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## Resource constraints as triggers of radical innovation: Longitudinal evidence from the manufacturing sector

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### ABSTRACT

Despite the significant role of radical innovation as a driver of firm growth and performance, the consequences of resource constraints for radical innovation outcomes remain unknown. Our paper addresses this gap. We combine arguments from entrepreneurship theory and the theory of recombinative innovation to construct an overarching theoretical framework that argues why resource constraints can *promote*, rather than *impede*, radical innovation. We then build hypotheses on two specific resource constraints, knowledge and financial, and test these by a lagged-variable random-effects Tobit model with longitudinal data from an exceptionally large and detailed innovation survey. Controlling for absorptive capacity, firm age, and firm growth, we find full support for the hypothesis that knowledge constraints spur radical innovation and partial support for the hypothesis that financial constraints spur radical innovation. We discuss the theoretical significance of these findings and point to managerial implications and paths for future research.

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### 1. Introduction

Do resource constraints make firms generate radical innovations (RI)? This question has important implications for academic research and managerial practice, since RI is critical for long-term organizational success (Christensen, 1997; Hamel, 2000; Utterback, 1994). An innovation is radical if it is novel to the innovating firm (Bantel and Jackson, 1989; Damanpour and Evan, 1984) and based on unique knowledge and/or technology compared with the firm's prior knowledge and/or technology (Katila and Ahuja, 2002; Tushman and Nadler, 1986; Dahlin and Behrens, 2005). Firms that innovate radically desire to move away from current organizational routines (March, 1991; Miner et al., 2001), to replace current by new knowledge bases (Hill and Rothaermel, 2003; Katila and Ahuja, 2002), and to redefine existing or create new markets (Abernathy and Clark, 1985; Benner and Tushman, 2003; Danneels, 2002). A firm that succeeds at innovating radically often enjoys superior performance, whereas firms that fail are likely to lose market share (Christensen, 1997; Christensen and Bower, 1996; Leifer et al., 2001).

Extant arguments on the implications of resource constraints for innovation outcomes are conflicting. On the one hand, many scholars argue that the discontinuous nature of RI (Leifer et al., 2001; Majchrzak et al., 2004) implies a higher probability for delays, unpredictability of results, context dependency, and complexity (Cardinal, 2001; McDermott and O'Connor, 2002; O'Connor and Ayers, 2005) as well as high costs, risks and resource demands when an RI project is begun (Audia and Goncalo, 2007; Christensen, 1997; March, 1991; Levinthal and March, 1993). They therefore conclude that resource constraints tend to impede innovation (Amabile et al., 1996; Camison-Zornoza et al., 2004; Damanpour, 1991; Mone et al., 1998; Singh, 1986).

On the other hand, a more recent perspective suggests that organizations less well endowed with resources are more likely to explore, especially when they operate in competitive environments (Katila and Shane, 2005). Entrepreneurship studies (Baker and Nelson, 2005; Bradley et al., 2010; Sarasvathy, 2001), creativity research (Moreau and Dahl, 2005; Ward, 2004), team-level studies of project outcomes (Hoegl and Gemuenden, 2001) and exploratory studies conducted in diverse industry and technology contexts all show that RI can be developed efficiently despite – or even *because of* – resource constraints (Gibbert and Scranton, 2009; Gibbert et al., 2007; Nonaka and Kenney, 1991).

These inconsistencies are unresolved since, to date, few studies have analyzed resource constraints as antecedents of RI outcomes. Some studies consider resource constraints as predictor variables in diverse contexts (Goldenberg et al., 2001; Hoegl and Gemuenden,

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2001; Katila and Shane, 2005; Moreau and Dahl, 2005; Mone et al., 1998; Mishina et al., 2004; Castrogiovanni, 1991; McKinley et al., 1986), but none of these studies analyzes RI outcomes. Ironically, studies that *do* analyze RI outcomes (Debruyne et al., 2010; Rao and Drazin, 2002; Germain, 1996; Subramaniam and Youndt, 2005; Wadhwa and Kotha, 2006; Ahuja and Lampert, 2001; Nystrom et al., 2002; O'Connor, 1998; Leifer et al., 2001; O'Connor and McDermott, 2004; Hargadon and Sutton, 1996, 1997; Rice et al., 2001) have ignored resource constraints as possible antecedents of RI.

The few studies that consider resource constraints as predictors of innovative outcomes are either descriptive (Freel, 2000; Hewitt-Dundas, 2006), exploratory factorizations (Baldwin and Lin, 2002; Galia and Legros, 2004; Tourigny and Le, 2004), conceptual (Hoegl et al., 2008), or qualitative (Gibbert and Scranton, 2009; Nonaka and Kenney, 1991). To the best of our knowledge, no theory linking resource constraints to radical innovation exists yet.

The purpose of our study is to formulate and empirically test such a theory.<sup>2</sup> Our study is set at the organizational level. We combine arguments from entrepreneurship theory and the theory of recombinative innovation to construct an overarching theoretical framework that argues why resource constraints can promote, rather than impede, RI. We then build hypotheses on two specific resource constraints, knowledge and financial, and test these by a lagged-variable random-effects Tobit regression model with longitudinal data from an exceptionally large and detailed innovation survey. Controlling for absorptive capacity, firm age, and firm growth, we find full support for the hypothesis that knowledge constraints spur radical innovation and partial support for the hypothesis that financial constraints spur radical innovation.

These findings contribute to resolving inconsistencies regarding the effect of resource constraints on innovation outcomes by proposing novel theoretical mechanisms by which resource constraints positively influence the development of RI. We further contribute to reducing empirical inconsistencies of prior studies by focusing on one specific type of innovation, by introducing relatively direct and objective measures, and by testing the proposed mechanisms with longitudinal data from the manufacturing sector of a whole economy. Our study also deepens prior exploratory approaches that have studied and described resource constraints without studying their consequences for innovative outcomes. To the best of our knowledge, our study is the first empirical paper that directly studies the impact of resource constraints on RI outcomes. This focus allows us to control for unobserved heterogeneity by studying why resource constraints are likely to induce innovation outcomes before innovation leads to firm growth and performance. Finally, executives can benefit from our study when they harness resource constraints to spur RI in their organizations.

## 2. Theoretical framework and hypotheses

Entrepreneurship research suggests that organizations avoid experimentation if resources are available: firms then search for innovation opportunities along their known technological domains, administering current resources rather than exploring new opportunities (Bradley et al., 2010; Burgelman, 1983a,b). Particularly, a strategic orientation driven by currently controlled resources makes a firm focus on internal efficiency rather than on the discovery of novel opportunities (Cheng and Kesner, 1997). In

<sup>2</sup> Note that an analysis of resource *slack* is beyond the scope of our paper; we focus solely on resource constraints since the absence of resource slack in a firm does not necessarily imply the presence of resource constraints and vice versa (Burgelman, 1991).

such a setting, firms have only limited incentives to experiment since the need to take risks is significantly reduced (Levinthal and March, 1993; Miller and Leiblein, 1996; Sinclair et al., 2000), and consequently, they often lack entrepreneurial orientation (March, 1994; Mishina et al., 2004). They feel compelled to use their available resources and spend less time conducting opportunistic searches outside the firm which they perceive as costly and risky (Miller, 1994; Helfat, 1994; Stuart and Podolny, 1996). Thus, over time, firms with excess resources tend to favor familiar over unfamiliar, mature over nascent, and near over *de novo* technologies (Ahuja and Lampert, 2001). Therefore, firms with excess resources should be relatively unlikely to develop RI since the development of RI necessarily involves the risky exploration of hitherto unknown technological domains or the discovery of new knowledge (Levinthal and March, 1993; March, 1991).

In contrast, resource scarcity stimulates managers to adopt entrepreneurial management practices that foster the search for new opportunities (Stevenson and Gumpert, 1985; Stevenson and Jarillo, 1986, 1990). An entrepreneurial strategic orientation looks beyond the possible limits of currently available resources and assumes that needed resources can be recombined or found as opportunities develop (Bradley et al., 2010). Under conditions of resource scarcity, firms are required to use new search paths since no resources are available to increase either search scope or depth of the established paths. Resource scarcity as such is unlikely to impede firms from embarking on such novel search paths; instead, organizations just need to recognize an idiosyncratic problem or an opportunity to start a new search (Cyert and March, 1963; Shane and Venkataraman, 2000). Perceptions of resource inadequacy may trigger a variety of novel search paths, such as socialization, recombination, and internalization (Nonaka and Takeuchi, 1995; Schulze and Hoegl, 2006). Cognitive psychology research suggests that individuals who have to solve an innovation problem are more creative under condition of resource constraints (Durham et al., 2000; Moreau and Dahl, 2005). These improvements in individual creativity are likely to result in organizational-level outcomes. For example, research on the team/group level finds that resource constraints are positively associated with innovation project performance (Hoegl et al., 2008; Hoegl and Gemuenden, 2001). The increased creativity and entrepreneurial orientation that results from resource scarcity also makes it more likely that individuals can identify analogies (Hoegl et al., 2008; Kalogerakis et al., 2010) and serendipitous findings (Baker and Nelson, 2005; Denrell et al., 2003), both of which are likely to increase the chance that the firm can develop novel technological solutions and even breakthrough innovations (Ahuja and Lampert, 2001). Exploratory search behaviors that eventually lead to the development of RI involve a conscious effort to move away from current organizational routines and knowledge bases (March, 1991; Miner et al., 2001). Along the same lines, Iammarino et al. (2009) find support for the hypothesis of a positive association between firms' perception of constraints and their innovation propensity. These arguments suggest that resource constraints are likely to increase the chance that a firm develops RI.

We believe that these effects are particularly strong in the case of first, knowledge and second, financial constraints. Knowledge constraints represent idiosyncratic problems for the organization that cannot easily be overcome since innovation-related knowledge is often highly special and dependent on specific firm routines and prior search paths (Ahuja and Lampert, 2001; Carlile, 2004). Moreover, simply increasing search scope or depth to further develop and deepen the existing knowledge elements is unlikely to alleviate such problems since resource demands grow strongly as the deeper exploration of existing search paths or broad search into novel areas is fostered (Katila and Ahuja, 2002). In this situation, entrepreneurial searches for opportunities triggered by

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