs, the crucial contributions derived from engagement supersede the negative characteristic effects. This also relates to practice selection. The selection and adoption of open innovation practice relates to firm size and the presence of sufficient resources, particularly financial. Nonetheless, in some situations the innovation objectives may drive early adoption of resource-demanding practices in pursuit of growth opportunities.

Although specific open innovation practices exhibit particular implications, key benefits and detrimental effects span across practices. The benefits spanning practices highlighted by the case firms relate to:

- Acquisition of resources, especially knowledge, compensating for resource shortcomings considered the most significant benefit to open innovation. The access to required resources affording the realisation of innovation objectives otherwise not feasible (Hoffman et al., 1998)
- Organisational learning is considered a highly significant benefit and supportive of innovative SMEs' activities.

Organisational learning contributes to firm and individuals’ knowledge, improves processes, and builds relational abilities. Moreover, the organisational learning gained from open innovation endeavours further develops SMEs' organisational practices. Repeated engagement in open innovation therefore improves future open innovation endeavours, organisational practice improvements, and continual managerial relationship development.

However, there are key detrimental affects identified by case SMEs:

- Extensive pressure on managerial resources
- Negative internal behaviour
- All facets of the external relationship are highly complex and resource demanding
● Difficulties with knowledge management: extent of revealing intellectual property to the external entity, the challenge and recognition of contribution, internal assimilation of knowledge and protection of firm’s intellectual property.

Findings indicate negative behaviour is counterproductive to innovative SMEs’ characteristic feature of behavioural benefits. However, some characteristics can be supportive of endeavours, for example low levels of bureaucracy, flexibility, and agility. The extensive presence of detrimental implications of open innovation contradict Gianiodis et al. (2010) assertion regarding open innovation having no adverse impact on practitioner firms.

Case SMEs respond to detrimental effects through instigating organisational practices, which also assist to optimise benefits of engagement. While the conceptual framework identifies some of the organisational practices, data from the case firms offer further insight into the managerial efforts extended to manage open innovation.

Concluding this thesis is Chapter 8, next. The chapter summarises this study, draws conclusions and implications from the research findings. The later part of Chapter 8 presents the contributions of this study to the innovation literature, specifically the fields of open innovation and innovative SMEs. The chapter closes with the limitations offering avenues for further research.
Chapter Eight

CONCLUSION

Open innovation is expected to benefit innovative SMEs by facilitating acquisition of innovation required resources, thereby improving realisation of innovation objectives (Major & Cordey-Hayes, 2003; Wynarczyk et al., 2013): access therefore compensating for the well-recognised innovative SMEs’ characteristic of resources shortages. However, whether open innovation affects other intrinsic characteristics of the innovative SME is unknown. Interest in determining the implications of engagement, especially negative effects, led this study to ask: “How does engagement in open innovation influence the characteristics of innovative SMEs?” Three objectives ensued from the question: firstly, to identify the benefits of engagement; secondly, determine the detriments; thirdly, how SMEs respond to manage these effects.

The following sections summarise this study and draws conclusions regarding the consequences of SMEs’ open innovation engagement. A brief overview of the related literature (8.1) and the research design (section 8.2) is followed by a summary of the main findings (section 8.3). Section 8.4 then revisits the conceptual framework in light of the empirical research. Section 8.5 sums up the contributions to theory and practice while Section 8.6 discusses the implications. Section 8.7 considers the limitations of this study and offers suggestions for further research. The chapter ends with concluding remarks (section 8.8).

8.1 Overview of this study

8.1.1 The open innovation domain

Although a relatively new area of research, open innovation rests upon established theoretical pillars. Such pillars include von Hippel’s (1986, 1988) user innovation, Freeman’s (1987) National System of Innovation, Teece’s (1986) regimes of appropriability, Cohen and Levinthal's (1990) absorptive capacity, and Howell’s (2006) necessity effect. The different perspectives have an affinity with firms’ utilisation of external sources to realise innovation.

While precedents of externalised innovation activities exist, Chesbrough’s (2003) categorisation of the various external innovation practices as open innovation generated fresh awareness. Academic and practitioner interest developed rapidly, exploring the concept and
aspects relating to open innovation (Fu, 2012). To date, research has generally focused on large and high-tech firms with a propensity to promote the benefits of engagement. More recently open innovation research has expanded to explore the phenomenon in organisations of all sizes and different industries (Belderbos, Carree, & Lokshin, 2004; Laursen & Salter, 2006; S. Lee et al., 2010).

The attraction of exploring alternative options, beyond closed innovation activities, is congruent with the challenges of the contemporary business environment. Firms increasingly collaborate with other entities to overcome external changes and internal innovation impediments to achieve innovation objectives (Chesbrough, 2003a; Fitjar & Rodriguez-Pose, 2012). Such external changes include knowledge mobility, globalisation, and increasingly rapid technological profusion, while firm-specific drivers centre on the acquisition of innovation-required resources and the enhancement of organisational learning (Grimpe et al., 2008; Laursen & Salter, 2006). These drivers and changes encourage firms to adopt supplementary practices, or in preference to, closed innovation (Montalvo, 2006).

However, challenges accompany open innovation. While open innovation literature is light on the subject, prior literature on externalised innovation activities indicates a myriad of concerns (Dahlander & Gann, 2010; Keupp & Gassmann, 2009). Exogenous factors relate to collaborative relationship complexities, dependence on partner performance, and inability to control partner actions (Fliess & Becker, 2006). Internal problems are prolific and challenge firms’ existing structures (Nieto & Santamaria, 2010). Internal problems primarily relate to internal resources and behaviour: managerial competency, knowledge assimilation and management, and internal structural inadequacies (Dahlander & Gann, 2007; Luoma et al., 2010a; van der Meer, 2007).

Nevertheless, the benefits from engagement serve firms well. Consequently, firms develop organisational practices to manage the side effects in order to maximise open innovation gains. The practices entail managers championing open innovation outcomes to gain staff buy-in (Lefebvre & Lefebvre, 1992), the development of open innovation management strategies including methods for coping with partner-related problems, and favouring familiar partners to reduce risk (Hadjimanolis, 2003; Y. Lee & Cavusgil, 2006). In addition, firms may default to open innovation practices that are perceived as being lower-risk and less demanding on resources, with the adoption of further practices occurring as their experience of open innovation increases (S. Lee et al., 2010; Trott & Hartmann, 2009).
Firms may select from a range of open innovation practices. These practices divide between inbound practices, defined as external contribution to firms’ innovation activities, or outbound practices, which is the offering of internally developed innovations externally (Chesbrough & Crowther, 2006). Others divide the practices into equity and non-equity, as well as formal and informal practices (Cosh & Zhang, 2011; West & Bogers, 2010b). Practice selection varies depending on experience of the firm, its innovation-resource sufficiency, and innovation objectives, as well as management competency with each practice offering specific benefits and detriments (Trott & Hartmann, 2009).

Firms prioritise the open innovation practice of involving the customer to satisfy demand, to improve, and to develop new offerings. If internal resources are insufficient to achieve innovation objectives, firms will most commonly turn to their networks to meet shortcomings (van de Vrande et al., 2009; von Hippel, 1988). Collaboration with organisations in the firm’s network is favoured to address resource deficits, especially knowledge. The additional benefit of exposure to other organisations’ work processes and routines enhances firms’ organisational learning (Jiménez-Jiménez & Sanz-Valle, 2011). Another common practice is soliciting all staff to contribute innovative ideas.

Adoption of resource and competence-demanding practices occurs less often. Larger firms, who possess sufficient resources and managerial wherewithal to afford the activities, more generally implement these practices. For instance, intellectual property protection, such as patenting or other legal instruments, is necessary to support external participation, licensing-in and -out (West & Bogers, 2013).

Open innovation is contingent upon the presence of one or more external entities. Whether customer, supplier, inter-industry firm, or other organisation, collaboration with others provides required innovation resources. Simultaneously, the collaborative partner is also the greatest source of problems. Identifying, qualifying, and developing collaborative arrangements make high demands of firms’ resources and requires relational competencies; with managing of such relationships especially challenging for smaller firms (Rothwell, 1983). Yet, effective management of the partner dimensions is critical for successful open innovation.

8.1.2 The innovative SME

SMEs are not immune to the contemporary business environment, indeed, they are often more vulnerable than their larger counterparts (Bierly & Daly, 2007). Global and local market developments require innovation responses to drive business success, however SME resource deficits regularly obstruct their efforts. Resource deficits are a well-recognised
barrier to innovation in smaller firms and a fundamental negative feature of innovative SMEs’ characteristics (Aldrich & Auster, 1986; Gassmann, 2006; Rothwell & Zegveld, 1985). The positive SME characteristics principally relate to behavioural benefits and are embodied in the closeness of staff, low bureaucracy, and flexibility (Rothwell & Dodgson, 1994).

That SMEs experience open innovation differently from their larger counterparts is attributable to these characteristics (Susman et al., 2006). For SMEs to best take advantage of open innovation, they require knowledge of the implications to engagement not revealed from open innovation research in large firms. However, many benefits of open innovation emerge regardless of firm size such as access to information, technologies, as well as organisational learning (Coombs & Hull, 1998; O. Jones & Macpherson, 2006; G. P. Pisano & Verganti, 2008; Wynarczyk et al., 2013). The detrimental effects associated with open innovation arise from demands on firms’ internal resources to manage the engagement both internally and externally; demands which impose a greater burden on the resource-strapped SME (Chesbrough, 2010; Park et al., 2002).

Yet the open innovation partner fulfils a vital role in compensating for SMEs’ internal resources shortages, which would otherwise inhibit innovation (Ireland et al., 2002). Moreover, because SMEs typically lack managerial resources and abilities, they struggle to develop the beneficial relationships necessary for successful collaboration (Terziovski, 2010). SMEs tend to rely on familiar entities and informality in arrangements to manage relationship risks, compromising the full realisation of open innovation (Bogenrieder & Nooteboom, 2002). Consequently, while open innovation may resolve SMEs innovation resource deficits, the inadequacy of resources to support practice adoption, combined with managerial challenges and negative behaviour, form barriers to success (Hadjimanolis, 1999).

For innovative SMEs to realise the value of open innovation efforts requires specific understanding in light of their intrinsic characteristics (J. F. Christensen et al., 2005). Knowledge, however, remains sparse regarding the side effects of open innovation in SMEs, the managerial implications of engagement, and the impact on their characteristics (Wynarczyk et al., 2013). The literature appears essentially silent on open innovation practice guidance for SMEs, accentuating the need to better understand its application in smaller practitioner firms (Bianchi et al., 2010; Vanhaverbeke et al., 2012). Although recently some attention has directed towards improving open innovation knowledge in regards to SMEs, there continues to be only a limited understanding of the consequences to engagement (Dahlander & Gann, 2010; van de Vrande et al., 2009; Wynarczyk et al., 2013).
8.2 Research design

This study responds to calls for a better understanding of SMEs’ engagement in open innovation by considering the consequences of open innovation to innovative SMEs’ characteristics. To address the research question, derived from an examination of the innovation literature was a conceptual framework to underpin the study and provide a tentative understanding of the phenomenon (Leshem & Trafford, 2007; Maxwell, 2005).

8.2.1 The conceptual framework

Drawing from two bodies of the innovation literature - open innovation and the innovative SME - key constructs formed the conceptual framework to guide this study. The framework is comprised of four key constructs offering insight into the dynamics of open innovation and SMEs (Figure 1, repeated below):

- Open innovation as manifest in the eight practices of van de Vrande et al. (2009)
- The expected effects of engagement accumulated from the open innovation-associated literature
- The innovative SMEs’ characteristics, amassed from the innovative SME literature, divisible between resource deficits and behavioural benefits
- Organisational practices adopted by SMEs to manage open innovation effects.

The framework incorporates these theoretical constructs to guide the study and the design of the empirical research.

Figure 1 (repeated): The Conceptual Framework

The conceptual framework directed the research protocol, data collection, and analysis to inform the research question.
8.2.2 Research methods

Gathering the empirical data occurred through a two-stage research process. The first stage consisted of a questionnaire applied to SMEs from New Zealand’s engineering industry. Results indicated that most engineering firms continue to pursue closed innovation or intentionally do not pursue innovation. Results also revealed the presence of open innovation-active and SMEs suitable to participate in Stage 2.

The study obtained most of the empirical data in Stage 2, which comprised of a multi-case study of six open innovation-active SMEs. From the firms who had expressed interest in participating as case studies at Stage 1, six met the criteria established by this study. The criteria included demonstration of innovative SMEs' characteristics together with sufficient depth of open innovation partner involvement as the measure of innovation openness (Laursen & Salter, 2006; Vanhaverbeke et al., 2012). Primary and secondary data collected details of case SMEs’ experiences from pursuing open innovation. Analysis applied the conceptual framework, as representative of the literature, to the case data to establish the implications of open innovation engagement to innovative SMEs' characteristics from practitioners’ experience.

8.3 Case SMEs’ experiences of open innovation

Findings from the case firms contribute to our understanding of open innovation with the empirical data supporting the majority of the effects in the conceptual framework, as follows:

8.3.1 Practice engagement

Case firms employ a range of open innovation practices as a logical solution to their innovation-resource deficits. The case firms all engage in the open innovation practices of customer involvement, network collaboration, and all-employee involvement in pursuit of innovation. Five case firms engage, or have engaged, in external participation. Four case firms outsource their R&D, while three case SMEs implement the practices of venturing and licensing-out with only two practicing licensing-in.

8.3.2 Effects of open innovation engagement identified in the conceptual framework

Case firms confirm the beneficial effects distinguished in the conceptual framework. The case SMEs prioritise resource acquisition as the main attraction of open innovation, followed closely by enhanced organisational learning. Increased revenue and improved firm reputation also feature as beneficial outcomes of successful engagement (Table 28).
financial rewards may be long-term; in addition, firms often find it difficult to attribute financial benefits directly to open innovation. However, while human resources benefit from open innovation, they are also the most negatively affected. Detrimental managerial effects stem from the collaborative partner as well as internal impositions relating to the management of open innovation and the attendant negative behaviour of staff. Therefore, consistent with the conceptual framework, the negatives are significant in terms of managerial resources from all practices; the impositions on management of open innovation cascading to impose stress both on employees and on general business.

Other detrimental effects are practice-specific (full details see Table 28). Detrimental effects include instances of NIH syndrome, evident in staff reluctance to adopt introduced innovations from open innovation engagement, as well as resistance to changes in routine. Furthermore, staff may be uninterested and avoid participating in a firm’s innovation activities. The smaller SME managers exhibit OUH and NSH behaviour in response to innovations developed by the firm, thereby thwarting exploitation opportunities.

Open innovation stresses case firms’ internal resources. Management faces constant challenges with balancing resources between open innovation endeavours and BAU. Non-performance or delays by partners exacerbate the problems associated with managing open innovation: the demands of multi-party collaborations accentuating common open innovation issues. Another consistently impacted resource is knowledge. Case firms struggle with judging the appropriate level of disclosure to partners, managing knowledge development, and assimilating learning from open innovation engagement.

Relationships and partner difficulties dominate case firms’ concerns with open innovation. The amount of time and effort expended in addressing these issues weighs heavily on management. Relationship development is a continuous responsibility and reliant on the presence of managerial relational competencies. Issues associated with interorganisational relationships may present in the form of cultural and communication dissimilarities or problems created by partner non-performance. Dysfunctional relationships impose further hardships, with managers expending considerable time attempting to identify and assess the right partner to best reduce risk. Table 28 summaries the key features of behavioural and resource-related effects arising from case firms’ open innovation engagement.
Table 28: Influence of Open innovation on Innovative SMEs’ Characteristics

<table>
<thead>
<tr>
<th>Practice</th>
<th>Behaviour</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spanning all/majority of practices</td>
<td>(✔) Organisational learning</td>
<td>(✔) Innovation-required resources</td>
</tr>
<tr>
<td></td>
<td>(✔) Management: relational development</td>
<td>(✔) Organisational resources</td>
</tr>
<tr>
<td></td>
<td>(✘) Management: ability</td>
<td>(✘) Management: time, responsibilities</td>
</tr>
<tr>
<td></td>
<td>(✘) Management: relationship and relational competency</td>
<td>(✘) Knowledge/I.P. management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(✘) Partner-related resource costs</td>
</tr>
</tbody>
</table>

**INBOUND**

| Customer Involvement | (✔) Close communication | (✔) Finances: customer retention  |
| | (✔) Closeness to customer | (✘) Finances: costs to realise  |
| External Network | (✘) Relationship complexities | (✘) Management reliant  |
| | (✘) Partner dependence | (✘) Finances: partner-related costs  |
| | (✘) Staff: NIH, change resistance | |
| External Participation | (✘) Management expertise | (✘) Finances  |
| | | (✘) Increased stress on managerial resources  |
| Outsourcing R&D | (✘) Relationship complexities | (✔) Innovation-required resources  |
| | (✘) Staff: NIH, change resistance | (✔) Finances: negates internal investment  |
| Licensing-in | (✘) Relationship complexities | (✘) Management reliant |
| | (✘) Staff: NIH | (✘) Finances: legal, contract  |

**OUTBOUND**

| All Employee | (✔) Staff engagement, learning | (✔) Staff retention (finance)  |
| | (✘) Staff alienation, disinterest | |
| Licensing-out | (✘) Relationship complexities | (✔) I.P. development  |
| | (✘) NSH/OUH | (✘) Management reliant  |
| | | (✘) Finances: legal, contract  |
| Venturing | *(None specific other than addressed under effects spanning practices)* | (✔) Finances (delayed return)  |
| | | (✘) Management reliant  |
| | | (✘) Finances  |
| Additional practice: R&D Provision | *(None specific other than addressed under effects spanning practices)* | (✔) Finances  |
| | | (✘) Physical resources to meet BAU  |
| | | (✘) Staff stress: practice imposes on routine  |

Key: (✔) Beneficial to characteristic
(✘) Detrimental to characteristic

Open innovation therefore benefits SMEs by offering valuable access to innovation resources and enhancement of organisational learning. Correspondingly, the detriments from engagement are significant, primarily affecting human resources and evidential negative behaviour. The results among the case firms also highlight the recurrent issue of knowledge management. Yet, the benefits dominate, encouraging repetitive engagement in open innovation.
8.3.3 Detrimental effects of engagement not evident in case SMEs

However, while a construct of the conceptual framework, case SMEs do not experience certain detrimental effects to their characteristics said to accompany open innovation:

- The importance of meeting customer requirements overrides many negative open innovation effects, including behaviour: the necessity to satisfy and thereby retain the customer represents the case SMEs’ overriding mandate to ensure the firm’s survival.
- Case firms practice open and closed innovation, finding that each complements the other, with both critical to maximising innovation.
- Outsourcing R&D is more cost effective for case firms, neutralising the internal costs associated with the practice.
- Case firms do not automatically collaborate with familiar partners. Instead, the firms intentionally search widely for the most suitable partner. However, if the choices include a known entity this preferences the partner decision: collaborating with a known entity found to reduce the relationship complexities, correspondingly impose less stress on management.
- The more resource-expensive practices demand formal intellectual property mechanisms and the presence of sufficient resources; therefore, according to van de Vrande et al. (2009) usually the domain of larger firms. However, dominating growth objectives of some smaller case SMEs, despite their smallness, justify the risks and expense to adopt the resource-demanding practices of external participation, licensing-in and -out. This is contrary to van de Vrande et al.’s (2009) research that suggests smaller SMEs do not adopt these higher-level practices.

8.3.4 Organisational learning

While appearing in the conceptual framework as a beneficial consequence, the significance of organisational learning extends beyond the open innovation endeavour. The extent of its value to case SMEs was unexpected with firms intentionally employing open innovation to access organisational learning opportunities. Case firms gain organisational learning directly through open innovation experiences and indirectly through exposure to partner structures and routines, regardless of the success of the innovation collaboration. Consequently, organisational learning is an outcome of open innovation whether endeavours are successful or not. The learning enhances managerial relational competencies and firm organisational practices; these in turn improve future open innovation endeavours. While organisational learning is recognised as an attribute of innovation activities, absent are apparent studies exploring the significant organisational learning benefits that open innovation facilitates.
8.3.5 Organisational practices

Case firms demonstrate the full range of organisational practices contained in the conceptual framework. These include the presence of innovation champions to garner acceptance of open innovation outcomes by staff, and the development of management strategies to optimise open innovation. In addition, case firms adopt further countermeasures to address effects associated with open innovation: pretesting open innovation outcomes before launching into firms’ internal environment, scheduling time extensions into projects to compensate for partner delays, and developing open innovation partner-selection criteria, among others.

8.3.6 Open innovation interrelationship

This study reveals an interrelationship between open innovation, organisational learning, and organisational practices. Open innovation facilitates organisational learning, which in turn enhances organisational practices, which further improve open innovation endeavours in a cyclic iterative process (Figure 9 repeated below).

Figure 9 (repeated): The Interrelated Cyclical Relationship

8.4 Advancing the conceptual framework

Returning to the conceptual framework: Grounded in the literature and subsequently evolving through empirical data, the framework guided the research method and data analysis. During analysis, the importance to SMEs of the organisational learning facilitated by open innovation revealed the interrelated relationship. The interrelationship suggests a continual cyclical process of open innovation facilitating organisational learning, in turn improving organisational practices to then support future open innovation endeavours (Figure 9).
Integration of the cyclical process refines the conceptual framework (Figure 10) to produce the final model, and offers a deeper understanding of SMEs’ engagement in open innovation and the optimising of engagement benefits. The conceptual framework developed through the empirical research provides a model to meet one of the aims of this study. The production of an integrated model is an outcome consistent with other studies in nascent fields (Barker, 1993; Gersick, 1988; Maznevski & Chudoba, 2000).

Figure 10: Implications of Open Innovation and the Innovative SME: An Integrated Model

8.5 Contributing to the knowledge of open innovation in SMEs

This study employs an innovation perspective focusing on open innovation in SMEs. As such, it contributes to the field of innovation, and in particular, to the open innovation literature. As a rapidly emerging area of research, the field of open innovation lacks unifying theories; this study thus offers insights to develop a better understanding of open innovation in theory and in application.

Open innovation literature claims that engagement offers advantages in furnishing resources which assist innovative SMEs to overcome their characteristic deficit: of resource constraint (Hoffman et al., 1998), and thereby overcome their liability of smallness (Fagerberg, 2003; Gassmann et al., 2010; S. Lee et al., 2010). While some recognise the
practice of open innovation differs in large and small firms, little is known about the existent costs, and true effects of SMEs’ engagement in open innovation (Bianchi et al., 2010; Brunswicker & Vanhaverbeke, 2014; Spithoven et al., 2013). Dahlander and Gann (2010) and Huizingh (2011) stipulate that open innovation research is dominated by the advantages of open innovation, whereas the negative aspects lack the same scrutiny. While some refer to potential consequences (e.g., U. Lichtenthaler, 2010b; van de Vrande et al., 2009), these studies lack detail regarding engagement effects, most notably in regard to SMEs’ application of open innovation practices, (Bianchi et al., 2010; Huizingh, 2011).

This study contributes to the open innovation literature in developing an understanding of the detrimental effects of open innovation. Furthermore, in determining the effects, the research findings revealed the organisational mechanisms adopted by SMEs to manage these effects. Indications are that innovative SMEs benefit from open innovation engagement primarily through acquisition of required resources to address internal innovation deficits. However, engagement in open innovation is not without negative consequences for SMEs. The research discerned a number of potential detriments.

Consistent across the SMEs in this study, detrimental effects of open innovation engagement include the stress on scarce internal resources, especially managerial resources relating to time and skills. The SMEs reported that the time demands of open innovation are extensive and burdensome; similarly, the relational competency demands are high. Furthermore, behavioural issues may arise from resistance to the adoption of open innovation-sourced innovation. Such resistance is akin to NIH (Katz & Allen, 1982), NSH (Chesbrough, 2006b), referring to the inability of another organisation to appropriate value from an internally developed innovation, and OUH (U. Lichtenthaler & Ernst, 2006), where firms argue against internal innovation offering any external value. Negative behaviours associated with open innovation engagement shed new light on this concept, where previous studies and theory have almost exclusively focused on the beneficial behavioural attributes of innovative SMEs. These findings are relevant to developing a better understanding of the application of open innovation in SMEs and how engagement influences the small firm.

The results suggest that SMEs can benefit from open innovation, as indicated in the extant literature, yet the costs of doing so should not be underestimated. The impositions on SMEs’ internal resources are considerable; however, the opportunities afforded by open innovation to achieve innovation objectives encourage continued and iterative engagement. Results from this study suggest a paradoxical relationship between the concept of open
innovation and SMEs. Practitioners may realise the benefits of open innovation in realising innovation-required resources. At the same time, they may incur unanticipated high costs associated with the practice, which potentially may be detrimental to their fully achieving such benefits.

This study thus extends previous open innovation research by highlighting the consequences of engagement by SMEs associated with the different open innovation practices. While the literature in general indicates a range of potential issues relating to open innovation practices, these draw from a broad range of research and are rarely SME- or open innovation-specific (Dahlander & Gann, 2010). Considering the issues resulting from open innovation engagement in light of the particular characteristics of innovative SMEs reveals details of the effects incurred by open innovation practitioners. This finding is important in guiding SMEs’ practice selection in respect of resource and behavioural limitations, particularly the higher-level practices of external participation, licensing-in, licensing-out, and venturing. An awareness of the potential difficulties, as well as the advantages and disadvantages of open innovation in application, will likely reduce the uncertainty around practice adoption and contribute to improve engagement in open innovation.

SMEs are not homogeneous; variations are apparent within size bands (Lefebvre & Lefebvre, 1992). In general the selection and engagement in various open innovation practices associates with firm size and the accompanying sufficiency in resources (van de Vrande et al., 2009). However, contrary to their assertion that SMEs are reluctant to adopt higher-level practices due to the perceived increased risks, the findings from this study suggest that this is not always the case. Rather, practice adoption can correspond with the innovation and growth objectives of the individual firm, pointing to the importance of relating firm strategy to open innovation practice selection (Keupp & Gassmann, 2009).

As indicated by the literature, common beneficial effects are resource realisation resulting from engagement, and the enhancement of organisational learning. The main negative effects relate to the managerial burden associated with engaging in open innovation, the balancing of resource allocation between demands, and relationship complexities. Managers are required to juggle business-as-usual with open innovation demands. Furthermore, engagement in open innovation is contingent upon external relationships; managers face a heavy demand for relational competence to manage the partner and open innovation arrangements. Yet, SMEs often lack such relational competence due to the small number of managerial staff (Hofer & Adametz, 2007; S. Lee et al., 2010; van de Vrande et
al., 2009). The results of this study indicate that it is crucial for SMEs to recognise that the success of their open innovation endeavours rests on their ability to manage open innovation relationships and the multiple stresses on management, which result from engagement in open innovation activity.

The enhancement of organisational learning is consistently advanced as an important facet and outcome of innovation activities (among others see Bao et al., 2011; Laursen & Salter, 2006; Patel & Pavitt, 1994). However, the open innovation literature is relatively silent on the link between enhancement of organisational learning and open innovation engagement; indeed, van de Vrande et al. (2010) stipulate the need for exploration of the interaction between the two factors to develop understanding. This study contributes to this knowledge gap by highlighting the importance SMEs place on engaging in open innovation specifically to enhance organisational learning. The case firms purposely seek the organisational learning benefits gained from exposure to other innovation partners’ work routines and processes. In addition, firms seek to build managerial relational ability through experience beyond the resource acquisition benefit typically attributed to open innovation. This finding points to the importance of firms’ intentional involvement in open innovation to enhance organisational learning. As such, receive important benefits beyond gaining innovation resources extending the advantages of engagement.

Another area lacking understanding concerns the problems associated with open innovation in terms of organisational effects and managerial implications, as highlighted by many scholars (e.g., Dahlander & Gann, 2010; Huizingh, 2011; Laursen & Salter, 2006; van de Vrande et al., 2009; Vanhaverbeke et al., 2007; Wynarczyk et al., 2013). Brunswicker and Van de Vrande (Publishing October 2014) and others (Bianchi et al., 2010; S. Lee et al., 2010; Rahman & Ramos, 2010; Wynarczyk et al., 2013) advise of insufficient research attention directed towards open innovation in SMEs with regard to the internal mechanisms and management of open innovation. This research highlights the importance of this matter for innovative SMEs that engage in open innovation. While a list of organisational practices was compiled drawing widely from the literature (see Table 16), the findings herein offer greater clarity on the particular organisational responses that SMEs develop to manage open innovation.

These practices may occur by default: persisting with internal innovation to support knowledge development and engender external opportunities, for example, or the tendency to favour familiar organisations as partners to reduce risk (Major & Cordey-Hayes, 2003).
Compensatory practices adopted include having an innovation champion to drive open innovation acceptance, pretesting before internal introduction, and intentionally searching for open innovation partners beyond the firms’ familiar network. Another practice, not apparent in the literature, is for firms to identify the most appropriate and receptive person at the partner organisation. Based on the experiences of the SMEs in this study, identifying such individuals is critical to risk reduction and the overall success of the endeavour. The findings regarding the effects of open innovation on the characteristics of innovative SMEs and the internal mechanisms adopted to manage these effects builds upon previous empirical research and adds to the body of knowledge.

The interrelationship between open innovation, organisational learning, and organisational practices suggests that innovative SMEs develop both their innovation capabilities and organisational capabilities despite the negative effects of open innovation. This interrelationship is not apparent in the open innovation literature; however, it has important implications both for the open innovation literature and for SMEs. The interrelated nature of these factors indicates where practitioners need to focus to manage both the effects of open innovation and to enhance organisational learning to optimise their innovation endeavours. Moreover, the conceptual model developed in this study integrates the existing literature and expands on it through empirical research as recommended by Dubois and Gadde (2002). The model enhances theoretical understanding by illustrating the dynamics of open innovation in innovative SMEs and their characteristics, and provides a structure further testing.

Finally, this study responds to calls to examine how firms in different industries employ open innovation (Bianchi et al., 2011; Chiaroni et al., 2009). While engineering firms are key sources of innovation (van de Vrande et al., 2009), this study is the first to position open innovation research within the engineering industry context and, in particular, to examine innovative SMEs’ application of open innovation within the industry. The findings indicate a shift from closed to open innovation among innovative engineering SMEs, especially in terms of resource acquisition and organisational learning. However, relational skills issues present barriers to SMEs’ full realisation of open innovation benefits.

8.6 Implications

The research helps to clarify the effects of open innovation in SMEs with findings offering theoretical and managerial implications. Overall, this study deepens scholarly understanding of SMEs engagement in open innovation by providing details on the
consequences of adoption. For instance, an important facet to emerge is the serious impingement on management. If managers are aware of the potential negative effects, better understanding may improve their ability to overcome such effects, or at least minimise the associated risks.

The interrelated, iterative nature of open innovation, organisational learning, and organisational practice has implications for both open innovation theory and organisational learning theory. While Transfield et al. (2000) identified a connection between external innovation and firm routines; this study further integrates open innovation and organisational learning. Knowledge of the significance of the interrelationship can encourage firms to maximise the benefits of learning from open innovation and partner experiences, which is considered to be advantageous by Hadjimanolis (2003).

Current understanding is limited regarding the organisational practices implemented for open innovation management. The framework of this study develops awareness of the range of organisational practices adopted by SMEs in managing open innovation. However, while this study extends the knowledge of the organisational practices employed, ascertaining their relevance with regard to suitability, benefits, and cost effects, requires further examination.

8.6.1 Managerial implications

This study has important implications for improving SMEs’ management of open innovation. Although open innovation offers benefits to SMEs in accessing requisite resources for innovation, there are also costs. Indications are that success depends upon effective management to reduce negative consequences to maximise return. In particular, open innovation negatively imposes on internal resources, most heavily on managerial resources and capabilities.

- The impact of open innovation on management is significant in terms of time and skill demands (U. Lichtenthaler, 2010b; van de Vrande et al., 2009). Awareness of the managerial effects of open innovation indicates the requirement for SMEs to implement suitable mechanisms to manage the consequences to engagement.
- Similarly, the demands on staff, relational issues associated with engagement, and best use of physical resources require close management to support open innovation activities. The findings imply that managers must exercise caution in committing internal resources without compromising BAU.
- This study provides insights into the open innovation engagement difficulties encountered by management. These include conflicting responsibilities and difficulties in best resource allocation, internal and external relational behaviour, and
overall management of the partner dimension. Mitigation of such effects may occur through effective management and early attention to concerns relating to open innovation engagement.

- The consequences of negative behaviour require close attention - pre-planning, championing, and monitoring - to minimise detrimental effects and maximise buy-in. Staff demonstrating NIH and NSH potentially limit the realisation of open innovation success; similarly, the managerial attitudes of OUH and NSH prevent potential gains from additional income streams in terms of licensing-out and similar open innovation practices.

- Determination of open innovation success relates to the effectiveness of the collaborative relationship: effectiveness is conditional upon the presence of sufficient managerial relational competencies. From the standpoint of identifying, arranging, and facilitating interorganisational collaboration, investment in developing managerial relational competences is highly recommended for SMEs. The interrelated, cyclical nature of open innovation and the development of relational skills indicate opportunities to enhance the learning gained by experience. Consequently, as suggested by Simonin (1997), reviewing previous endeavours and assessing efforts can help build relational skills.

- The research highlights the open innovation practice effects, which are specific to a given practice, as well as those common across practices. Understanding the effects is important in assisting SMEs to select the most appropriate practices fitting their requirements, resource holdings, and innovation objectives.

- This study indicates a range of organisational practices and mechanisms available for managing open innovation and its associated effects, which can enhance SMEs’ utilisation of open innovation. With knowledge of a wider range of options available to them, managers can select from a variety of organisational practices, according to the stresses and effects experienced by their firm from engagement in open innovation.

- Development of organisational practices assists with the management of open innovation; however, this study raises the question of whether there are other practices - training opportunities, perhaps - that may serve managers better.

### 8.6.2 Engineering SME implications

- While this study did not compare engineering firms with firms in other industries, certain points emerge of relevance to engineering SMEs as well as other innovative SMEs:
Engineering SMEs are typically run by, and largely employ, well trained individuals who tend to rely on their own expertise to solve problems and generate innovations (Gann & Salter, 2000; Laforet & Tann, 2006). This characteristic self-reliance appears to restrict the growth opportunities presented by open innovation. This tendency to remain secluded as closed innovators potentially limit the realisation of innovation that could accrue from shared knowledge and experiences. Moreover, by excluding itself from open innovation, a firm risks reducing its core competencies, which may occur when the firm’s expertise and accumulated knowledge are narrowly held.

Post-project revision of open innovation endeavours may prove valuable for optimising the return on engagement through developing an appreciation of efficacies in such engagement and identifying areas ripe for relational improvement.

Of relevance to management, the availability of a potential income stream, through offering internally developed innovations to external entities, pertains particularly to the engineering SME. A major barrier to this practice is owner/managers’ misconception that such innovations are of limited application. While in some instances this may be accurate, awareness of OUH (U. Lichtenthaler & Ernst, 2006) tendencies may assist to overcome blind spots of this nature. Improved reflection on value may assist firms to overcome their reticence and explore alternative external applications for internally developed innovations.

In addition, open innovation presents opportunities for collaboration with offshore entities by pooling resources and skill sets. For New Zealand firms, this presents an avenue to overcome the tyranny of distance (OECD Reviews, 2007).

Collaborating as a networked group may realise more innovations that are radical. While this activity also presents greater risk and incurs higher internal resource costs, there are potential benefits from improved business growth. The ability to combine resources and draw on varied experiences from collaborative groups potentially offers a level of innovation success not otherwise possible for single firms operating in isolation. The learning opportunities presented by such collaborative endeavours are highly favourable for individual SMEs.

While pressures on managerial resources are not unique to engineering SMEs, often the same individuals are key hands-on engineers, which compounds the stress. A commitment to relational training and time management is essential if the full benefits from engagement in open innovation are to outweigh the inevitable associated costs.
8.6.3 Implications for policy

Open innovation offers SMEs the opportunity to overcome resource restraints to realising innovation. That increased innovation activity is beneficial to the creation and commercialisation of technology and knowledge is well recognised (OECD, 2001). However, the findings of this study argue against a uniform open innovation policy. The variations in the implications experienced from open innovation engagement suggest there are differences in effects, even within the SME bracket; effects which must be taken into account when developing open innovation supportive mechanisms for SMEs.

Variations in open innovation practice adoption were recognised by van de Vrande et al. (2009) and Lichtenthaler (2008) and are generally attributed to differing resource holdings associated with SME size. However, while this study finds similar variations between the smaller and larger SMEs, it draws attention to the importance of clarifying SMEs’ innovation objectives, which also dictate (intentionally or unintentionally) firm practice adoption. Supportive polices which target SMEs and facilitate open innovation need to take into account the heterogeneous nature of SMEs’ resource and skill limitations, in conjunction with their innovation objectives, and to aim at capacity-building through flexible support mechanisms.

The research indicates that current mechanisms for providing financial grants are too complex and the requirements for obtaining them change often. This results in frustration for innovating SMEs and deters them from utilising these grants. Simplification of policy in this regard is attractive to firms, as is assistance beyond monetary incentives that will support SMEs’ open innovation engagement. Such mechanisms could include education on practice options and open innovation management. Such firms would also welcome knowledge protection support and education on alternative mechanisms to patenting. Policies with the flexibility to better meet and support the varied needs of innovating SMEs would help to achieve the wider economic gains that are the promise and imperative of greater engagement by firms in innovation.

8.7 Limitations and recommendations for further research

There are limitations to this study indicating areas for further research. A comprehensive review of relevant literature led to the selection of constructs for inclusion in the conceptual framework. However, selecting certain constructs meant discarding others. For example, some open innovation practice options such as crowd sourcing were not included. In addition, practices are considered by mode, not by equity and non-equity
arrangements (Dahlander & Gann, 2010). Application and/or inclusion of these different constructs could yield further insight into SMEs' engagement in open innovation.

This study presents a model of open innovation useful for further research to enhance theory and application in SMEs. However, given the small sample and the limited scope of the study, the model would benefit from further substantiation. For example, the study is limited in not comparing the engineering innovative SME with the non-innovative or closed SMEs in the same industry. Moreover, New Zealand firms exhibit distinctive characteristics due to their geographical isolation and small population. Likewise, the engineering industry, although a major New Zealand industry, is small by international standards and dominated by micro and small firms. Nevertheless, similarities exist with innovative SMEs elsewhere. The characteristics of the innovative case SMEs are consistent with those in the literature and appear to be subject to the same demands and pressures found in SMEs globally (Shangqin et al., 2009). SMEs struggle for relevance and survival in the contemporary business landscape and the search for methods to overcome limitations appear to be universal. However, qualitative and quantitative research to extend the findings of this study in comparative studies, other industry, and country settings would generate additional data, upon which further theoretical and practical contributions might be built.

There are limitations in the ability to generalise findings, which arise from the small sample size and situating the study in New Zealand. Application of the integrated model in other situations and industries could result in a wider variety of perspectives to develop the model. Such efforts would improve generalisability of the results, as would larger-scale empirical research to explore the how well the model represents the phenomenon (Perry, 1998b). A deeper understanding of the priorities of effects would support SMEs to improve innovation activities, by then affording due consideration to the best investment of scarce internal resources. In addition, the study primarily aimed to investigate the adoption of open innovation in the SME context. However, the model is also applicable to larger firms keen to develop their organisational ability through increased awareness of the effects presented by adoption.

Furthermore, data based on self-reported performance can be problematic, given its propensity for recall bias in participants (J. H. Barnes, 2006). In addition, there may be alternative explanations for the SMEs’ experiences of open innovation. However, each case firm’s perceptions of their open innovation experiences contribute towards developing a better understanding of the field. Efforts were made to enhance internal and external validity through the use of multiple cases based on the replication logic and the collection of multiple
sources for triangulation of data (Yin, 2003b). Each case provided a number of interviews enabling narrative accounts among participants to be cross-checked within each firm and substantiation from diverse sources (Denscombe, 2003; Lincoln & Guba, 1985). Firms’ confirmation of the final case write-ups presented in Chapter 6 assisted with alleviating concerns over possible misinterpretation of transcribed data, as well as the researcher’s onsite impressions (Rocks et al., 2007; Yin, 2003b).

The cyclical interaction of open innovation, organisational learning, and organisational practices, and the contribution of this interaction to open innovation endeavours, offers a promising area of research. The assimilation, integration, and development of each currently appears to be haphazard in SMEs. To improve the use of open innovation then more in-depth process studies are required to further develop our understanding of these interrelated facets.

Two other areas illuminated by the study lend themselves to further research. Firstly, the study highlights the relationship dimension is particularly challenging for SMEs. Although not explicitly identified in the conceptual framework, external entities are nevertheless contingent to open innovation. Despite much prior research in other disciplines, little has been said about the interorganisational relationship domain, especially concerning open innovation and SMEs. Further understanding of these relationships may support SME open innovation endeavours. Secondly, further research into the formal and informal organisational practices adopted by SMEs as a result of open innovation effects, through participant observation, would build understanding of their relevance to the SME and to larger firms needing to develop organisational responses to open innovation effects.

8.8 Concluding remarks

Prior studies note the importance of SMEs to innovate, that doing so through external cooperation can mitigate risk and provide access to complementarity and required resources (Buisseret & Cameron, 1994). This study confirms that innovative SMEs adopting open innovation experience significant benefits, while detrimental effects risk compromising practice application and the rewards thereof. Engagement is not without cost, internal resources and behavioural issues demand attention in order to ensure open innovation benefits. Yet although considerable detriments accompany engagement, firms perceive the benefits outweigh the negative effects, justifying continued pursuit of open innovation.

This study agrees that adoption of open innovation addresses SME resource limitations to realise innovation objectives. Furthermore, engagement enhances organisational learning.
Consequently, open innovation should be encouraged with caution, noting that application is neither straightforward nor the effects of engagement minor. The recommendation of the study is for close management of practice initiatives with the implementation of appropriate organisational mechanisms to optimise return.

This study adds to the discussion on open innovation and to that of innovation in SMEs, offering an integrated model to guide open innovation scholars and practitioner engagement. This study deepens practitioner understanding of open innovation in application, and the management of engagement consequences. Greater awareness of the dynamics of open innovation in SMEs may improve practice selection, management of effects, and improve organisational practices. Furthermore, this study highlights potential issues relating to open innovation practices and indicates areas to improve management of open innovation.

Examining the effects on innovative SMEs’ characteristics associated with open innovation engagement develops academic understanding and supports firms seeking to improve open innovation practice effectiveness. This study therefore contributes towards addressing knowledge gaps regarding open innovation, especially in the context of the SME, the detriments incurred, and the organisational responses to practice effects. In doing so, it responds to calls for such a contribution to this body of knowledge by van de Vrande et al. (2009), Dahlander and Gann (2010) and others (e.g., Brunswicker & Van de Vrande, Publishing October 2014; Brunswicker & Vanhaverbeke, 2014; Huizingh, 2011; Spithoven et al., 2013; West et al., 2014).
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