

Learning to Grow: Dynamic Capabilities in New Technology-based Firms

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Abstract

In this conceptual paper we consider resource acquisition and configuration in new technology-based firms. Essentially, we propose that bootstrapping and bricolage are essential dynamic capabilities in such firms. We argue these embedded routines, which are connected by learning processes, provide a way to remain lean and agile while managing innovation in a dynamic environment. Bootstrapping enables new entrepreneurs to obtain otherwise inaccessible resources, while bricolage results in new configurations of resources to solve problems and create new opportunities. We suggest that bricolage and bootstrapping are linked by learning routines since they provide the opportunity both to explore new ways of using resources ‘at hand’ and then sharing this insight to exploit new configurations. These types of dynamic capabilities are necessary given the general resource scarcity within NTBF and they also will help sustain firms’ innovation potential.

Keywords: Dynamic Capabilities, Learning Routines, Innovation.

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1. Introduction

Understanding why some new firms grow quickly while the majority remain small and relatively insignificant is a key issue in entrepreneurship (Van Stel and Storey, 2004). In this paper we draw on literature from a range of 'fields' to develop a better conceptual understanding of those factors that influence growth in new technology based firms (Laranja and Fontes, 1998). One view about the importance of resources for competitiveness is embodied in the resource-based view of the firm (Barney, 1991). The ability to reconfigure resources in order to respond to environmental challenges has been termed 'dynamic capabilities' (Teece et al., 1997; Eisenhardt and Martin, 2000; Zollo and Winter, 2002). In their conceptual paper, Zahra et al (2006: 918) define dynamic capabilities as 'the abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principle decision makers'. In addition, they argue that there is a lack of research exploring the different types of dynamic capabilities required by new firms.

We agree that the dynamic capabilities associated with new ventures, and high-technology firms in particular, are likely to be different to those in more established firms, since they have access to fewer resources. One way for entrepreneurs to gain such resources is to engage in 'bootstrapping' activities (Brush, 2008; Timmons, 1999). Carter and Van Auken (2005:13) provide a narrow definition of bootstrapping: 'financing methods other than the traditional debt and equity from financial institutions and personal equity'. Others such as Harrison et al. (2004, p308) have a much broader definition: 'Bootstrapping involves imaginative and parsimonious strategies for marshalling and gaining control of resources'. Techniques for bootstrapping resources other than finance include sharing or borrowing equipment, hiring

temporary employees, sharing premises/employees as well as obtaining knowledge, skills and emotional support from family and friends (Sequeira et al, 2007).

In accordance with dynamic capabilities theories, it is the way in which senior managers envisage and enact available resources that defines a firm's trajectory (Eisenhardt and Martin, 2000; Penrose, 1959). Baker and Nelson (2005) take a view that entrepreneurs often use physical, social and institutional resources that are disregarded by more established firms. Drawing on work by Lévi-Strauss (1967), Baker and Nelson (2005) adopt the concept of bricolage to suggest that such resources can be re-defined by enacting alternative practices and routines. Bricolage, 'making do by applying combinations of resources at hand to new problems and opportunities', helps conceptualize the flexible and innovative adaptation of available resources (Baker and Nelson, 2005: 333). Furthermore, Easterby-Smith and Prieto (2008) note that learning processes have an integrative and moderating influence that leads to the creative use of resources in dynamic firms. Zahra et al (2006) also suggest that learning processes are central to the development and application of dynamic capabilities, while Bowman and Ambrosini (2003) propose learning as a dynamic capability.

It is our contention that both bootstrapping and bricolage are essential dynamic capabilities in new technology-based firms (NTBFs) that are connected by learning processes embedded in a firm's routines. In this conceptual paper, the key research question involves consideration of how bootstrapping, bricolage and learning combine to influence innovation and growth trajectories in NTBFs. Our contribution concerns the identification of bootstrapping and bricolage as core processes for the acquisition, reconfiguration, integration and exploitation of resources to establish NTBF growth through product innovation. This issue will be addressed by bringing together literature related to bootstrapping, bricolage, learning and theories of dynamic

capabilities. Our contribution is to explain that bootstrapping and bricolage are dynamic capabilities that can be (but are not necessarily) the basis of innovation, growth and agility in NTBFs.

In this paper we make a number of unique contributions to the literature on dynamic capabilities and new firms. First, we identify those resources that are central to the creation of any new business that has the potential to grow. Second, we distinguish between resources and dynamic capabilities in the context of NTBFs. Third, we propose that bootstrapping and bricolage, linked by learning processes, are the foundation of dynamic capabilities in emerging businesses. Fourth, we provide a number of proposals that develop the theoretical links between bootstrapping, learning and bricolage. Thus, in our conceptual model, we illustrate the key mechanisms by which resources are mobilized to create innovatory new products. Finally, we highlight some of the difficulties in obtaining the right balance between bootstrapping, learning and bricolage, since the dynamic nature of resource reconfiguration may also serve to undermine existing capabilities when responding to environmental changes (Ambrosini et al, 2009). We begin by outlining development of the resource-based view and making links to bootstrapping studies. This is followed by literature that summarizes key ideas associated with the shift from the resource based view (RBV) to the concept of dynamic capabilities. Thereafter, we discuss the notion of bootstrapping and bricolage as dynamic capabilities that are linked by learning processes. Finally, we present our conceptual model and conclude by suggesting the most appropriate approaches to undertaking empirical work in this area.

2. Identifying Resources for NTBFs

Based on the resource-based view, a firm's stock of valuable, rare, imperfectly inimitable and non-substitutable (VRIN) resources are a significant source of competitive advantage (Barney, 1991). These VRIN resources include a range of material, human and functional capabilities through which the firm can generate rents (Helfat et al, 2007), and are sometimes more specifically categorized as financial, physical, human and organizational resources (Colombo and Piva, 2008). Lichtenstein and Brush (2001) identify what they describe as 'salient resources' for entrepreneurial ventures which include: capital, organizational systems/structures, management know-how, technology, physical resources, leadership, culture and 'informal systems'. The authors go on to argue that, in new ventures, organizational resources evolve over a period of weeks, months and years. For new firms are to become established or self-sustaining, 'a series of resource acquisitions and combinations might be necessary' (Lichtenstein and Brush, 2001: 41).

In terms of financial resources, there are substantial risks for investors considering NTBFs: scientific and technological uncertainty, time to market, lack of tangible assets, lack of a track record and information asymmetries (Bozkaya and De La Potterie, 2008). Thus, during the stages of conception and gestation entrepreneurs rely on their own funds plus those obtained from family and friends (Cassar, 2004). As firms grow there is a shift from 'insider' to 'outsider' finance as investment becomes more attractive to business angels and venture capitalists (Bozkaya and De La Potterie, 2008). While financial resources are generally crucial to enable the acquisition of physical resources such as premises, machinery, equipment and distribution channels, other resources are also salient for NTBFs. Clearly, knowledge in the form of human capital is significant for the development of new technologies as well as for the delivery of those functional competences necessary to run a business (Mosey and Wright, 2007; Wright et al.,

2007). Human capital delivers both functional capabilities (such as marketing), as well as the capability to innovate and solve organizational problems (Penrose, 1959). In that regard, technological entrepreneurs often lack the capacity and capability to enact the full range of managerial competences necessary to build a new venture. High performance is more likely to be achieved if a range of skills are available *via* a start-up team, embedded within the firm's employees, or accessible from external networks (Jones and Macpherson, 2006). If appropriate skills are absent then talented expertise may be recruited (Kaulio, 2003), developed within a wider managerial team (Littunen, 2000; Littunen and Tohmo, 2003), obtained *via* external consultants (Hill et al., 2002), or through alliance partners and other firms in close proximity (Fernhaber et al., 2009).

Smith et al. (2005: 335) confirm the importance of 'key employees' whose social relations (networks) are central to the knowledge creation process. They argue that by bringing together internal and external resources, the 'existing and accessible knowledge in a firm affects the rate of new products and services entirely through the firm's knowledge creation capability' (Smith et al, 2005: 335). In NTBFs the range of knowledge resources necessary to create a successful business are unlikely to be readily available or embodied in the entrepreneurs themselves. Rather, knowledge resources and capabilities need to be identified, borrowed, appropriated and integrated from outside the firm's boundaries. Here pre-existing networks and the capability to bridge into new networks are both important (Lee and Jones, 2008). Networks are also important because friendship and kinship ties can provide access to resources at less than market price (Starr and Macmillan, 1990), or even provide resources that are simply not available *via* market transactions (Baker et al, 2003: Witt et al, 2008). Networks thus strongly shape the trajectory of a firm because they are the resources 'at hand' that entrepreneurs use

when solving problems (Baker et al, 2003). The literature thus highlights a range of resources that entrepreneurs are likely to require when establishing NTBFs. In particular, there is a focus on tangible resources - physical and financial - and intangible (human and social capital) that can deliver key organizational capabilities via networks.

3. From Resources to Dynamic Capabilities

While resources are necessary to deliver capability, the resource-based view (RBV) of competitive advantage is too static to explain how firms create new capabilities to exploit opportunities within dynamic markets (Teece et al., 1997; Lichtenstein and Brush, 2001; Lockett et al, 2009). Resources are assets positions that can be deployed creatively in order to (re)configure opportunities rather objective entities as described in resource dependence theory (Pfeffer and Salancik, 1978). Organizations confronted with changing markets or changing technologies must develop new capabilities to avoid the problem of ‘core rigidities’ (Leonard-Barton, 1994). ‘Dynamic capabilities’ thus refer to the ability to create innovative responses to a changing business environment.

Eisenhardt and Martin (2000) suggest that, while much of the strategy literature is ‘vague’ on the nature of dynamic capabilities, there are a number of specific examples from other areas. These include product development routines, strategic decision-making routines, resource-allocation routines and routines related to the acquisition and release of resources (Eisenhardt and Martin, 2000:1107). Such activities create new ‘asset positions’ from which it is possible for economic rents to be generated. In essence, entrepreneurship is seen as a collective, creative process in which mental models are enacted to arrange resources and create new asset positions superior to that which can be achieved by an individual (Foss et al, 2008). These new

asset positions depend on the entrepreneurial team's ability to sense and respond to the environment as well as identifying and configuring resources to (re)create opportunities for competitive advantage (Penrose, 1959). A firm's competitive advantage is thus determined by its dynamic capabilities which depend on the human ability to reconfigure, combine and integrate knowledge (De Boer et al, 1999; Teece et al, 1997). However, because managers/entrepreneurs can be fallible, the reconfiguration of resources may also result in unfavorable outcomes and can even destroy valuable extant capabilities (Zahra et al, 2006; Ambrosini et al, 2009; Ambrosini and Bowman, 2009).

Newbert (2005: 74) based on a study of 817 US nascent entrepreneurs claims that a 'dynamic capabilities perspective provides a theoretical perspective by which to understand the process of new firm formation'. Another study that identifies dynamic capabilities as a key antecedent to innovation and growth is the case of a small, rapidly growing technology-based entrepreneurial firm (Macpherson et al, 2004). The case demonstrates how building effective business networks help expands a firm's resource capacity, allowing it to respond flexibly to customers' needs and to exploit opportunities quickly by mobilizing external assets. Both these studies suggest that, in resource-scarce NTBFs, a key competitive capability involves accessing the necessary knowledge and information to enact the entrepreneur's vision of a potential opportunity (Shane, 2000). Dynamic capabilities, as we have seen, emerged from the RBV which link a firm's internal 'bundle' of resources with their competitive performance in the market (Lichtenstein and Brush, 2001; Barney, 1991; Wernerfelt, 1984; Penrose, 1959). It is the ability to respond to changing environments that offers sustained competitive advantage (Grant, 1991; Eisenhardt and Martin, 2000; Wiklund and Shepherd, 2003). Thus, a dynamic capabilities approach places more emphasis on activities and processes rather than the possession of

resources (Ambrosini and Bowman, 2009). In new and emerging firms such capabilities can bring value to otherwise worthless resources and assist in the growth of the firm despite resource scarcity (Baker and Nelson, 2005). This suggests that developing and enhancing dynamic capabilities at the outset is crucial for technology-based start-ups facing rapidly changing environments (McKelvie and Davidsson, 2009; Wu, 2007).

4. Bootstrapping as a Dynamic Capability

Ambrosini and Bowman (2009: 35) suggest that the ‘core’ of dynamic capabilities concerns transformation of the firm’s existing resource base in such a way that enhances its competitive advantage. Dynamic capabilities have four main processes: reconfiguration, leveraging, learning and creative integration (Bowman and Ambrosini, 2003). Leveraging, which refers to the replication of processes or systems in another business unit, is unlikely to be relevant in the context of a NTBF. Reconfiguration involves the transformation of assets and resources; learning allows tasks to be performed more effectively as a result of previous experimentation; while creative integration refers to the firm’s ability to combine assets and resources that leads to new resource configurations (Ambrosini and Bowman, 2009: 35).

In addition to research mentioned in the last section, a number of studies highlight the way in which NTBFs access a range of resources informally and integrate them into existing routines. For example, studies of high-technology firms examine the way in which entrepreneurs access external human capital resources to enhance innovation (Hayton and Zahra, 2005). The technological expertise and other forms of human capital depend significantly on the scope and scale of the firm’s networks (Mosey and Wright, 2007; Wright et al., 2007). Such resources can be used to access functional and technical expertise missing from the firm’s human capital

portfolio (Smith et al. 2005). By drawing on the experience available from existing business relationships, prior employment, customer and supplier networks and non-executive directors, access can be gained to scarce 'intangible' resources including technological and managerial skills, information and knowledge (Deeds et al 1999; Boussouara and Deakins, 1999; 2000; Lichtenstein and Brush, 2001; Baker et al, 2003; Bruni and Verona, 2009).

Social networks can also provide access to tangible assets such as labour, office space and equipment (Jenssen and Koenig, 2002). Networks are thus a 'means at hand' through which entrepreneurs can access a variety of resources that are either surplus to requirements or discarded by other firms (Baker et al, 2003). Baker and Nelson (2005) note that some resource-constrained entrepreneurs are able to create something of value by combining their physical inputs, labour, skills, customers and the institutional environment in order to meet or create a market demand. Further, a systematic review of knowledge resources in small firms identifies a range of ways in which particular types of human and social capital can help promote growth (Macpherson and Holt, 2007). The authors conclude, *inter alia*, that while networks provide access to essential technical and functional knowledge social skills are essential to access such resources (Baron and Tang, 2009; Edwards and Jones, 2008; Holt and Macpherson, 2010). These types of capabilities help high-technology ventures navigate through periods of difficulty (Carolis et al., 2009). In other words, those firms that can bootstrap knowledge, equipment and financial resources may be able to respond more effectively to crises or new opportunities. Hence, our argument is that the effective management of NTBFs depends on the entrepreneur becoming adept at managing a dynamic network, since this network potentially provides access to a wide range of resources.

Bootstrapping, as a dynamic capability, involves a range of activities that are undertaken

in order to provide resources which support business development when more formal sources are unavailable (Winborg and Landström, 2001; Wu, 2007). The size and diversity of the entrepreneur's social network and influence of the institutional context in which the firm is embedded influence the availability of resources (Evald et al., 2006; Hessels and Terjesen, 2010). Indeed, it is difficult to see how access to formal and bootstrapped resources can be separated from the availability of human resources, including experience and education, acquired *via* the social networks developed by nascent entrepreneurs during business conception and gestation. Hence, bootstrapping is an essential dynamic capability in NTBFs since it allows the entrepreneurial team to supplement existing resources quickly and cheaply in order to respond effectively to new opportunities.

5. Bricolage as a Dynamic Capability

While access to external resources is important, they must be reconfigured and integrated with existing resources if the firm is to successfully undertake the innovation of technology-based products and services (Liechtenstein and Brush, 2001). However, resource integration and reconfiguration requires entrepreneurs to exercise very different skills than those involved in the acquisition of bootstrapped resources. According to Baker and Nelson (2005), open systems theory (Boulding, 1956) has dominated theories of organization by focusing on variations in resource environments and constraints. Baker and Nelson (2005) also draw on the work of Penrose (1959) to suggest that the resources available to new firms are more idiosyncratic than portrayed in resource dependency theory. As a consequence, they argue, there are three important implications for entrepreneurs engaged in business start-up. First, this means that all new firms are unique in their 'idiosyncratic' relationship with the resource environment. Second,

there are substantial variations in the ability of such firms to survive even if they have access to ‘ostensibly similar resource environments’. Third, resources that are worthless to one firm may be extremely valuable to another if they are combined with existing internal knowledge and skills (Baker and Nelson, 2005: 332).

The third point is central to the importance of integrating and reconfiguring underutilized resources, or those discarded by other firms. This is similar to the distinction between potential and realized absorptive capacity: any external resources acquired by a new business are worthless unless they are combined with existing resources (Adler and Kwon, 2002; Jones, 2006; Jones and Macpherson, 2006). Baker and Nelson (2005) go on to argue that Lévi Strauss’s (1967) term ‘bricolage’ is useful for understanding how entrepreneurial firms can thrive in resource-constrained environments. Bricolage is defined as ‘making do by applying combinations of the resources at hand to new problems and opportunities’ (Baker and Nelson, 2005: 333). Hence the concept of bricolage fits very well with entrepreneurial activity. In their study Baker and Nelson (2005) note that bricolage relies on scavenging resources in order to extract use from goods that others do not value or do not intend to use. Importantly, entrepreneurs who target this activity at a particular problem (selective bricolage) are more likely to be successful. While bricolage provides a way of recombining and reconfiguring resources the solution has to be embedded into the firm’s existing routines if it is to provide long-term rents. Baker and Nelson (2005) contrast this with ‘parallel bricoleurs’ who flit between projects depending on customer expectations and obligations. While entrepreneurs take pride in being able to fashion something from nothing they rarely generate substantial long-term rents from their projects. Notwithstanding the differences between these types of bricolage, they both rely on experimentation or improvisation in order to trial and test solutions; in so doing resource

combinations are broken down and/or reconfigured. In that sense, bricolage helps firms both explore and exploit new opportunities that might otherwise be too expensive to investigate by more traditional means (Baker and Nelson, 2005; Miner et al, 2001). This articulation of bricolage resonates with the dynamic capabilities literature. Also, dynamic capabilities are the ability to reconfigure a firm's resources in a 'a manner that is deemed appropriate by its principal decision makers' (Zahra et al, 2006: 918). Hence, this is more likely to occur during a firm's emergence when routines and resource configurations are yet to be institutionalized.

NTBFs may use bricolage as a unique dynamic capability in the early years to allow them to achieve legitimacy and provide returns on their innovations. This also foregrounds the role of entrepreneurial agency in creating adaptive capacity within the firm (Newey and Zahra, 2009). In situations of uncertainty, it is the sensemaking resources (such as those needed to enact bricolage) that are applied to re-think or re-imagine alternative routines and products. The concept of bricolage, as an agentic and purposeful activity, targeted at creating new resource combinations thus resonates with a Penrosian view of how firms create idiosyncratic solutions within similar resource and market constraints in order to create growth potential.

6. Linking Bootstrapping and Bricolage through Learning Processes

Dynamic capabilities 'as the capacity to effect change' are routines and processes that depend on managerial cognition and intangible knowledge to make a difference and remain hidden until exercised (Easterby-Smith et al, 2009:S4). There are a number of different dynamic capabilities such as the capacity to sense and shape opportunities, to take those opportunities and continually renew tangible and intangible assets (Teece, 2007). Zollo and Winter (2002) specifically note the significance of learning mechanisms that are deliberately enacted to

continually build experience and to change existing routines and practices. Indeed, Easterby-Smith and Prieto (2008: 245), in their conceptual paper, also argue that learning processes are ‘a common theme underlying both dynamic capabilities and knowledge management’.

Learning is central to entrepreneurial activity particularly in relationship to opportunity recognition and exploitation (Katila and Shane, 2005; Sanz-Velasco, 2006). Because most growing firms lack resources they are particularly dependent on external knowledge including feedback from customers and suppliers (Gibb, 1997; Pittaway et al, 2004). While individual characteristics are important, it is crucial to understand entrepreneurs as situated learners (Cope, 2003). The entrepreneur’s approach to management and their attitude to employees are important in shaping the nature of learning in small firms (Thorpe et al., 2008). As a wide range of authors have pointed out, the work environment is where most learning takes place and, in small firms, this is strongly influenced by the entrepreneur (Baron et al., 1999). However, this does not mean that learning within small firms is *ad hoc* and unstructured (Sadler-Smith et al., 2001). Jones and Macpherson (2006) stress the importance of creating effective communication structures and repeatable routines if learning is to be effectively embedded in smaller firms. In their study of 25 small horticulture businesses in the Netherlands, Lans et al., (2008) distinguish between internal and external factors which promote learning. Formal internal communications included team meetings and clear communication lines. Informal communications include opportunities to obtain and provide feedback, trust and attention to cultural differences. External interactions had four elements: traders/buyers, consumers, suppliers and ‘experts’ (Lans et al, 2008: 606/7). In summary, the authors suggest that there are four features which are crucial to the entrepreneurial learning environment: support and guidance, task characteristics (division of labour), internal communication and external interaction.

While this may be the case, it is clearly not tenable that entrepreneurial firms will all adopt the same learning activities; learning trajectories are influenced by the cultural and historical antecedents embedded in existing norms, tools and divisions of labour (Engeström, 1987; Blackler, 1993). Zhang et al., (2006) identify clear links between the entrepreneur's human capital and the nature and scope of organizational learning. Zahra et al (2006) identify four learning modes that are linked to the utilization of dynamic capabilities within entrepreneurial firms (improvisation, trial and error, experimentation and imitation). They also note that in the early years of formation firms are likely to engage in improvisation and experiential learning. As firms age they begin to adopt specific learning routines as they become restricted by their path dependencies (David, 1985). This is supported by Baker et al (2003) who note that improvisation, which they argue is distinct from bricolage, occurs at the point of both design and execution. Firms adopting improvisational learning routines make it more likely that they can reconfigure 'resources at hand' in the act of problem-solving that delivers unplanned (beneficial) organizational outcomes (Miner et al., 2001). New firms are unlikely to have the slack resources that allow prior planning to create a solution. Therefore, by using resources that have been available or bootstrapped, improvisation and trial and error learning occurs unsystematically and co-terminously with bricolage. NTBFs are likely to use this type of learning early in their formation in order to overcome specific problems as well as to create or respond to new opportunities. As NTBFs grow they are more likely to develop substantive R&D facilities and engage in formal experimentation (Baker et al, 2003).

There is a central tension in a firm's learning routines: the balance between exploration and exploitation (March, 1991). Learning processes can facilitate a renewal of existing routines at the collective level if individual learning is shared with others and institutionalized into new

systems and routines (Crossan et al., 1999; Jones and Macpherson, 2006). So, while improvisation and bricolage may lead to a new configuration of resources, such learning has to be embedded if long run benefits are to be accrued. This argument is similar to that posed by Baker and Nelson (2005) who note the difference between parallel and selective bricolage. The former is a habituated process of making-do and a *modus operandi* for some entrepreneurs. The latter is a way of targeting particular problems or opportunities such that long-run rents can be generated by embedding the outcomes in new processes and routines. Jones and Macpherson (2006) make a similar argument in their empirical study of three mature firms undergoing periods of renewal. The authors show that the institutional arrangements within which firms are embedded influence the degree to which entrepreneurial learning is shared and institutionalized leading to genuine organizational-level learning.

In summary, NTBFs are generally short of resources from which to generate new products and process. In this situation, resource acquisition through bootstrapping is linked with bricolage by routines that support improvisation and experiential learning. Bricolage in turn requires resource integration in order to achieve long-run utilization of these new resource configurations. As such, learning routines that support the sharing and institutionalization of new routines are likely to develop a revised resource base from which new products and processes can be developed. However, as such successful innovation becomes embedded in the firm, tensions between exploration and exploitation are likely to make improvisation and bricolage less likely since the institutionalization of learning creates path dependencies and rigidities (David, 1985; Leonard-Barton, 1994). Moreover, as noted earlier, improvisation and trial and error learning can disrupt the very resource configurations that created favourable outcomes in the first place (Zahra et al, 2006; Ambrosini et al, 2009; Ambrosini and Bowman, 2009). Thus,

the creative aspect of bricolage and learning can have negative effects on long term rents, particularly if such learning is not embedded and exploited effectively, such as is the case with parallel bricolage (Baker and Nelson, 2005).

7. Towards a Conceptual Model and Research Strategy

One of the central problems in the literature is that there is little agreement about what actually constitutes a ‘dynamic capability’. We suggest that resource acquisition, based on ‘bootstrapping activities’ and resource reconfiguration and integration, based on ‘bricolage’, are key dynamic capabilities in the context of NBTFs. These two activities are linked by ‘feedforward’ and ‘feedback’ learning processes (Crossan et al, 1999; Jones and Macpherson, 2006), which enable the firm to integrate bootstrapping and bricolage to ensure the resources are used effectively. The outcomes of this process are (potentially at least) the rapid development of new products and concurrent growth in firm size. Our intention in this section is to articulate a clear explanation of our approach to ‘theory building’ in relationship to the evolution of NTBFs.

The concept of dynamic capabilities has become the dominant theoretical perspective in strategic management. According to Wu (2007) dynamic capabilities are the mediator between entrepreneurial resources and business performance. Although, as pointed out by Zahra et al (2006: 919), ‘most research and theory building has focused on established companies, ignoring new ventures and SMEs’. The authors go on to say that they find this gap ‘puzzling’ as dynamic capabilities are important for both the survival and growth of small firms. Zahra et al (2006) identify a number of ‘inconsistencies and ambiguities’ in the existing literature and these include: difficulty in separating dynamic capabilities from their effects (i.e., performance) and the association with rapidly changing environments (Teece et al., 1997).

Entrepreneurial activities are the starting point for the model of dynamic capabilities developed by Zahra et al., (2006). This stresses the importance of strategic choice (Child, 1972: 1997), which underpins the role of key decision-makers in the creation of dynamic capabilities. Zahra et al., (2006) also distinguish between substantive capabilities, organizational knowledge and dynamic capabilities. Winter (2003) describes substantive capability as the abilities and resources which are concerned with problem-solving or attaining specific goals. The concept of dynamic capabilities refers to the firm's ability to reconfigure its resources and routines (existing substantive capabilities). Organizational learning processes are also an important influence on the creation of both substantive capabilities and organizational knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002; Easterby-Smith et al, 2009). Dynamic capabilities are what link organizational knowledge and substantive capabilities, which lead eventually to enhanced performance (Zahra et al, 2006). Figure 1 illustrates the way in which the dynamic capabilities of bootstrapping and bricolage are linked by learning processes in contributing to innovation and growth in NTBFs.

Insert Figure 1 Here

Our conceptual model is based on three distinct resources. All nascent entrepreneurs have access to a range of resources in the early stages of business start-up, which we have categorized as: knowledge, tangible and network resources. Clearly entrepreneurs must acquire additional resources, which will be 'reconfigured' and 'integrated' with existing resources if firms are to grow and successfully innovate technology-based products and services. Studies of bootstrapping have tended to focus on the technique as a way of obtaining additional financial

resources (Carter et al, 2003; Carter and Van Auken, 2005). We acknowledge that finance is certainly one of the most important resources for any start-up firm and is particularly crucial for NTBFs (Bozkaya and De La Potterie, 2008; Cassar, 2004). Without adequate financial resources start-up firms find it difficult to obtain and develop their physical resources including premises, machinery, equipment and distribution channels (Lichtenstein and Brush, 2001). Knowledge resources, incorporating technical, functional and social skills, are based on the entrepreneur, members of the management team and other employees. Resources that can be accessed through networks are categorized as personal contacts, experience and knowledge, physical resources and financial resources (Witt et al., 2008: 954).

In the early stages of business creation, nascent entrepreneurs concentrate on their 'close ties' which are primarily previous colleagues, family and friends (Manolova et al., 2006). These networks provide the potential to access bootstrapped resources that are crucial in overcoming the liability of smallness (limited resources including managerial skills) and the liability of newness (lack of history/reputation) (Witt, 2004). Such resource limitations otherwise circumscribe the ability of new firms to compete against their more established rivals. However, the cognitive abilities and sense-making faculties of entrepreneurs and their management teams are required to envisage alternative configurations of internal and external resources that provide the opportunity to create and/or exploit opportunities (Penrose, 1959; Narayanan et al, 2009; Pandza and Thorpe, 2009).

Our argument is that in NTBFs the original resource base must be supplemented by accessing additional resources. Hence, we introduce three additional concepts into our model: bootstrapping, bricolage and learning. As discussed above, entrepreneurs compensate for their lack of resources by utilizing links to the environment: network linkages help entrepreneurs

obtain raw materials from upstream suppliers, downstream channels to deliver goods/services and research institutions to supply technological knowledge (Wu, 2007). Van Auken (2004) points out that there are particular problems which face NTBFs with a focus on innovation. Difficulties include uncertainty associated with new product development, unproven markets, intellectual property rights and information asymmetries (Bhide, 1992). Such issues combine to make the problems of raising external financial capital, debt and equity, a significant challenge for most NTBFs. Bootstrapping, using the various techniques identified by Winborg and Landström (2001), enables entrepreneurs to acquire a wide range of resources including finance, premises, machinery, equipment, labour, information and business opportunities (Lichtenstein and Brush, 2001). Thus, bootstrapping is a key dynamic capability since it allows firms that are resource-constrained to access resources relatively quickly in order to create, or respond to, market opportunities. Supplementing existing resource endowments with the acquisition of resources available through networks relies on the skill of those within the firm. Bootstrapping then, if it is built in to the fabric of the firm through its embedded routines may also provide a way for a firm to remain responsive and agile by encouraging a lean approach to its operating strategy (Timmons, 1999).

Proposition 1: *The potential for bootstrapping resources is a function of the entrepreneur's (or management team's) prior experience, network structure and social skills.*

Having acquired additional resources, they must then be reconfigured and integrated with existing resources. Bricolage, 'making do by applying combinations of the resources at hand' (Baker and Nelson, 2005), means that entrepreneurs can ensure that bootstrapped resources are

used in the most effective way to enhance their firm's survival prospects. To do this requires that entrepreneurs reconfigure resources through improvisation and trial and error learning activities (Miner et al., 2001). Thus, bricolage is a dynamic capability that sustains the renewal and reconfiguration of the resource base. However, utilization of the resource base depends on how entrepreneurs' (or entrepreneurial teams') intuition and perception is applied to solve problems and to create something useful with discarded resources (Baker and Nelson, 2005). Such sensemaking activity is not without risk, based as it is on bias, past experience, bounded rationality and a limited capacity to predict the changing environment. Such change can also have negative outcomes (Ambrosini et al., 2009).

***Proposition 2:** The potential for bricolage is a function of the entrepreneur's or management team's perception of environmental opportunities and their ability, or willingness, to create new resource combinations.*

Despite this risk, bootstrapping and bricolage provide a way of both replenishing and reconfiguring the resource base. However, both of these processes are influenced by the firm's learning processes. Improvisation and trial and error learning provide ways of searching for, exploring and or creating new opportunities that result in reconfiguration of the resource base. Such learning, and a commitment to experimenting with new ideas in order to solve novel problems, provides the impetus to manipulate and renew available resources (external and internal) into new combinations, potentially creating innovations in response to changing environments. Our argument is that developing bootstrapping and bricolage as dynamic capabilities has the potential to limit path dependencies since they reduce reliance on the

acquisition of substantial resources by encouraging renewal and reconfiguration in order to explore new opportunities. If dynamic capabilities are path dependent, as suggested in the literature (Ambrosini and Bowman, 2009; Teece et al., 1997), developing bootstrapping and bricolage as embedded routines will provide processes that can encourage long-term agility and continued renewal. Baker et al., (2003) for example suggest that improvisation, which occurs in the founding stages of a firm, is a strategic activity. The utilization of dynamic capabilities within entrepreneurial firms requires such learning activity as improvisation, trial and error, experimentation (Zahra et al., 2006). These creative processes provide potential solutions for environmental changes and/ or specific opportunities identified by management (Miner et al, 2001, Katila and Shane, 2005). Maintaining a commitment to bootstrapping and bricolage could also provide continual replenishment and reconfiguration of these resources and thus maintain strategic and regenerative dynamic capabilities; this leads to two more propositions:

Proposition 3a: *NTBFs that engage in bootstrapping will access a wider range of resources develop creative and innovative solutions in response to a changing environment.*

Proposition 3b: *NTBFs that promote improvisation and trial and error learning will engage in bricolage that leads to a reconfiguration of resources.*

However, if entrepreneurial opportunities are to be realized over the long term, it is important that learning is institutionalized and shared throughout the firm allowing economic rents to be generated (Jones and Macpherson, 2006; Crossan et al, 1999). It is crucial to the arguments in this paper that the initial resources possessed by the firm/entrepreneur are

converted into outputs in the form of technology-based products and growth. Kelley and Nakosteen (2005) employ three output-based measures of a new firm's resources which result from technological innovation: patent data, new products and the 'innovativeness' of those new products. Another measure crucial to NTBFs is 'innovation speed' in the form of the time taken to develop new products which can generate income for the firm (Heirman and Clarysse, 2007; Schoonhoven et al, 1990). Heirman and Clarysse (2007) suggest that the resource-based view (Wernerfelt, 1984) provides the best approach to evaluating innovation in start-ups. In particular, tangible and intangible assets associated with the 'creation and infancy of new ventures can have long-lasting effects on their future development' (Heirman and Clarysse, 2007: 305). As we have argued it is not just resource appropriation that defines innovative capacity. Clearly, if NTBFs are to make a substantial economic impact, they have to use those resources to innovate products which fulfil or create market opportunities. While we propose bootstrapping and bricolage as dynamic capabilities we are mindful that achieving such rents is not guaranteed. As identified by Ambrosini et al., (2009), there are costs to reconfiguration, such as losing rents from exiting configurations, while entrepreneurial perceptions of opportunities may be misguided. Thus, while bootstrapping and bricolage have the potential to create rents for NTBFs, through innovation, they also have the potential to destroy benefits gained from previous configurations.

We acknowledge that this creates a tension between exploitation and exploration in learning routines as defined by March (1991). This is exemplified by links shown between parallel and selective bricolage noted by Baker and Nelson (2005), where the former has a commitment to innovation and the latter commitment to generate rents from specific innovations. Nevertheless, repetition and sharing potentially allow 'selective bricolage' (Baker and Nelson, 2005) to be leveraged to generate ongoing rents from new resource configurations.

Proposition 4: *NTBFs that institutionalize and share learning that arises out of bricolage will generate long-term rents on their innovations.*

Theoretical Implications:

Figure 1 illustrates the key concepts related to the creation of dynamic capabilities in NTBFs. In setting out the ‘how’ of our model we suggest that resources, bootstrapping, bricolage and learning are linked in the following manner. As Teece et al., (1997) argue, those processes that represent a firm’s ability to respond to the changing business environment are ‘dynamic capabilities’ (see Leonard-Barton, 1994). Furthermore, dynamic capabilities help create competitive advantage for start-up firms by transforming their resource base (McKelvie and Davidsson, 2009; Wu, 2007). There is an emerging literature which examines bootstrapping in small firms and a much smaller literature related to bricolage. Our contribution concerns the idea that bootstrapping and bricolage, linked by learning processes, are dynamic capabilities which potentially form the basis of innovation and growth in NTBFs. The core of our argument is that entrepreneurial abilities in extending their existing resources endowments, such as human capital, ultimately underpin the range of their creative solutions that influence the ability of a firm to grow (Penrose, 1959). This notion of agency confirms the importance of entrepreneurial capabilities directed at resource acquisition and reconfiguration activities essential for innovation. Moreover, Baker et al., (2003) clearly link entrepreneurs’ improvisational capabilities to the decision-making associated with bricolage. The processes associated with enhancing and extending the entrepreneur’s existing resource base by a combination of bootstrapping and bricolage depend heavily on their ability to improvise and to learn.

In contrast to the model developed by Zahra et al (2006), we have been very explicit about the nature of dynamic capabilities in the context of NTBFs. The key contribution of this paper, then, is to identify bootstrapping and bricolage as key processes which are central to the acquisition, reconfiguration, integration and exploitation of those additional resources required to establish business growth through product innovation. Growth will only occur if the resources possessed by nascent entrepreneurs at the point of new business creation are combined with existing resources. It is our contention that bootstrapping and bricolage provide the basis for the acquisition, integration, reconfiguration and utilization of those additional resources. Furthermore, these two activities are linked by learning processes involving improvisation, trial and error, repetition and sharing. Hence, we suggest that ‘learning to bootstrap’ is an important aspect of entrepreneurship, which has a number of benefits including promoting good management practices (Harrison et al., 2004; Timmons, 1999). Brush et al., (2006) studied bootstrapping amongst a sample of 88 women-led high growth technology firms and found those using their ‘capital raising ingenuity’ were more likely to achieve rapid growth. While Timmons (1999, p.39) notes that bootstrapping introduces ‘a discipline of leanness’ which forces firms to spend wisely and deploy their resources effectively. Bootstrapping also frees NTBFs from excessive debt and enables the entrepreneur to seek new growth opportunities. At the same time, effective bootstrapping and bricolage, in the form of tangible innovations, and the legitimacy that this potentially creates for the firm, can be the basis for acquiring other resources including outside equity investment or venture capital, which fund the next stage of growth (Brush et al., 2006; Carter et al., 2003).

8. Conclusions

As stated at the outset, one of the most important issues in entrepreneurship concerns the

processes associated with firm survival and growth (Macpherson, 2005). NTBFs face the typical problems associated with business start-up in that they are likely to lack managerial, financial and knowledge resources (Thorpe et al., 2008). In addition, NTBFs have to deal with the difficulties of innovating new technology-based products, uncertain markets and better resourced rivals (Bhide, 1992; Bozkaya and De La Potterie, 2008; Deeds et al., 1999). A number of authors have discussed dynamic capabilities in the context of small, entrepreneurial firms (Chirico and Nordqvist, 2010; McKelvie and Davidsson, 2009; Wu, 2007). However, there is very little congruence in defining the exact nature of those dynamic capabilities that are important to the success of start-up businesses. The central contribution of this paper is the identification of three core processes associated with the creation of dynamic capabilities in the context of NTBFs.

Bootstrapping, as defined by Harrison et al., (2004), is the ability of entrepreneurial firms to obtain resources by the application of ‘imaginative and parsimonious strategies’. While finance is certainly important there are a range of other resources which can be effectively bootstrapped: employees, premises, knowledge, skills and emotional support (Sequeira et al., 2007). In order to maximise the benefits, new resources must be incorporated with the firm’s existing resource-base. As Baker and Nelson (2005) point out, bricolage is the ability of firms to apply ‘combinations of resources’ to new problems and opportunities. Bricolage is crucial to understanding why some new firms are better than others in exploiting similar resource environments (Baker and Nelson, 2005). Many authors have confirmed that effective learning is central to the entrepreneurial ability to recognise and exploit new opportunities (Katila and Shane, 2005; Sanz-Velasco, 2006). As illustrated in Figure 1, we suggest that bootstrapping and bricolage are linked by feedforward and feedback learning processes (Jones and Macpherson, 2006). Feedforward learning is concerned with improvisation and trial/error activities while

feedback learning concerns repetition and sharing (Easterby-Smith and Prieto, 2008.)

In our view, entrepreneurial agency in NTBFs is targeted at solving concrete problems and, is thus, an overtly teleological activity. In this paper we have attempted to link the concept of dynamic capabilities to the ability of NTBFs to effectively engage in the innovation of new products. This activity is not without risk, since new resource configurations may also result in destruction of previous rent generating activity, but the dynamic capabilities of bootstrapping and bricolage (linked by appropriate learning processes) may provide the agility for resource scarce NTBFs to respond to environmental shocks and opportunities.

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Figure 1: Conceptual Framework

