Internal and External Antecedents of SMEs' Innovation Ambidexterity Outcomes

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Abstract

Purpose –This study aims to examine internal and external antecedents of SMEs' innovation ambidexterity outcomes. Prior studies have suggested that organizational and environmental antecedents are influential to the development of a balance dimension of innovation ambidexterity, which are proposed to be central to superior firm performance. However, little is known about how such antecedents affect the shaping of innovation ambidexterity in small- to medium-sized firms (SMEs) and how these innovations go on to shape firm performance.

Design/methodology/approach – This research used a survey method to investigate the 1000 small-and medium sized enterprises in Scotland. Firms were randomly selected from the FAME database. Of this sample, 265 firms (26.5 percent) responded to our survey.

Findings - The data analysis reveals that internal organizational structures in a highly dynamic environment stimulate the appearance of innovation ambidexterity. Moreover, it is found that the relationship between organizational and environmental forces and firm performance is partially mediated by a balance dimension of innovation ambidexterity.

Originality/value - Prior studies have paid little attention to the effects of internal organizational structures and external environmental conditions on the appearance of a balance dimension of innovation ambidexterity within SMEs. Our results show how dangerous the lack of adequate research of these issues at the SME level is. By contrast to larger firms, our results show how internal organizational structures and external environmental conditions affect SMEs to pursue a balance dimension of innovation ambidexterity .

Keywords Explorative innovation, exploitative innovations, innovation ambidexterity, internal structure, environment, SMEs.

Paper type Research paper

Contemporary studies into innovation management hold that successful firms are effective at exploiting existing competencies to create gradually improved exploitative innovations while at the same time successfully exploring new competencies and technologies to create explorative breakthrough innovations (Levinthal and March, 1993; Floyd and Lane, 2000; Gibson and Birkinshaw, 2004; He and Wong, 2004). To achieve this, a firm must reconcile internal tensions between both innovation pathways as well as tensions caused by contradicting demands placed on the firm by its external environment (Jansen *et al*., 2006). Thus, previous studies argue that a firm needs to learn how to achieve a balance between exploitative and explorative innovation activities if it is to achieve sustainably superior performance (Burgelman, 1991; Tushman and O'Reilly, 1996; Volberda, 1996; Eisenhardt and Martin, 2000; Benner and Tushman, 2003). A firm that fails to achieve this balance risks falling into a downward spiral of mediocrity (March, 1991).

Explorative innovation captures the 'research' aspect of the R&D process while exploitative innovation captures its 'development' component. Unsurprisingly, the vast majority of academic research has, as a result, focused on large and multiunit firms, emphasising the overwhelming importance of simultaneously or sequentially pursuing explorative and exploitative innovations (Tushman and O'Reilly, 1996; Birkinshaw and Gibson, 2004; Gibson and Birkinshaw, 2004; Jansen *et al*., 2006; Raisch and Birkinshaw, 2008; Raisch *et al*., 2009). There is a need to understand how such innovations work in small- to medium-sized firms (SMEs) however, because there are differences in the innovation strategies of SMEs and large firms owing to their differing response and susceptibility to external environment pressure (Dean *et al*., 1998). Prior studies found that SMEs tend to use different types innovation ambidexterity compared to larger firms (Cao et al., 2009; Ebben and Johnson, 2005). This is because SMEs differ from larger firms regarding available resources such as human resources capital and financial capital (Cooper *et al*., 1994; Forbes and Milliken, 1999). Moreover,

SMEs may pursue different innovation strategies from larger firms due to the fact that SMEs have restricted managerial expertise (Pissarides, 1999; Forbes and Millken, 1999) as a result of different internal and external environments (Ebben and Johnson, 2005). Research (e.g. Cao et al., 2009) found that SMEs as relatively resource-constrained firms benefit from a balance dimension of innovation ambidexterity (BD) but larger firms benefit from a combined dimension of innovation ambidexterity (CD). Accordingly, SMEs faced greater challenges in managing tensions, contradictions, and tradeoffs associated with explorative and exploitative innovations than larger firms (Andriopoulos and Lewis, 2009; Bierly and Daly, 2007). There is, however, few empirical attempts into how SMEs can achieve a BD owing to the relatively resource constraints existing in SMEs (Cao *et al.*, 2009). This is surprising when considering how various studies note the difficulty that firms have in resolving opposing organisational structure and process requirements put forward by different forms of innovation ambidexterity (Adler and Borys, 1996; Andriopoulos and Lewis, 2009; Sheremata, 2000; Jansen *et al.*, 2006).

Conceptual and empirical research has so far suggested that combinations of contradictory firm characteristics such as centralization and connectedness may be needed to develop a balance of explorative and exploitative innovations (i.e., BD) (Gibson and Birkinshaw, 2004; Jansen *et al.*, 2005, 2006), implying in turn that truly innovative firms combine organic and mechanistic structural features (Adler and Borys, 1996; Sheremata, 2000). Moreover, theory suggests that external environment factors such as environmental dynamism and degree of competitiveness can generate opposing pressures for innovation ambidexterity as well (Levinthal and March, 1993; Lewin *et al.*, 1999; Auh and Menguc, 2005; Jansen *et al.*, 2005). Dynamically competitive environments can require firms to pursue both types of innovations concurrently or risk failure in time (Benner and Tushman, 2003), for example, whereas competitive environments might push firms towards exploitative

innovations owing to the need to keep up with rivals (Jansen *et al*., 2006). But little is understood about the role of the external environment in aiding or impeding the appearance of BD in SMEs. Coupled with the absence of empirical research that examines how combinations of organizational and environmental antecedents affect SMEs' innovation outcomes (Lubatkin *et al*., 2006), generating new insights in this respect is a chief scholarly and managerial priority.

The objective of this study is to examine internal and external antecedents of SMEs' a balance dimension of innovation ambidexterity outcomes. We hypothesize that the extent to which SMEs engage in either type of innovation is shaped by external environmental conditions and internal organizational structure characteristics. By empirically examining these relationships, this study contributes to current research into innovation ambidexterity in several ways. First, empirical research has only begun to explore the antecedents and consequences of these opposing innovations, typically in large firms, to understand alignment and adaptability of the firm towards explorative and exploitative innovations (Gibson and Birkinshaw, 2004; He and Wong, 2004). This work adds to these studies by including complementary measures for SMEs and provides new insights into managing these innovations. Second, our research examines how combinations of environmental properties lead SMEs to pursue innovation ambidexterity (i.e., BD). Third, we examine how SMEs are able to profit from innovation ambidexterity and consider whether these innovation outcomes mediate the impact of organizational structure and external environment pressures on SME performance, adding SME level evidence and insight over and above prior works from Adler and Borys (1996), Sheremata (2000), Smith and Tushman (2005), and Jansen *et al*. (2006), among others. Empirical support for our hypotheses can advance the current theories of innovation management by addressing the neglect of SMEs in this conversation so far (Raisch *et al*., 2009), offering guidance for managers in turn.

In the body of this article, we review the theory and literature that underpins the hypotheses pertaining to innovation ambidexterity. We put forward internal organizational structure characteristics and external environmental antecedents and explain their relation to SMEs' innovation ambidexterity in turn. Afterwards, we describe our research method and then present our empirical findings. We conclude with a discussion of the results, issues for future research and contributions to managers from the work.

Literature Review and Hypotheses

Internal organizational antecedents of balanced dimension of innovation ambidexterity

Explorative and exploitative innovations are two fundamentally different innovation activities that lead firms to diversify their efforts and resources as they pursue one form or another. Exploitation is associated with activities such as refinement, efficiency, selection and improvement whilst exploration refers to activities such as search, variation, experimentation and discovery (March, 1991). Theory put forward that exploitative and explorative innovations may need two fundamentally different internal organizational structures and contexts (Jansen *et al*., 2006; Raisch and Birkinshaw, 2008). Several studies suggest that various internal organizational structures such as centralization and interdepartmental connectedness are critical to facilitate the appearance of these innovations at the firm level (Dewar *et al*., 1980; Jaworski and Kohli, 1993; Atuahene-Gima, 2003, 2005; Jansen *et al*., 2006). In this study, we examine these two main conditions and consider the extent to which they facilitate the occurrence of exploitative and explorative innovations (i.e., innovation ambidexterity) in SMEs.

Centralization refers to the extent to which power is distributed among social positions in the organization (Hage and Aiken, 1970). This can reflect itself in the concentration of decision-making and the degree to which authority to problem solve is devolved within firms

(Aiken and Hage, 1968). Sheremata (2000) suggest that centralization of decision-making can enable firms to react fast to the requirements of current customers and can assist to speed up exploitative innovation. Centralization reduces the fullness of information due to limited communication and the quantity of information and knowledge retained, however (Sheremata, 2000).As a result, centralization of decision-making and authority would be expected to have an adverse effect on explorative innovation (Jansen *et al*., 2006). This is because explorative innovation needs large amount of rich information and knowledge as it is reliant on increasing flexibility, adaptability and creativity in problem solving (Brown and Eisenhardt, 1995; Jansen *et al*., 2006). In contrast, previous studies have suggested that centralization of decision-making and authority is valuable to exploitative innovation because it relies on seeking timely information so that firms can react quickly with its current competences to respond to market uncertainties (Perrow, 1984; Sheremata, 2000; Jansen *et al*., 2006). Incidentally, such decision-making processes decrease the pursuit of creative innovative solutions (Atuahene-Gima, 2003) and reduce the reach for new ideas and information for explorative innovation (Sheremata, 2000). Therefore, we propose that greater degrees of centralization of decision-making will facilitate SMEs' exploitative innovation.

Connectedness describes how individuals and employees work together through direct contact within firm (Sheremata, 2000; Atuahene-Gima, 2003). It raises openness to knowledge resource within organizations (Jaworski and Kohli, 1993). It also helps organizations to strengthen their links among project teams and people in different functions (Clark and Fujimoto, 1991). In turn, connectedness can facilitate explorative innovations to appear by facilitating the combination and development of individual knowledge and ideas that underpin such innovations (Atuahene-Gima, 2003; McFadyen and Cannella, 2004). In addition, highly dense networks, through diffusing strong norms, assist in the establishment of collective behavioral beliefs (Uzzi, 1997; Rowley *et al*., 2000) and this has been found to lead

to fast problem solving (Atuahene-Gima, 2003). Trust and cooperation will occur when member of organizations are informally connected (Adler and Kwon, 2002). This in turn assists firms to refine and improve existing products and services through getting support from other functional departments (Rowley *et al*., 2000; Atuahene-Gima, 2003). Connectedness within SMEs, therefore, would be expected to facilitate the development and improvement of knowledge to fuel increases in a SME's explorative and exploitative innovations.

Hypothesis 1: Internal organization with high centralization and high connectedness is positively associated with the appearance of innovation ambidexterity (i.e., BD) in SMEs.

External environmental antecedents of BD

Studies suggest that the external environmental context of an organization influences the appearance of innovation outcomes across firms (e.g, Jaworski and Kohli, 1993; Zahra, 1996; Zahra and Bogner, 2000; Gibson and Birkinshaw, 2004; Atuahene-Gima, 2005; Jansen *et al*., 2006). Environmental dynamism and environmental competitiveness represent two particular environmental conditions believed to pressurize firms to behave in explorative or exploitative ways (Jaworski and Kohli, 1993; Jansen *et al*., 2006).

Dynamic environments are attributed by high-velocity changes in technological conditions, irregularity in the behavior of customers, and turbulence in markets conditions (Jaworski and Kohli, 1993; Zahra and Covin, 1993; Jansen *et al*., 2006). Firms operating in dynamic environments are pressurized by such conditions to develop new products and services in order to suit customers' changing demand (Sorensen and Stuart, 2000; Atuhene-Gima, 2005). Moreover, dynamism encourages firms to provide new products and to strengthen their technological capabilities by following new market opportunities (Zahra,

1996). Accordingly, firms need to develop explorative innovations to explore beyond current products and markets and to capture new revenues from existing and promising markets (Zahra, 1996). In dynamic environments, explorative innovations create opportunities for firms to secure superior financial performance by targeting market segments as first movers and then blocking competitors' entry (Utterback, 1994; Zahra and Bogner, 2000). Thus, we propose that in dynamic environments, SMEs will pursue explorative innovations because of the nature of the pressures that such environment conditions place on firms' growth and performance.

Environmental competitiveness refers to intense competition in the market segments in which firms operate (Jaworski and Kohli, 1993; Zahra and Bogner, 2000; Atuahene-Gima, 2005). Organizations in competitive environments tend to reduce available resources for explorative innovations because of the pressure to continuously improve to maintain position vis-à-vis market rivals (Miller and Friesen, 1984). Also, under highly competitive environment conditions, organizations may not consider to develop new products and services owing to their associated high risks and high costs and lower probability of success (Zahra and Bogner, 2000). Instead, firms in competitive environments normally focus on cost control strategies through reducing costs and refining products to generate better performance (Grant, 1995; Zahra and Bogner, 2000). In such environments therefore, firms tend to use exploitative innovation such as adjusting and increasing existing range of products and services to generate better profits and thus sustain their financial performance in the face of severe competition (Lumpkin and Dess, 2001). Through exploitative innovations, organizations are able to better cater to existing customers and build customer loyalty without incurring the many costs associated with explorative innovations (Jansen *et al*., 2006). Thus:

Hypothesis 2: An environment with high dynamism and high competitiveness is positively

related to the appearance of innovation ambidexterity (i.e., BD) in SMEs.

Mediating effects of BD

The argumentation contained in the hypotheses presented above implies that internal organizational structures, external environmental conditions and innovation ambidexterity (i.e., BD) are linked to SME performance. Specifically, the arguments suggest that the consequences of internal organizational structures and external environmental conditions on firm performance are due to innovation ambidexterity. Previous studies (e.g., Pinto *et al*., 1993; Atuahene-Gima, 2003) suggest that internal organizational factors have indirect effects on firm performance when firms engage in innovation ambidexterity. In addition, prior studies suggest that innovation has a mediation effect on the relationship between external competitive environments and firm performance (e.g., Noble *et al*., 2002). Han *et al*. (1998) also put forward that innovations mediate the association between firm performance and highly dynamic environments. He and Wong (2004) and studies since have reported positive firm performance returns to innovation ambidexterity. However, on the basis that the hypotheses above hold true, we expect innovation ambidexterity (i.e., BD) to affect SME performance by mediating the effects of internal structure conditions and external environment pressures. Thus:

Hypothesis 3: In SMEs, (a) the effects of centralization and connectedness on firm performance are mediated by innovation ambidexterity (i.e., BD), and (b) the effects of dynamic environment and competitive environment on firm performance are mediated by innovation ambidexterity (i.e., BD).

Methodology

Sampling and data collection

The initial sampling frame consisted of 1000 SMEs in Scotland. The choice of SMEs in Scotland is due to the fact that the Scottish government has made a significant push over the last several years to stimulate innovation among business for economic growth owing to the very complex competitive conditions at national and international levels its firms face (Scottish Government, 2009). Firms were randomly selected from the FAME database. Of this sample, 265 firms (26.5 percent) responded to our survey. Of the 265 respondent firms, 132 firms (49.9 percent) ranged from 1-49 employees and 133 firms (50.1 percent) ranged from 50-249 employees. Industries represented in the sample included manufacturing (transportation equipment, electrical equipment, industrial and precision equipment, chemical and pharmaceuticals, other manufacturing) and service firms (computing services, engineering and architecture, banking, insurance and real estate, advertising, accounting, and consulting, oil and gas) (see Table 1).

Managing directors and members of the top management team in SMEs were selected as informants for data collection owing to their knowledge of the processes, activities, pressures and overall identity of their businesses (Cohen and Musson, 2000). Among 1000 firms, 265 firms provided multiple responses (i.e., one MD and one top manager in each firm). This was achieved from three rounds of attempts (two two postal mailings and a final round of phone calls) along with incentives (i.e., voucher and company report) provided. All respondents were voluntary and were asked to fill in a seven-point Likert scale questionnaire. Following Dillman's (2000) guidelines for the Total Design Method, an invitation letter was sent explaining the nature and the purpose of the study prior to this. We used an interrater reliability coefficient created by James *et al*. (1993) to inspect the intragroup reliability (r_{wg}) of responses. There is a sign of good agreement within a group if an r_{wg} is greater than or equal to 0.70 (George and Bettenhausen, 1990). The average intragroup reliability is 0.79.

This authorizes the aggregation of individual team member scores. Moreover, we followed the data aggregation procedure proposed by Enticott et al.'s (2008), i.e., two-layer echelon approach to average the responses of two groups: MDs and member of top managers in each firm. The two scores were then averaged to create an overall firm score in SPSS. Adoption of two-layer echelon approach to produce an overall firm score was that this approach reflects 'the most significant managerial fissures within the firm' between MDs and member of top managers and 'is less likely to lead to the exclusion of organizations from statistical analyses because of missing respondents' (Enticott et al., 2008: 246). In addition, we validated the data reliability through checking the representativeness of the sample. First, the Armstrong and Overton's (1997) extrapolation method was used to assess non-response bias. We compared the responses of the first third and last third of last phone call round (Armstrong and Overton, 1977). No significant differences were found ($p<0.01$). We also compared the responses of the first 10% and last 10% of last phone call round. No significant differences were found ($p<0.01$). The subsamples were compared on dimensions including descriptive variables (i.e., firm age, profit and sales, the number of employees) and theoretical variables (i.e., centralization of decision-making, interdepartmental connectedness, environmental dynamism, environmental competitiveness, and innovation ambidexterity). The results revealed no significant difference ($p<0.05$). We deployed several post hoc tests including the Harman single-factor test, confirmatory factor analysis (CFA) and bivariate correlations to search for common method bias (Podsakoff *et al*., 2003). Exploratory factor analysis combining items from the dependent and independent variables revealed that several factors were extracted. The first factor accounted for 22.042 percent variance with an eigenvalue of 3.792. This offers evidence that there is no single factor emerging from these variables to suggest common method bias in the data. Moreover, all dependent and independent variables were loaded onto a one-factor, a two-factor, and a three-factor CFA model to examine fit. If common method

variance exists among these variables, then the one-factor CFA model will fit the data well. The results of a one-factor, a two-factor, and a three-factor of CFA disclosed that the fit of a one-factor model as the poorest containing wholly unacceptable fit statistics (χ^2=585.62, d.f.=54, p=0.00, CFI=0.62, GFI=0.72, NNFI=0.53, RMSEA=0.19). Finally, in order to more directly exclude the common method bias in our data, we examined bivariate correlations between subjective performance from respondents and objective performance obtained from the FAME database. These were significantly correlated (r = 0.761, p<0.001). The final response rate of 26.5 percent was achieved after three rounds of attempts (two postal mailings and a final round of phone calls). All data were collected during an eight-month period from November 2008 to June 2009.

Measures

A seven-point Likert scale was used to measure constructs. Respondents were asked to assess the extent to which their firm has undertaken a range of activities (1 = strongly disagree; 7 = strongly agree). Measures for operationalizing the constructs were developed from an extensive literature review that identified previously developed and tested scales.

Dependent variables

The dependent variables are innovation ambidexterity (i.e., BD) and business performance. BD relates to the balance, or relative magnitudes of exploration and exploitation (Cao *et al*., 2009: 788). Following He and Wong's (2004) treatment, BD was equal to the absolute difference between exploration and exploitation. Measures of explorative innovation capture the essence of the exploration of new possibilities and measures of exploitative innovation capture the essence of exploitation of old certainties (He and Wong, 2004). These measures reflect the fact that "exploration versus exploitation should be used within reference to a firm itself and its existing capabilities, resources, and processes, not to a competitor or at the

industry level" (He and Wong, 2004: 485). Regarding business performance, measures were adapted from the work of Gibson and Birkinshaw (2004) on explorative and exploitative innovation. These measures reflected on the effectiveness of performance over the last five years in terms of satisfying customers, employees and managers' objectives. As previously described, these measures correlate with objective financial performance acquired from FAME.

Independent variables

Measures of characteristics of internal organizational structures of centralization and connectedness were taken directly from Jaworski and Kohli (1993) and Jansen *et al*. (2006). These measures capture the relationship between internal organizational structure (centralization and connectedness) and innovative strategies used by the firms. Measures of characteristics of external environmental conditions were taken directly from Birkinshaw *et al*. (1998) and Jaworski and Kohli (1993). The measures capture the extent to which external environments are characterized by technological changes and differences in products and markets as well as intense competition (Matusik and Hill, 1998; Jansen *et al*., 2005).

Control variables

We controlled for possible confounding effects by including relevant control variables, specifically firm age, firm size (number of employees) and industry sector. Firm size and firm age are controlled as they have been found to affect firm growth (Carroll and Hannan, 2000; He and Wong, 2004) and linked with the institutional routines and norms that cause unchanging behaviors (Tushman and Romanelli, 1985). We logged firm age and firm size to balance variation. Two broad industry sectors (manufacturing and service) were used as an additional control variable as industry sector has been related to firms' motivation to adapt to

varying resource conditions and to their performance (Lubatkin *et al*., 2006).

Analysis methods

We first used factor analysis to identify the underlying dimensions of the characteristics of internal organizational structures (centralization and connectedness), external environmental conditions (environmental dynamism and environmental competitiveness), exploitative innovation, explorative innovation and business performance. Factor analysis is useful to evaluate how each item relates to its own construct and how it relates to other associated or similar constructs (Gorsuch, 1997). Following the profile model of multidimensional constructs (Law *et al*., 1998), the dimensional components of a larger construct would be expected to correlate with each other (convergent validity) (Blau, 2001). This was the case. We then applied hierarchical regression and Preacher and Hayes' (2004) mediation regression method to test our hypotheses. The adoption of regression analysis is because first, the structural equation modelling (SEM) model was too big for the number of data this study had so the study would break the acceptable parameter-to-observation ratio as argued by Bentler and Chou (1987); second, bootstrapping offers a better alternative to investigate the mediation effect as it does not assume normality of distribution of the indirect effect (Preacher and Hayes, 2004). Following previous studies (e.g., Bandalos and Finney, 2001), we subsumed centralization of decision-making and interdepartmental connectedness together as internal organizational characteristics, environmental dynamism and competitiveness together as external environmental characteristics. We followed Baron and Kenny's (1986) procedure to conduct the hierarchical regression analyses. Hierarchical regression adds controls and independent variables in sequence to measure the relative contributions of each construct to the dependent variable. Preacher and Hayes' (2004) mediation test was used to explore the proposed mediation between independent and dependent variables.

Empirical analysis and results

Analysis of sample

Respondent characteristics are shown in Table 1. A wide distribution of industries can be seen among the respondents. For example, 12.8 percent were in 'other' manufacturing industries and 7.5 percent were in the engineering and architecture sector, 10.2 percent were in the wholesale and retailing sector and 40 percent were in 'other' service industries such as oil and gas. Almost an equal distribution of SMEs (49.9 percent) employed from 1 to 49 employees and (50.1 percent) from 50 to 249 employees.

------ Insert Table 1 about here ------

Factor analysis and intercorrelations

Following best practice, we performed principal components factor analysis to assess the items used in the survey and to assess whether the desired constructs emerged from these measures. The specified factors constructs emerged as expected. Moreover, the internal consistency (Cronbach alpha) of the factor constructs was in the range of 0.697 to 0.921 (Table 3) and is comparable to those obtained in previous studies using the same construct measures (Gibson and Birkinshaw, 2004; He and Wong, 2004; Jansen *et al*., 2006). Also, the constructs formed explain a large degree of variance in each instance further supporting the measures drawn from prior studies. Table 2 shows the intercorrelations, means and standard deviations for the variables used in the regression analyses.

------ Insert Table 2 and 3 about here ------

The hierarchical regression and hypotheses testing

Table 5 presents the results of hierarchical regression analysis for relationships between internal organizational structures, external environmental conditions and innovation ambidexterity (i.e. BD). The baseline model 1 contains control variables. In relation to hypotheses 1, there appears a positive significant relationship between internal organizational

characteristics and innovation ambidexterity (i.e. BD) in model 2 and model 3 (β = 0.173 and 0.172 respectively, p<0.01). In model 3, following theoretical predictions there is a positive significant relationship between external environmental conditions and innovation ambidexterity (i.e. BD) (β = 0.19 p<0.05). Thus, the results support hypotheses 1 and 2.

------ Insert Table 5 about here ------

Table 4 and 6 present the mediation analysis of innovation ambidexterity on the link between internal organizational structure and external environmental conditions and firm performance. These results indicate that innovation ambidexterity (i.e., BD) partially mediate the effects of internal organizational structure and external environmental conditions on firm performance. The 95% confidence limit was constructed based on Meeker, Cornwell, and Aroian (1981) and MacKinnon (2008). The results support hypotheses 3 therefore and signal the importance of the confluence of internal structure, external environment conditions and innovation for SMEs to secure superior performance.

------ Insert Table 4 and 6 about here ------

Discussions and conclusions

Prior studies have paid little attention to the effects of internal organizational structures and external environmental conditions on the appearance of innovation ambidexterity (i.e., BD) within SMEs (Gibson and Birkinshaw, 2004; Raisch and Birkinshaw, 2008), despite the fact that effective adoption of innovation ambidexterity is essential to a firm's survival (March, 1991). Our results show how dangerous the lack of adequate research of these issues at the SME level is. Indeed, whilst our hypotheses draw on the theoretical predictions that have found support in larger firms, our results show how these factors affect SMEs quite differently. The results advance our understanding of innovation ambidexterity in SMEs both theoretically and managerially.

Theoretical contributions

The results contribute to innovation management in several ways. First, consistent with previous arguments that internal organizational structures conditions of centralization and connectedness are vital to facilitate the occurrence of explorative and exploitative innovations (e.g., Dewar *et al*., 1980; Jansen *et al*., 2006), the results suggest that both centralization and connectedness are useful to motivate SMEs to adopt both explorative and exploitative innovations (i.e., BD) simultaneously. An explanation may be found in the nature of SMEs internal environments. Dean *et al*. (1998) discovered that SMEs respond differently to internal and external pressures than larger firms. Larger established firms are often slower to respond to opportunity than SMEs owing to the fact that their entrepreneurship is eroded over time as their internal structures becomes increasingly laden with rules, procedures and systems (Morris *et al*., 2008). SMEs are typically more internally adaptive. These findings support Cao et al. (2009) contention that a close balance of explorative and exploitative innovations (i.e., BD) is beneficial to SMEs with fewer resources accessibility both internally and externally. Supporting prior studies' assertion (e.g., Andripoulos and Lewis, 2009), SMEs could achieve innovation ambidexterity through use of appropriate organizational structures. Second, this paper adds to our understanding of external environmental conditions as driving forces, rather than moderators as suggested by Jansen *et al*. (2006), to facilitate the appearance of innovation ambidexterity (i.e., BD) and business performance in SMEs. Our findings are consistent with previous studies in that a highly dynamic environment and a highly competitive environment are beneficial to innovations and business performance (Jaworski and Kohli, 1993; Atuahene-Gima, 2003, 2005). However, we find that SMEs internalise external environment pressures to promote a close balance of explorative and exploitative innovations (i.e., BD). This implies that SMEs are advised to prioritize their internal resources to pursue a close balance of explorative and exploitative innovations (i.e., BD) and thus enhances firms' performance as a result of awareness of external environmental

signals (Barney and Zajac, 1994; Day, 1994; Atuahene-Gima, 2005). Third, the findings of a significant partial mediating role of innovation ambidexterity (i.e., BD) on firm performance suggest that both innovations enhance firm performance through differentiating the effect of SMEs' internal and external resources (Atuhene-Gima, 2005; Day, 1994). In turn, the study directly contributes to calls by Gibson and Birkinshaw (200) to extend and validate research not only the antecedents of innovation ambidexterity but also the mediation effect of BD in SMEs.

Managerial implications

One apparent managerial implication is the need for top managers to allocate resources to pursue a close balance of explorative and exploitative innovations in SMEs. Our findings indicate that 'managers in relatively resource-constrained contexts may benefit from a focus on trade-offs between exploration and exploitation demands' (Cao *et al*., 2009). This could be achieved from utilization of internal competencies to respond to external environmental signs (Cockburn *et al*., 2000; He and Wong, 2004).

The significant mediating role of innovation ambidexterity (i.e., BD) between internal and external environment conditions and SME performance suggests that managers in SMEs should allocate their internal resources to ensure better decision-making processes to enable proper and effective responses to environmental changes.

Limitations and recommendations for future research

Several limitations to this study deserve attention and offer guidance for future research. First, the data collection was mainly from self-reported assessments of managing directors and member of top managers in SMEs. Although we had strong inter-rater reliability, alternative ways to detect the study constructs may enable future studies to further demonstrate their importance to innovation management. Indeed, while confidentiality and anonymity of participants reduce the probability that respondents artificially increase or mask

their responses (Podsakoff *et al*., 2003), alternative measurement methods may further distinguish the impact of the constructs assessed in this study.

Second, we applied the measures of explorative and exploitative innovations to the SME sector developed in previous studies for large firms (e.g., Gibson and Birkinshaw, 2004; Jansen *et al*., 2005). And although we extend the measures of explorative and exploitative innovations to SMEs and assess the validity of these measures therein, original measures may help to further detect the subtleties of innovation management in SMEs.

Finally, although our research has generated new insights into internal organizational antecedents and consequences of innovation ambidexterity, it does not address how the ability and willingness of top managers in SMEs influence the development of innovation ambidexterity. It would be useful to conduct both survey and case study research to better understand the relationships between the individual characteristics and behaviors of top managers and the appearance of innovation ambidexterity, with a view to improving SME performance. In addition, future research may examine the effects of individual characteristics beyond the consequences of top managers' innovation actions. The characteristics of organizational members to pursue innovation ambidexterity and mechanisms used by managers therein have only very recently begun to receive attention (e.g., Mom *et al*., 2009). Given our findings that internal structure in and of itself appear to tangibly affect innovation ambidexterity in SMEs, examining these constructs together with top manager behavior may well yield important new insights.

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Table 1: Respondent characteristics

Industry (main)	Industry type (sub-sector)	Frequency	Percent
Manufacturing	Transportation equipment	5	1.9
	Electrical equipment	3	1.1
	Industrial and precision equipment	4	1.5
	Metal, rubber, stone, glass & leather	8	3
	Chemical & pharmaceuticals	8	3
	Food, tobacco & textiles	13	4.9
	Wood, wood products, pulp & paper	11	4.2
	Other manufacturing industry	34	12.8
Services and Sales	Computer services	5	1.9
	Engineering & architecture	20	7.5
	Wholesale & retail trade	27	10.2
	Banking, insurance & real estate	7	2.6
	Hotels & restaurants	2	0.8
	Transportation services	12	4.5
	Other services industry	106	40.0
Number of total employees	1-49	132	49.9
	50-249	133	50.1
Total		265	100.0

Table 2: Intercorrelations, means and standard deviations of variables (N=265)

Variables	(`1)	(2)	(3)	(4)	(5)	(6)	(7)	Mean	SD

(1) Firm age	--							13.36	11.09
(2) Firm size	.166**	--						66.79	64.35
(3) Sector	-.205**	-.012	---					11.51	4.48
(4) Internal organizational characteristics	.123*	.090	-.224**	---				4.62	0.97
(5) external environmental characteristics	.075	.087	-.026	.043	---			4.99	0.88
(6) Balanced dimension of innovation ambidexterity	.136*	.086	-.225**	.225**	.310**	---		1.16	1.02
(7) Business performance	.098	.082	.191**	.130*	.300**	.223**	---	5.10	0.86

**p<0.01, *p<0.05

Table 3: Factor analysis results

Factor		**Factor loadings**	
A: **Internal Organizational Characteristics** – (1)Centralization of decision-making (2) Interdepartmental connectedness		1	2
A01	There can be little action taken until a supervisor approves a decision	0.684	
A02	People need to ask their supervisor before	0.931	

	they do almost anything		
A03	Most decisions people make here have to have their supervisor's approval	0.929	
A04	In our company, employees from different departments feel comfortable calling each other when the need arises		0.821
A05	In our company, it is easy to talk with virtually anyone you need to, regardless of rank or position		0.681
Eigenvalue		2.714	1.755
Accumulated variance explained (%)		67.858	43.879
Cronbach α		0.717	0.723
B: External Environmental Characteristics – (1) Environmental Dynamism (2) Environmental Competitiveness			
B01	Our clients regularly ask for new products and services	0.854	
B02	In a year, nothing has changed in our market	0.617	
B03	In our market, the volumes of products and services to be delivered change fast and often	0.732	
B04	Our company has relatively strong competition		0.755
B05	Competition in our local market is		0.637

	extremely high		
B06	Price competition is a hallmark of our local market		0.765
Eigenvalue		1.844	1.776
Accumulated variance explained (%)		46.101	44.392
Cronbach α		0.697	0.678
C: Balanced Dimension of Innovation Ambidexterity- (1)Explorative Innovation (2) Exploitative Innovation			
C01	New-to-market products or services	0.902	
	Transformation of new-to-market ideas into product lines	0.895	
C02	New-to-product innovations first started in our firm	0.837	
C03	Introduction of new generations of products	0.830	
C04	New-to-market product innovations in Research and Development.	0.827	
C05	Addition of new elements in current product range	0.789	
C06	Opening up new markets for current products or services	0.726	
C07	Improvement of our distribution channels in our current market	0.591	
C08	We improve our provision's efficiency of		0.865

	products and services	
C09	We increase economies of scales in existing markets	0.876
C10	Our company expands services for existing clients	0.781
C11	Lowering costs of internal processes is an important objective	0.741
Eigenvalue	5.188	2.674
Accumulated variance explained (%)	64.854	66.840
Cronbach α	0.895	0.828
G: Business Performance		
	People at all levels are satisfied with the level of business performance	0.900
	Our company is achieving its full potential	0.852
	This company gives me the opportunity and encouragement to do the best work I am capable of	0.673
	Our company does a good job of satisfying our customers	0.805
Eigenvalue	2.219	
Accumulated variance explained (%)	55.473	
Cronbach α	0.921	

Table 4: Results of hierarchical regression analysis for Business Performance

Variables	Model 1	Model 2	Model 3
Dependent: Business Performance			
Controls			
Constant (B)	18.803	9.927	10.397
Firm age	-0.078	-0.060	-0.044
Firm size (no. of employees)	0.094*	0.046*	0.055*
Sector	0.175*	0.228**	0.191**
Independents: main effect variables			
Internal organizational characteristics (Centralization of decision-making + Interdepartmental connectedness)		0.174**	0.137*
External environmental characteristics (Environmental dynamism + Environmental competitiveness)		0.290***	0.288***
Mediation effect variable			
Balanced dimension of Innovation ambidexterity			0.232***
R^2	0.049	0.163	0.212
Change		0.114	0.049
Adjusted R^2	0.038	0.146	0.193
Change		0.108	0.047
F	4.431**	9.987***	11.467***

N=265; *** p<0.001, ** p<0.01, * p<0.05

Table 5: Results of hierarchical regression analysis for Balanced Dimension of Innovation Ambidexterity

Variables	Model 1	Model 2	Model 3
Dependent: Balance Dimension of Innovation Ambidexterity			
Controls			
Constant (B)	1.540	0.640	0.690
Firm age	0.082	0.070	0.069
Firm size (no. of employees)	0.070*	0.057*	0.058*
Sector	-0.208**	-0.172*	-0.172*
Independents			
Internal organizational characteristics (Centralization of decision-making + Interdepartmental connectedness)		0.173**	0.172**
External environmental characteristics (Environmental dynamism + Environmental competitiveness)			0.19*
R^2	0.064	0.092	0.093
Change		0.028	0.001
Adjusted R^2	0.053	0.078	0.079
Change		0.025	0.001
F	5.955**	6.592***	6.593***

N=265; ***p<0.001, **p<0.01, *p<0.05

Table 6: Results mediation analysis of Innovation Ambidexterity on Business Performance

	Bootstrapping Statistics	Mediation variable	Dependent variable	95% Confidence Limit
Internal organizational characteristics	0.12***	Innovation Ambidexterity	Business Performance	(0.10, 0.37)
External environmental characteristics	0.15***	Innovation Ambidexterity	Business Performance	(0.13, 0.45)

Note: The 95% confidence limit is constructed based on Meeker, Cornwell, and Aroian (1981) and MacKinnon (2008).

N=265; ***p<0.001, **p<0.01, *p<0.05; number of bootstrapping resamples: 5000.

RESPONSES TO DR. JOHN PETER (EDITOR) AND REVIEWER

Executive Summary

Dear Dr. Peter:

We appreciate your time and your constructive comments. To facilitate our research conversation, we have taken the liberty to *italicize the reviewers'* words, and have inserted our responses point-by-point after each comment.

Response to Reviewers:

Reviewers' comments:

This paper presents results from a study that was conceptualized to relate explorative and exploitative innovation in SMEs to potentially anteceding factors (internal and external). The analysis is based on an appropriate sample of SMEs and suggests that internal and external factors exert different influences on the two general types of innovation.

I appreciate the author/s attempt to shed additional light on alternative explanations for the emergence of explorative/exploitative innovation in the SME context. I was particularly impressed by the various technical measures employed to eliminate potential biases and to cross-validated the reliability and validity of the measures. However, there are still some (mostly technical) issues that the author/s might want to consider and that could be attended to further improve the paper. These are:

We appreciate your great comments which helped us improve the paper.

- First and foremost, I am absolutely not convinced that the analytical strategy chosen is the most appropriate in this particular case. The difference of explorative and exploitative innovation is in the literature quite often treated under the notion of "ambidexterity", which suggests that both concepts are closely related to each other and have to be treated simultaneously. I am sure that the author/s will agree with this point of view as they write in their paper about the importance of adequately balancing both types of innovation. Against this background, I cannot understand why we should be allowed to analyze both concepts separately, as it is done in this particular paper. In essence, the underlying model of this paper (I suggest that the authors try to combine all their hypotheses and causal relationships in one figure, then they will see my point) explains two dependent variables simultaneously, which suggests that an appropriate structural equation modeling technique should be employed. By this, they would not only address the interrelatedness of the key constructs but would as well resort to a methodology that is able to account for measurement error.

Thank you for the great suggestion. Following your suggestion, we have linked the hypotheses directly to ambidexterity in SMEs as suggested by Cao et al. (2009), i.e., balanced dimension of innovation ambidexterity. Please refer to hypothesis 1 (p.5-7), 2(p.7-8), 3 (p.9). We also changed the results and conclusions. Please refer to p.

Also, use of regression analysis in this study was due to the fact that first, the SEM model was too big for the number of data this study had so the study would break the acceptable parameter-to-observation ratio as argued by Bentler and Chou (1987); second, use of mediation regression can provide a better solution to explore the mediation effect as it does not assume normality of distribution of the indirect effect (Preacher and Hayes, 2004). Please refer to p.14. We used Preacher and Hayes' (2004) mediation regression method to test our mediation hypothesis. The use of mediation regression method is due to the fact that bootstrapping provides a better option to explore the mediation effect as it does not assume normality of distribution of the indirect effect (Preacher and Hayes, 2004). We followed Baron and Kenny's (1986) procedure to conduct the hierarchical regression analyses. Please refer to p.14.

Following your suggestion and prior studies (Bandalos and Finney 2001), we subsumed centralization of decision-making and interdepartmental connectedness to represent the same construct as internal organizational characteristic. Please refer to hypothesis 1 (p. 5-7). We also subsumed environmental dynamism and environmental competitiveness to represent the same construct as external environmental characteristic. Please refer to hypothesis 2(p.7-8). This is because we followed your suggestion to link the hypotheses directly to innovation ambidexterity in SMEs. Results hold the subsumed internal organizational characteristics and external environmental characteristics to the appearance of balanced dimension of innovation ambidexterity. Please refer to p. 15-16.

- I appreciate that a multi-informant design was employed where several respondents per firm were interviewed. I know how challenging it is to collect such data and am convinced that this is one particular point that could help to enhance the study's credibility. However, key information about this procedure is missing in the paper, e.g. how many firms provided multiple responses versus how many did not. Moreover, multi-informant designs come along with their own challenges as they raise the question of how much weight should be given to different groups of respondents. I suggest that the author/s consult Enticott et al. (2008) to develop a clear aggregation rationale.

We appreciate your great comments which helped us improve the paper. Among 1000 firms, 265 firms provided multiple responses (i.e., one MD and one top manager in each firm). This was achieved from three rounds of attempts (two two postal mailings and a final round of phone calls) along with incentives (i.e., voucher and company report) provided. Please refer to p. 10. Following your suggestion, we followed the data aggregation procedure proposed by Enticott et al.'s (2008), i.e., two-layer echelon approach to average the responses of two groups: MDs and member of top managers in each firm. The two scores were then averaged to create an overall firm score in SPSS. Adoption of two-layer echelon approach to produce an overall firm score was that this approach reflects 'the most significant managerial fissures within the firm' between MDs and member of top managers and 'is less likely to lead to the exclusion of organizations from statistical analyses because of missing respondents' (Enticott et al., 2008: 246). Please refer to p.11.

- *The non-response-test is not convincing. I recommend to explore the impact of separating the sample into differently sized chunks (e.g., comparing first third to last third or thirst 10% to last 10%) and the author/s will probably agree that they have chosen the most forgiving approach to testing for non-response by comparing the first half to the second half of respondents. This criterion should be select more rigorously; moreover, it is probably not sufficient to simply compare some descriptive variables – non-response might as well affect the theoretical variables in the model, which would be much more severe than, for instance, a simple difference in size or age of the late and early responding organizations.*

Thank you for the suggestion. Following your suggestion, we validated the data reliability through checking the representativeness of the sample. First, the Armstrong and Overton's (1997) extrapolation method was used to assess non-response bias. We compared the responses of the first third and last third of last phone call round (Armstrong and Overton, 1977). No significant differences were found ($p<0.01$). We also compared the responses of the first 10% and last 10% of last phone call round. No significant differences were found ($p<0.01$). The subsamples were compared on dimensions including descriptive variables (i.e., firm age, profit and sales, the number of employees) and theoretical variables (i.e., centralization of decision-making, interdepartmental connectedness, environmental dynamism, environmental competitiveness, and innovation ambidexterity). The results revealed no significant difference ($p<0.05$). Please refer to p.11.

- From my perspective, the paper's USP is that concepts such as relatedness and

centralization along with environmental factors are entered into the equation. The title of the paper does not reflect this potential contribution and should be adjusted respectively.

Thank you for the suggestion. Following your suggestion, we change the title of this paper as Internal and External Antecedents of SMEs' Innovation Ambidexterity Outcomes. Please refer to title page.

In closing, we very much appreciate your helpful comments. Thank you very much!

Response to Reviewer 2:

Reviewer #2:
Thanks for the opportunity to review this paper. I think it has potential to be published in EMJ but I have a number of questions and concerns for the authors to consider, some major, some minor.

Major concerns

1. There is a lot of research on ambidexterity at the moment, so it is important for the authors to be very clear on what their unique contribution is. I think it is clear that the intention is to tell a story about ambidexterity in SMEs, as distinct from larger companies, but I don't think we get a sufficiently compelling story about what makes SMEs distinctive. The only point that comes out clearly in this regard is that SMEs don't have multiple business units so the classic "structural" approach to ambidexterity is not relevant. But I think there is scope for doing much more here. For example, SMEs are often less professionally managed than larger firms, so to the extent that they have brought in management systems of any type (e.g. formal rules, performance management measures) they are likely to be helpful for innovation. I also think the role of the senior executives is much more important in SMEs, as they are often in direct control of everything, and this may play into the importance of adaptability and risk-taking as personal traits much more than they would in larger firms.
So my point, in other words, is that the paper should do a better job of linking the statistically-significant findings more tightly with the theoretical arguments. I think it is a bit of a missed opportunity to simply lay out a large number of hypotheses and then show that some of them apply in the SME context while others don't. Much better to start with a set of expectations up front about how and why ambidexterity in SMEs is likely to be rather different from ambidexterity in larger firms.

Thank you for the great suggestion. In the revision, we have linked the hypotheses directly to ambidexterity in SMEs. Also, following previous studies (e.g., Cao et al., 2009; He and Wong, 2004), we argued how and why the balance dimension of innovation ambidexterity appear in SMEs. Please refer to p. 4-7.

2. In terms of the analysis, I am mostly happy with what was done but there were a few surprises for me. For example, if we are testing the link between ambidexterity and performance, it might also be interesting to know how many of the independent variables are predictors of ambidexterity per se. rather than just predictors of exploration or exploitation. That is, if ambidexterity is an interesting phenomenon, we need to be able to show that it has a distinctive set of predictors that are not identical to the predictors of exploration OR exploitation on their own.

It might also be interesting to see if there is a mediation effect here, i.e. does ambidexterity mediate the relationship between the independent variables and

performance?

Thank you for the great suggestion. In the revision, we have linked the hypotheses directly to ambidexterity in SMEs. Please refer to p. 14, 20, 24. Also, following your suggestion, we tested the mediation effect of balance dimension of innovation ambidexterity between the independent variables and performance. Please refer to p.24-25. Results hold. Please refer to Table 4, Table 5, and Table 6.

3. I would like to know more about the goal-based and effort-based performance management findings. This is a tricky finding, because it is extremely interesting and yet it really doesn't tie into the theoretical arguments you are developing. There is, I suspect a good story about the generic conditions under which innovation happens in SMEs (i.e. its about goal setting not about effort), but as it is currently constituted it doesn't really fit here.

Thank you for the suggestion. In the revision, we have subsumed the social context and performance management to represent the same construct as suggested by previous studies (e.g. Gibson and Birkinshaw, 2004). This fits better with theoretical argument. Thus, we did not test the independent effects of goal-based performance management and effort-based performance management in the revision. Please refer to p. 17-19.

Minor points

1. I don't think I would see "structural" and "leadership" solutions to ambidexterity as competing (page 4). In my world view, the work on structural ambidexterity argues that we need leaders to decide how to allocate roles to the different structural units. So they are kind-of working together, whereas the contextual approach is about giving responsibility to balance exploration and exploitation to those lower down in the company. Some people have also argued for "temporal" ambidexterity as a further approach, though I am not entirely convinced we need it.

Thank you for the suggestion. In the revision, we agreed with your suggestion and removed the 'competing'. Please refer to p.4. Also, in the revision, we have linked the structural, contextual, and leadership conditions directly to the balance dimension of innovation ambidexterity in SMEs. Please refer to p.5-7, 9-10, 14, 20, 24.

2. I was a bit surprised you don't mention autonomy/decentralisation alongside formalisation and connectedness as a relevant structural characteristic. Even in small companies, the extent to which individuals employees are free to make choices (rather than everything going through the boss) is important. And it is certainly an important element in most formulations of how organisations are structured.

Thank you for the suggestion. In the revision, we argued that this study focuses on the formalisation and connectedness was due to the impact of formalisation and connectedness as the main coordination mechanism to facilitate the appearance of explorative and exploitative innovation has not been examined in an integrative model (Jansen et al., 2006). Please refer to p.11. Also, in the conclusion section, we have

mentioned that our antecedents are not an exhaustive set of conditions and additional factors , for instance, structural characteristics such as autonomy and centralisation, may support or undermine innovation ambidexterity and the returns to it that are not accounted for here. These issues do raise avenues for fruitful future research however. Please refer to p. 41.

3. I struggle a lit with how you separate out "devotion based" and "fact based" social context. Given that these results are not significant I would suggest simplifying this part of the story - either lump them together if they make a reasonably-reliable construct, or just use the one of these that works best.

Thank you for the suggestion. Following your suggestion and prior studies (e.g., Gibson and Birkinshaw, 2004), we subsumed “the devotion based" and "fact based" social context and performance management to represent the same construct of contextual characteristics. Please refer to p.14-20.

In closing, we very much appreciate your helpful comments. Thank you very much!