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Low-Tech Entrepreneurship

Sophie Reboud¹ and Mazzarol Tim²

¹CEREN, EA 7477, Burgundy School of Business, Université Bourgogne Franche-Comté, Dijon, France

²University of Western Australia Business School, Crawley, WA, Australia

Synonyms

Low R&D intensity entrepreneurship; Low- to mid-tech SMEs; Low-tech small firms; Non-research intensive entrepreneurship

Definition and Issues at Stake

The Organisation for Economic Co-operation and Development (OECD) classifies a high-technology industry as one in which the level of research and development (R&D) intensity (a measure of the proportion of annual turnover invested in R&D) is greater than 5%. By contrast, low-tech firms have an R&D intensity of less than 3%, while mid-tech firms have an R&D intensity of between 3% and 5% (Bender et al. 2005; Hirsch-Kreinsen et al. 2008). A large proportion of industries are low- to mid-tech, including motor vehicle manufacturing, pharmaceuticals, aerospace and electronics industries, food processing, printing, furniture manufacturing, household

appliances, and plastics (Hirsch-Kreinsen et al. 2006). The vast majority of small firms all around the world are active in low- to mid-tech industries.

From the Literature

Previous findings suggest that significant differences exist between the low R&D firms and their high R&D counterparts in relation to the number and type of innovations generated and how such firms manage the process of commercialization (Mazzarol et al. 2011). As small firms are different from large firms in the way they operate and are managed (Welsh and White 1981; Gibb and Scott 1985; D'Amboise and Muldowney 1988; Julien 1993; Torres 1997), it is not surprising to find that they have different approaches to their innovation processes. Limited scale and resources encourage small firms to adopt more informal processes for organizing their activities, utilizing personal ties and social networks, and taking advice from non-traditional sources such as friends who are also in business (see ► [Network and Entrepreneurship](#) and ► [Partnerships and Entrepreneurship](#)). This seems particularly true in low- to mid-tech sectors.

Studies of small to medium enterprise (SME) manufacturing firms suggest that innovation is a necessary, but not sufficient prerequisite for competitive performance (Liao and Rice 2010). Such SMEs appear to gain from having clear innovation strategies and formal structures for commercialization (see ► [Innovation Opportunities and Business Start-Up](#)) (Terziovski 2010). Yet differences

appear to exist between low-tech firms and those with higher levels of investment in R&D. The mid- to high-tech manufacturers seem to get more benefit from R&D investment that is directed toward product development, while the low-tech firms get benefits from investment in product development process innovations (see ► [Product Innovation](#), [Process Innovation](#)). These are innovations relating not to the creation of new products, but of processes (e.g., computer-aided design (CAD) systems) that can assist them to produce their existing products more flexibly and faster (Raymond and St-Pierre 2010).

Importance and Issues at Stake

Despite the relative importance of low- to mid-tech firms, much of the focus of government policy within what is often called the national innovation system (NIS) (see ► [National Innovation System](#)/► [National Innovations Systems](#)) (Lundvall 2007) is upon high-tech industries or what has been referred to as “the Silicon Valley Business Model” (see ► [Business Model](#)) (Cohen 2010; OECD 2010). These policies seek to promote high-growth “Gazelle” firms, which offer the promise of enhanced job creation and economic prosperity (OECD 2002, 2010b, 2010c). However, while such firms may be capable of generating employment and adding to the GDP growth rate, they are inherently risky. Such firms also represent on average less than 1% of all businesses (OECD 2010b), making them a problematic target for government policy. It is also worth noting that high-growth “Gazelle” firms can be found in all industries not just high-technology sectors (Acs et al. 2008).

Despite this, the emphasis on “high-tech” R&D-driven innovation has remained a priority for government policy, with academic debate over the merits of this emphasis (see Mazzarol et al. 2014; Nightingale and Coad 2013). However, innovation needs to be considered with a much wider lens (see Godet et al. 2010). Further, research suggest that the traditional high-tech “Silicon Valley” business model is not the only approach adopted by small firms seeking to innovate and many small innovative firms are growing without major external funding (see ► [Venture](#)

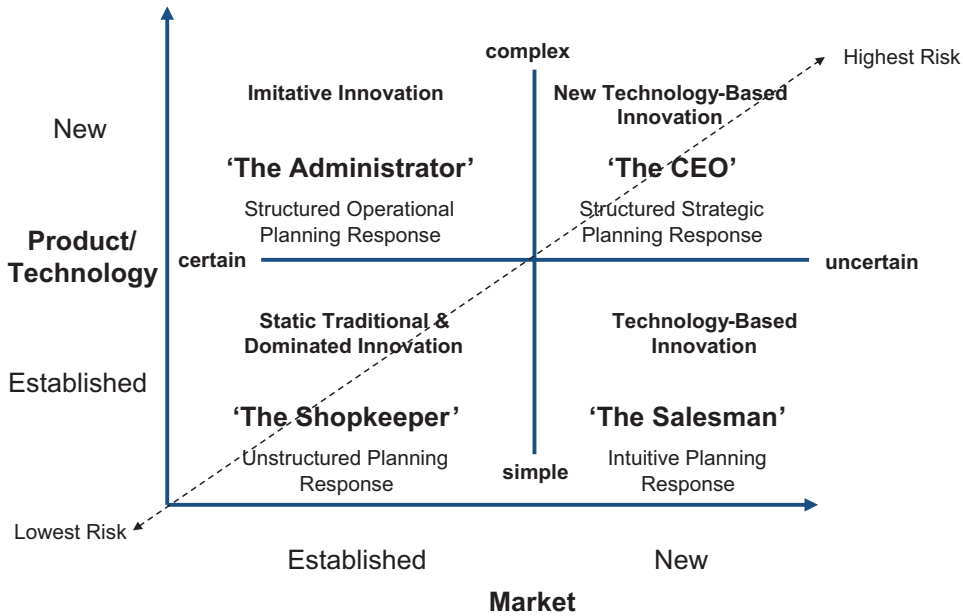
[Capital and Small Business](#)) (Maskell 1998; Von Tunzelmann and Acha 2006). Results on this matter are an important finding as they signal the importance of other models of innovation for small firms. Indeed, there is a strong case for “ordinary SMEs” to innovate with more modest, self-funded innovations and still make a sound contribution to the national economy.

What is important from both research and policy perspectives is that significant innovations can occur throughout the value chain and may involve collaboration with other parties. This is particularly relevant for innovation processes in small firms. The ability of many SMEs to successfully engage in innovation and commercialization is often restricted by their lack of resources, weak or unsystematic marketing and management competencies, and inadequate use of appropriate third party advisors (Adams 1982; Vermeulen 2005). Yet findings demonstrate that small firms can be active innovators (see ► [Innovator](#)) in spite of their limited scale and resources.

High and Low R&D Intensity SMEs: Organizational Configuration for Innovation

Tidd (2001) observed that despite several decades of research into the management of innovation, there remained no clear or consistent findings or even a coherent set of advice for managers. He proposed a matrix model comprising four quadrants that were defined by the two primary dimensions of uncertainty and complexity. The four organizational structures (see ► [Entrepreneurial Organization](#)) that emerged from this framework were:

- *Differentiated* (low uncertainty and low complexity): in which the key competitive advantage comes from product and service differentiation, marketing competence, and the formation of a structure that is focused on product or market divisions.
- *Innovative* (high uncertainty and low complexity): here the key competencies required are



Low-Tech Entrepreneurship, Fig. 1 A model of strategic innovation management (Source: Mazzarol and Reboud 2009)

scientific or technological in nature and organizational structure is likely to be functional.

- *Networked* (low uncertainty and high complexity): this requires competence in project management and organizational structure focusing on professional skills and knowledge.
- *Complex* (high uncertainty and high complexity): this requires a range of competencies as well as adaptive learning.

Mazzarol and Reboud (2009) developed this complexity–uncertainty trade-off into a model of strategic innovation management which is illustrated in Fig. 1. As shown in the figure, there are four strategic planning responses depending on the uncertainty found within the market and the level of complexity found within the product technology. Simple innovations with low levels of complexity that are being commercialized within markets that are stable and certain are what has been referred to as static traditional or dominated (Rizzoni 1991). This type of planning response is what Mazzarol and Reboud (2009) refer to as “The Shopkeeper,” and is one that involves a

relatively unstructured planning response with low levels of formality.

By contrast the high risk, disruptive innovation that is associated with new technologies requires a structured strategic planning response, or what is described as the “Chief Executive Officer (CEO).” Situations in which the technology is already well established but the market environment is uncertain require the planning response of “The Salesman,” which is typically that of a less formal, more intuitive approach, while the new technological innovation that requires high levels of complexity in its development, but is to be commercialized into a market that is certain, requires the planning response described as that of “The Administrator.” This is formal and structured, but of an operational not a strategic nature (Mazzarol and Reboud 2009).

This model proposes that there is an interrelationship between the type of innovation that is being commercialized, the nature of its target market environment, and the type of planning response that is optimal for these conditions. It is consistent with the framework proposed by Tidd (2001) and, as discussed below, it provides a

conceptual basis for understanding the notion of low-tech entrepreneurship.

The Issue of Innovation Measure

Noting that although innovation is supposed to take several forms (including organization innovation for example, see the Oslo Manual (OECD 2005)), it is almost always measured based on product innovation only, other authors (e.g., Raymond and St-Pierre 2010) propose to encompass other forms of innovation like process innovation. As they state: *“While having been the object of numerous studies, the link between R&D activities and innovation in SMEs still requires clarification and further understanding.”* They argue that taking into account process innovation, even not giving a perfect picture of all innovative activities in a firm, improves the view of the amount of innovation produced by SMEs (see ► [Measuring Organizational Climate for Creativity and Innovation](#)).

Studying creative industries, where lots of SMEs are highly innovative, Lindman et al. (2008) give also elements indicating a high level of nontechnological innovation in small firms especially based on innovations in design.

Another proposition aiming at capturing other forms of innovation carried out by small firms is proposed by Teixeira et al. (2008). They analyze collaboration based on R&D between small firms and show that lots of SMEs in low-tech sectors develop relationships based on R&D and innovation. They suggest that proximity (both geographic and cultural) has a strong influence on the level of formalization and sophistication of the R&D involved in such partnerships.

Size and R&D Intensity and Consequences on Management and Strategy

In a study of innovation practices within small firms from 11 OECD countries, a size effect was found in relation to R&D intensity (Mazzarol and Reboud 2011). Micro and small firms were identified as having higher R&D intensity ratios than their medium to large counterparts. This suggests that as the business matures, it is more likely to focus on consolidation of existing products within established markets than trying to launch new

products into new markets. Funding for innovation was in this case largely derived from retained profits with little interest shown in equity financing. However, equity financing and venture capital were more likely to be of interest to firms with high R&D intensity.

Compared with their low R&D intensive counterparts, the high R&D intensive businesses were more likely to feel that the generation of new products and innovations were a major focus for their firm. They were also more likely to involve customers in the development of the innovation and to have a formal new product development (NPD) process in place. Such firms were likely to be focused in their NPD process on technological product innovations as a primary area of attention, followed by market development innovations as a secondary priority. By contrast, the low R&D intensive firms were more likely to be engaged in the development of technological process innovations. This finding is consistent with the research of Raymond and St-Pierre (2010) who examined manufacturing firms.

While these high R&D intensive firms were found across all industry sectors and throughout all the countries from which the study was drawn, it was more likely to find them in nontraditional industries such as information and communication technologies (ICT) or biotech rather than manufacturing, services, or retailing. However, it is not suggested that R&D intensity, and with it innovation management formality, is restricted only to these more “high-tech” sectors.

These findings are consistent with those of Covin and Prescott (1990) who found that low-tech product innovators differed from their high-tech counterparts in terms of their structure, market orientation, and need for external financing. High-tech firms were more focused on building their market share and had a greater need for external financing. As found by Terziovski (2010), formalization in the innovation management process and the organizational structure associated with it is likely to be rewarded with superior performance.

Managerial Competence

In high-tech fields such as biotech there is a need for senior management teams to comprise a balance between scientific, technical areas and financial and marketing skills (Sardana and Scott-Kemmis 2010). However, while such a balance of competencies is clearly valuable in all industries, it may be less common in microfirms in low-tech sectors (Maskell 1998).

Nonetheless, the success of new ventures in low-tech sectors can rely heavily on the capacity of adaptation and anticipation of their managers (Evers 2011) (see ► [Entrepreneurial Capability and Leadership](#)).

Proximity Effects

The concept of “proximity effect” is derived from “Proxemics Theory,” one of several interpersonal attraction theories within psychology (Roeckelein 2006). The principle of *proximity* is founded on the assumption that when people are physically closer to each other they are more likely to have greater understanding of and empathy toward each other. For example, Mencl and May (2009) explored the direct effects of and interactions between the magnitude of consequences and various types of proximity (e.g., social, psychological, and physical), in relation to ethical decision making and empathy. Their study found that no significant difference existed between different types of proximity and ethical decision making and that some evidence exists to demonstrate a causal link between proximity and such decision making.

Within the context of small business owner-managers, there is evidence that these “proximity effects” influence how such individuals interact with other owner-managers who compete in the same market. Cognitive proximity has been found to have both direct and indirect effects on innovation performance in small firms (Molina-Morales et al. 2014). This has also a consequence in terms of the feeling SME owner-managers will develop to “belong” to a local business context (Lähdesmäki and Suutari 2012). Such influence is acknowledged to both prevent a more accurate analysis of the environment and to facilitate a quicker decision-making process. Different

individuals can be more or less likely to be influenced, depending on their personality. It is thus quite important to understand the way these effects operate and their consequences. For example, Glaser and Halliday (1984) found that small business wholesalers in Australia were more likely to cooperate than to compete where all owner-managers were physically located in the same agricultural produce market. However, excessive geographic proximity can result in spatial lock-in as originally found by Ben Letaifa and Rabeau (2013).

Moles and Rohmer (1978) suggest that these laws of proximity result in people being prone to considering events, things, and other people of greater importance when they are physically close to them in time and space. This also seems to be applicable to owner-managers within SMEs (Ballereau 2012; Mahé de Boislandelle 1996). At least four “magnification effects” have been identified. The first of these is “small number effect,” which is where the fewer employees within a firm the more important each one is to the owner-manager. The second of these is the “microcosm effect,” which is where the owner-manager focuses on events that are near in time and space. This can result in the owner-manager favoring short-term and spatially proximate issues in their decision making. Things that are spatially proximate are therefore more important to the owner-manager than those further away in time and space. A third issue is “proportion effect,” where the small size of the business tends to amplify the weight and consequences of any decisions made. Finally, there is the “ego effect.” This focuses on the owner-manager as the key decision maker and where their personal ego can influence how they make decisions. Their ego can – if not controlled – affect their ability to look objectively at situations and consider all perspectives (Mahé de Boislandelle 1996; Torrès 2003).

Effectuation Style Decision Making

Several studies provides evidence to support the decision-making principles used by entrepreneurs in situations of uncertainty called effectuation (Sarasvathy 2001; Read and Sarasvathy 2005). Small low-tech firms are engaged in a view of

the future where they were seeking support and precommitments from customers. The basis for taking action toward the commercialization of these innovations is often intuitive. This is also true when seeking to internationalize their activity (Andersson 2011).

This suggests managers of small innovative firms demonstrate a willingness to take on new innovation and its unexpected outcomes. Furthermore, as discussed by Gibb and Scott (1985), the strategic awareness and personal commitment of the managers is vital for small firms to achieve their objectives for product and market development.

Conclusion and Future Directions

A Lower Public Support

Due to a number of reasons, from the difficulties of measuring innovation to the lower visibility of more incremental innovation, low-tech entrepreneurship and the innovative activity of low-tech SMEs are often underestimated. Even if a huge part of the economic activity is carried out by small low-tech firms all over the world, high-tech ventures are more visible and more supported by governments. Studying the situation in Austria, Radauer and Streicher (2007) note for example *“that Low-Tech SMEs are actually more innovative than commonly thought and that supporting these industries might yield positive effects. The Austrian innovation system is diversified, yet programmes that aim at low to mid tech (LMT) innovations are scarce”* (p. 247).

The Importance of the “SME Ordinaire”

Few taxonomy have focused on innovation within small firms. Rizzoni (1991) offered six types and, as discussed above, Tidd (2001) and Mazzarol and Reboud (2009) have offered four types. Jones-Evans (1995) sought to classify entrepreneurs from technology-based firms into four types known as: “researcher,” “producer,” “user,” and “producer” with some subcategories. Autio and Lumme (1998) also proposed a four-part typology for new technology-based firms that included:

(1) “application,” (2) “market,” (3) “technology,” and (4) “paradigm” innovators.

However, this does not address innovation directly. Although there is the classification of low-, mid-, and high-tech firms based on the proportion of annual turnover invested in R&D, it remains linked to technology-based ventures. Despite this, research suggests that there is a high level of innovation activity taking place among small firms that may not be “Gazelles,” or associated with traditional high-technology sectors. As a benchmark of innovation activity, the level of “R&D intensity” is a potentially better measure for differentiating firms, although to classify high and low R&D intensity firms into high or low technology was not strictly correct.

It seems therefore that further research is needed to develop a robust and universally applicable taxonomy for small firms engaged in innovation. A first attempt in that direction would be to use a two-part taxonomy in which firms are classified into what could be described as “*SME Ordinaire*” and “*SME Entrepreneuriale*.” The first group comprises the vast majority of small firms that are capable of innovation, but not necessarily strongly focused on growth or engaged in high technology. They do not conform to the “Silicon Valley business model” that has captured so much attention in recent decades. The second group is associated with the “Gazelle” type of high-growth enterprise.

These two types of firm should not be viewed as two ultimate choices. They are not mutually exclusive constructs. It is more appropriate to view them as the end points of a continuum and perhaps to be strategic choices that an entrepreneur or small business owner-manager can select from at given points in time. For example, as Mazzarol and Reboud (2009) suggest, the choice of a “Shopkeeper,” “Salesman,” “Administrator,” or “CEO” strategic planning response is contingent on the level of uncertainty and complexity facing the firm’s management team and the type of innovation they are seeking to commercialize. In the early years after establishment it is to be expected that a firm might be quite entrepreneurial as it seeks to find its market niche (see

► **Entrepreneurial Strategic Scanning**). However, once it matures and enjoys stability, the focus may return toward the *SME Ordinaire* behavior. More work is needed to fully develop this understanding, but it is clear that there must be greater recognition of the *SME Ordinaire* within academic and policy circles.

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