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UNPACK IT: ORGANIZATIONAL AMBIDEXTERITY BETWEEN STRUCTURE, KNOWLEDGE AND PERFORMANCE.   AN EMPIRICAL ANALYSIS

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Abstract

This paper analyses innovation ambidexterity (as defined in terms of exploration and exploitation attainments of knowledge and innovation), its antecedents in terms of organizational context and structure and its consequences in terms of financial performance. It is the first attempt to test the mediation effect of knowledge between antecedents on innovation ambidexterity. Findings, based on a 112 response survey, provide empirical evidence of the hypothesis and

confirm the positive influence of ambidexterity on financial performance.

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AN EMPIRICAL ANALYSIS

ABSTRACT

This paper analyses innovation ambidexterity – as defined in terms of exploration and exploitation attainments of knowledge and innovation - its antecedents in terms of organizational context and structure and its consequences in terms of financial performance. It is the first attempt to test the mediation effect of knowledge between antecedents on innovation ambidexterity. Findings, based on a 112 response survey, provide empirical evidence of the hypothesis and confirm the positive influence of ambidexterity on financial performance.

Keywords: organizational ambidexterity; knowledge; context and structure; survey; mediation test

1. INTRODUCTION

A large part of earlier management literature, implicitly or explicitly, conceived of management as the rational way of dealing with trade-offs between incommensurable alternatives (Burns and Stalker, 1961; Skinner, 1974; Porter, 1980). Following this particular view, managers have the possibility of choosing between different levels of alternatives that apparently cannot be simultaneously realized. As such, management consists of choosing different degrees in order to arrive at among optimal solutions.

Instead, recent contributions goes beyond the idea that there is a single optimal solution to a given problem and argues that management is about handling different dualities, tensions or paradoxes.

Over the last two decades, the topic of Organizational Ambidexterity (OA) has been widely debated in literature and the construct has attracted the growing attention of different literature streams. Whereas Duncan (1976) was the first to use the term, it`s March`s (1991) twin concepts of exploration and exploitation that has catalyzed the interest in the concept. As ambidexterity is `right on both sides`, it has increasingly been used to refer to an organization's ability to do two different things at the same time (or simultaneously). However, researchers have diversely defined OA basing on such different tensions: exploitation and exploration, efficiency and flexibility, alignment and adaptability.

In addition, over the past decade OA literature has enlarged from focusing on the elements of the process (in terms of learning, innovation, adaptation) to the antecedents and consequences (performance) as well as to moderators.

This paper refers to OA in terms of both knowledge acquired and innovation outcome and propose a model to test, where knowledge mediates the OA antecedents (in terms of both organizational context and structure) organizational context (i.e. one of its antecedents, as proposed by Raish and Birkinshaw, 2008) and innovation ambidexterity.

2. THEORY AND HYPOTHESES

In the last 10 years it has been published some literature overviews on OA. Among them, Simsek (2009) and Raish and Birkinshaw (2008) substantially report the same schema at the core: an input-process-output framework, which helps to distinguish among OA tensions or processes (i.e. exploration and exploitation), antecedents or input and outcomes (i.e. performance). This frame has been enriched with other factors, which can have a direct effect

on OA or can act as moderators – i.e. factors such as environmental dynamism (Lumpkind and Dess, 1995; Sidhu et al., 2004), competitive dynamics (Jansen et al. 2005; Auh and Menguc, 2005), market orientation (Atuahene-Gima, 2005; Kyriakopoulos and Moorman, 2004), resource endowment (Jansen et al., 2006; Kyriakopoulos and Moorman, 2004), firm scope (Lubatkin et al., 2006). Figure 1 reports the frame.
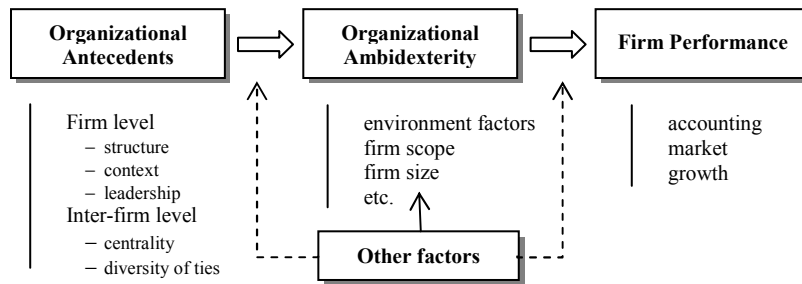

Figure 1. Literature overview of OA

In Table A, columns 2 and 3 (appendix) we summarize how researchers have operationalized OA on their works – i.e. the tensions to be resolved – (Simsek, 2009 collected the OA definitions, but for our empirical purpose a summary of the constructs is more useful). Following Simsek (2009), there are 3 ways to define OA: structural, contextual and realized view. Structural one (Jansen et. al., 2006) refers to organizational design, while contextual (Gibson and Birkinshaw, 2004) focuses on building a proper organizational environment to foster members` behaviours. Finally, the realized view defines OA in terms of organizational attainments: i.e. its focus is on OA as exploration and exploitation performance (He and Wong, 2004; Lubatkin et al., 2006).

As suggested by Simsek (2009), while the realized view explains what OA *consists of*, the other two views refer to what might *facilitate* OA – that is the OA Antecedents at firm level. Recently, another Antecedent - Top Management Team characteristics and processes – has been examined (Smith and Tushman, 2005; Chao et al., 2009).

OA Antecedents at inter-firm level refer to centrality and diversity of ties (Simsek, 2009).

It is evident from Table A that "*… the option for researchers to refrain from clearly defining OA in their work is no longer a viable one.*" (Simsek, 2009: p. 602). In this context, we define OA in terms of organization`s exploration and exploitation attainments, with attainments considered in terms of knowledge and innovation. OA is the simultaneous achievement of high levels of both exploration and exploitation performance.

Although there are some empirical articles which explored the process-output part of the framework in Fig. 1, or the role of the `Other factors` box (see Raish and Birkinshaw, 2008 for a detailed review), very few take into account all of the three boxes.

Gibson and Birkinshaw (2004), for example, considered an input-OA-output in terms of the contextual view; they applied some of the ideas, regarding context, developed by Sumantra Ghoshal and Christopher Bartlett (1994) and viewed context as the often invisible set of stimuli and pressures that motivate people to act in a certain way. Ghoshal and Bartlett identified four sets of attributes – stretch, discipline, support and trust – that interact to define an organization's behavioural context. Factor analysis identified two distinct constructs: one representing a combination of items developed for discipline and stretch – and referred as `performance management context` and the other representing a combination of items for support and trust – and referred as `social context`.

Performance management is concerned with stimulating people to deliver high-quality results and making them accountable. Social support is about providing people with the security, support, and latitude they need to perform consistently to their highest potential.

Gibson and Birkinshaw (2004) argued that a context characterized by a combination of stretch, discipline, support, and trust (i.e. OA contextual antecedents) facilitates contextual ambidexterity. Further, they found that OA mediates the relationship between these contextual features and financial performance.

Recently, Chang and Hughes (2011) reported evidence of the mediation effect of innovation ambidexterity between structural, contextual, and leadership characteristics on SME financial performance. Our work adds the simultaneous development of knowledge in both exploration and exploitation innovation processes (henceforth knowledge ambidexterity) as a mediating factor between innovation ambidexterity and its antecedents: the role of knowledge exploration and exploitation.

2.1 ORGANIZATIONAL CONTEXT HYPOTHESIS

The contextual ambidexterity view (Gibson and Birkinshaw, 2004) posits that organizational context may lead companies to accumulate new knowledge at a faster pace without the need to necessarily separate in different units exploration and exploitation activities. Firms can thus resolve the tension between exploration and exploitation within the same organizational unit by creating a consistent set of processes, practices and incentives. In other words, managers can create the conditions that lead individuals within the same organizational unit to maintain a balance between creativity and adaptability to accommodate strategic or technological changes on one hand, and attention to detail and quality on the other, so that exploration of new technological or market domains does not undermine quality and efficiency for established products. For example, building on the observation that Toyota has been able to explore and exploit for decades, Brunner et al (2009) argue that ambidexterity may be rooted in the ability of employees to engage in problem solving and in the circulation of ideas and knowledge throughout the company.

The idea at the core of Gibson and Birkinshaw's (2004) view of the organizational context as an antecedent of ambidexterity it that when employees can rely on support and trust from their top and middle managers and are required to follow rules and clear standards of performance and behaviour, they are more likely to be successfully engaged in the concurrent

knowledge development processes that relate both explorative or exploitation innovation endeavours. Employees may participate in different ways to the development of new knowledge: 1) by leveraging existing knowledge base through their involvement in learning-by-doing routines; 2) by recombining in new ways existing knowledge from different technological or market domains; 3) by absorbing and assimilating knowledge from external sources. Thus:

> *H1. The organizational context, as defined in terms of effort-based performance management and supportive social context, affects the firm's knowledge ambidexterity.*

2.2 *THE MEDIATING ROLE OF KNOWLEDGE BASE FOR THE ACHIEVEMENT OF AMBIDEXTERITY*

The idea that the capacity to accumulate and develop knowledge resources is at the origin of a firm's superior innovation capabilities is well rooted in strategic management studies (e.g. Subramaniam and Youndt, 2005; Smith et al. 2005). Accordingly, the simultaneous generation of knowledge resources in both explorative and exploitative innovation processes may lead a firm to achieve ambidexterity in managing incremental innovations in established products and the development of new radical products.

Consequently, if organizations have built an appropriate portfolio of knowledge resources, they can achieve ambidexterity by connecting previously unconnected ideas and knowledge or by recombining previously connected knowledge in new ways (Kogut and Zander 1992). Based on these considerations, the following linkage can be hypothesized.

> *H2. A firm's knowledge ambidexterity has a positive influence over its actual innovation ambidexterity.*

Although the relationship between the concurrent accumulation of knowledge resources in exploration and exploitation domains and the actual innovation ambidexterity may sound obvious, this linkage has been under-investigated in previous studies, with a consequent partial understanding on all the reasons that may lead firms to fail in managing simultaneously discontinuous and incremental innovation. For example, Iansiti and Clark (1994) argued that not the generation of detailed knowledge sources within different domains (i.e. operational capabilities at exploratory and exploitative units) is crucial, but rather the usage of architectural knowledge to generate new possibilities for meeting multiple contradictory customer demands.

There is indeed a general agreement in previous studies that because of poor and ineffective resource synthesis firms may fail in achieving a full utilization of their knowledge base, especially when this knowledge base is broad and regards different technological, scientific and market domains (Zhou and Li, 2012; Hill and Rothaetmel, 2003; Zahra and George, 2002). In other words, there is a general agreement in previous studies that a firm's combinative capabilities (Kogut and Zander, 1992) to use and integrate appropriately internal knowledge resources and complementing them with external knowledge plays a critical role in innovation processes.

Laursen and Salter (2006) add that the poor use of knowledge resources can be likely when firms work on too many ideas, as their limited cognitive attention may bring managers to pose insufficient attention to any individual idea. For Kogut (1997) accumulation of 'too many ideas' in R&D processes may be detrimental to product innovation also because some innovative ideas coming from outside may come at the wrong time and in the wrong 'place' to be fully exploited.

Christensen and Bower (2006) offer an example of the difficulties that firms encounter in balancing explorative radical innovation with incremental improvements in established

products once they have developed breakthrough ideas. Specifically, by considering the disk drive industry, these authors found that established companies were pioneers in developing discontinuous innovations, but failed to market them, because the new technologies did not address their existing customers' needs. Wrong resource allocation decisions, lack of slack resources and an overemphasis on short-term results may indeed lead firms to fail in transforming breakthrough ideas arising from exploration activities into new products.

Goals conflict, time constraints and bounded rationality may thus require firms to implement some forms of temporal or organizational separation, even when their organizational context promote a balance of adaptability to accommodate discontinuities and the alignment needed to improve efficiency and quality for established products (Adler Goldoftas, & Levine, 1999; Lavie et al., 2010). The diversities in attitudes, routines, metrics and reporting structures required to execute exploration and exploitation projects may therefore lead individuals and teams to temporary departmentalization and sequential allocation of attention on divergent goals.

For the same reasons firms may buffer exploration from exploitation in more formalized and structured way by dividing these divergent innovation types in separate temporary or permanent units, with each unit embodying distinct strategic and operating logics, cultures and performance metrics (Christensen and Bower, 1996). Thanks to structural separation of explorative innovation endeavours from exploitation activities firm may thus achieve ambidexterity. This organization design choice requires however the use of integration mechanisms to mobilize resources across units (Prahalad and Hamel, 1990) and to coordinate exploratory and exploitative innovation initiatives (Jansen et al. 2006; O'Reilly and Tushman, 2007). A shared organizational vision, social integration among senior managers of the different units, liaison roles and job rotations programs between units are examples of such integration mechanisms (Burgers et al., 2009; Jansen et al., 2009). Past studies illustrate that

firms may even use market-based ways rather than the internal hierarchy to pursue ambidexterity through structural separation, such as corporate venturing (Hill and Birkinshaw, 2006) – and alliances with other firms, universities and research centres.

Based on the same arguments, Hagel and Singer (1999) noticed that in many industries, such as apparel, financial services and media the diversities in the economics and the critical success factors needed in product innovation, infrastructure management and customer relationship management led many firms to separate some of these activities from their core business though outsourcing, thereby favouring an unbundling in value chains.

Anecdotal evidence provide many examples of how companies developed ambidexterity in times of great discontinuity through the structural differentiation of more radical and explorative projects from their established business. This was particularly successful when firms were able to combine structural differentiation with an organizational context that was at the same time adaptive and oriented to standardization. For example, Fujifilm, by reapplying the know-how on anti-oxidants that it originally developed to avoid that photos fade because of oxidation, entered solo the business of producing cosmetics by creating an ad-hoc unit. Instead, Kodak was not successful as Fujifilm in dealing with the discontinuity of digital photography (it indeed asked for bankruptcy protection on January 2012) as its attempts to diversify into the chemical and drug industries through some corporate venturing initiatives failed since the lack of absorptive capacities and internal explorative units in the pharmaceutical and chemical sector impeded the company to be able to vet acquisition candidates well, to integrate the companies it had purchased and to negotiate profitable partnerships.

Our position is that some degree of structural differentiation is needed when firms want to transform new knowledge accumulated in exploitation and explorative endeavours in the concurrent achievement of outcomes such as the improvement of efficiency and quality of

established products, on one hand, and the entrance in new technological trajectories or market segments, on the other. This may especially hold true when technological discontinuities arise. In this regard, Chandrasekaran et al. (2012) found that structural differentiation had no effect on the achievement of ambidexterity, but it was however determinant to the project performance of exploitation R&D projects. Thus:

> *H3. The degree of structural differentiation (in the form of organizational units,*
> *metrics and processes for exploration and exploitation projects) positively*
> *affects a firm's actual innovation ambidexterity.*

2.3   OA AND FINANCIAL PERFORMANCE HYPOTHESIS

A fundamental conjecture in ambidexterity literature is that firms that are able to combine and balance explorative and exploitative activities in innovation should enjoy superior performance respect to competitors. However, evidence on the financial outcome of ambidexterity is mixed, complex and only in part based on quantitative studies. This gap is mainly due to two reasons. First, previous studies that attempted to measure the performance effects of ambidexterity empirically rarely took into account both short-term and long-term performance effects of innovation initiatives. Indeed, Auh and Menguc (2005) demonstrated that exploration contributes to long-term performance, captured by market-share growth and sales growth, more than to short-term performance, measured with return on assets. Therefore, the analysis of the financial outcome of ambidexterity require a duality in performance measurement, given that exploration is expected to be more critical for long-term performance outcomes, whereas exploitation brings visible returns already in the short term (March, 1991).

The second reason for the lack of straightforward evidence in literature on the performance effect of ambidexterity is related to the differences in the ways previous studies conceived and operationalized ambidexterity. Such differences are at the origin of mixed evidence.

For example, some studies simply assessed separately the impact on performance due to exploration and exploitation (Jansen et al., 2006) and found that the impact of these innovation types depend on environmental contingencies (competitiveness and dynamism), different level of analysis employed in observing ambidexterity (for example some studies observed ambidexterity at the business unit level, while others at the firm level). Studies (Ebben and Johnson, 2005) that considered ambidexterity in a continuum between search for efficiency and flexibility found that firms that pursue either exploration or exploitation outperform those that combine these activities. Instead, some other studies that used independent measures of exploitation and exploration (He and Wong, 2004) found that firms that pursue both activities reported higher performance.

Another open issue is whether the performance implications of ambidexterity depend on the mode is achieved. For example, most studies on organizational separation fail to provide clear evidence of the performance of ambidextrous designs. The possible benefits on bringing radical innovation ideas into new products that firms achieve by introducing organizational separation may be out-weighted by the overhead costs and the asset redundancies introduced through dedicated resources to both exploratory and exploitative units (Van Looy et al. 2005). Following similar arguments, Venkatraman et al. (2007) report that in the software industry the simultaneous balance of exploration and exploitation by means of organizational separations yielded a weaker effect on sales growth respect to temporal separation.

In a similar way, Gibson and Birkinshaw (2004) have furnished evidence at the business unit level of a positive effect of contextual ambidexterity on performance. However, in this study performance has been operationalized through a self-reported scale that consider capacity

utilization and employees motivation. Even studies at the firm-level have usually adopted perceived measures of performance (especially in the case of small and medium enterprises) as in many countries firms are not legally required to publish these data, if their equity or debt is not listed in financial markets. Thus:

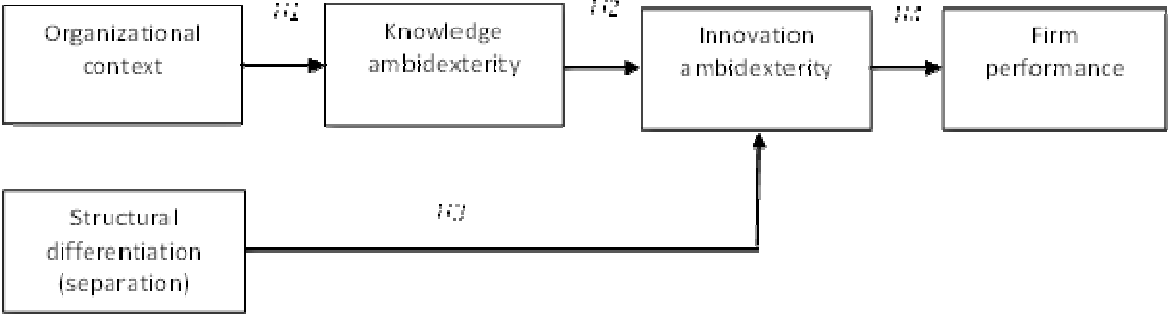*H4. Innovation ambidexterity positively affects firm financial performance.*

Figure 2. The proposed conceptual model

Figure 2 summarizes the proposed theoretical model. Taken together, H1, H2 and H3 hypotheses posit that the organizational context can bring firms to achieve ambidexterity thanks to its role in allowing the accumulation of knowledge resources in an ambidextrous way, whereas structural separation may favour ambidexterity by leading firms to a better use and integration of knowledge resources in their innovation processes. This is like to say that an appropriate organizational context and structural separation are not two alternative ways to achieve ambidexterity, but they are rather two complementary levers that have a key importance in two distinct moment of the knowledge life cycle that goes from generation to retrieval and capitalization (Birkinshaw and Sheehan, 2002). The former can be determinant to internal and external learning, namely the accumulation of knowledge from internal experiments, learning by doing and the assimilation of external knowledge through appropriate search practices. The latter can favour the transformation of knowledge and innovative ideas into products.

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This argument leads the way to suppose that firms can achieve lower performance improvements when they reach ambidexterity solely towards an organizational context that foster adaptability and alignment. Thus:

> *H5. Organizational ambidexterity leads to higher firm performance when it is achieved through structural differentiation of explorative and exploitative projects than when it is obtained solely through an organizational context fostering social support and effort-based performance management.*

3. METHODOLOGY

3.1 SAMPLE AND DATA COLLECTION

An online cross-sectional survey was adopted for data collection. A structured questionnaire was developed to measure the theoretical constructs and five-point Likert scales with end points of "strongly disagree" and "strongly agree" were used to measure the items. A test of the resulting questionnaire was conducted on two groups of subjects: colleagues and target respondents. These two tests were conducted independently and led to improvement and update of the survey instrument.

The target sample frame consisted of medium-sized and large Italian firms in the Medium and High Tech industries selected according to the international OECD science classification. The sample frame thus included companies with more than 50 employees and covering Aerospace, Computers, Office machinery, Electronics-communications, Pharmaceuticals, Scientific instruments, Motor vehicles, Electrical machinery, Chemicals, Other transport equipment, Non-electrical machinery sectors (the specific two-digit ATECO 2007 codes are 20, 21, 25, 26, 27, 28, 29, 30, 32). Five-hundred firms were randomly extracted and contacted from the AIDA dataset. The Aida dataset is the main repertoire of financial annual reports information

about companies and it covers all the population of medium-sized and large enterprises in the country. Descriptive statistics about the analysed sectors are reported in Tables 1a and 1.b.

Table 1a. Business sectors in the sample

HIGH-TECH	Aerospace	3%
	Computers, office machinery	10%
	Electronics-communications	3%
	Pharmaceuticals	10%
MEDIUM-HIGH TECH	Scientific instruments	3%
	Motor vehicles	9%
	Electrical machinery	22%
	Chemicals	15%
	Other transport equipment	3%
	Non-electrical machinery	22%

Table 1b. Number of employees of companies in the sample.

Number of employees	%
Less than 100 employees	35%
100-200 employees	14%
200-500 employees	20%
500-1000 employees	11%
More than 1000 employees	19%

The data collection process was spanned between May 2009 and February 2010 and was supported by the use of Survey Monkey® web utilities. Companies were contacted by phone to introduce the research initiative and identify respondents, who were vice presidents or directors of R&D departments, or CEOs. To those who agreed to participate an email, including a cover letter of the survey and the Survey Monkey® account for survey access, was sent. This was followed by a reminder by phone and email two weeks after the initial contact. Of the 500 surveys mailed in Italy, 112 responses were received, resulting in a response rate of 22.4%. 25 responses were discarded due to incomplete information, resulting in an effective response rate of 17.4%.

Finally, in order to test the non-response bias (Lambert and Harrington, 1990) we compared the early and late respondents by a t-test. The early wave group consisted of 66 responses while the late wave group consisted of 46 responses. The t-tests performed on the responses of these two groups yielded no statistically significant differences (at 95% confidence interval). Also responses given by CEOs or the other types of respondents were compared, without finding any systematic bias in responses due to the role of the respondent.

3.2   MEASURES AND CONSTRUCT VALIDATION

As for construct operationalization, we used multi-item scales (except for financial performance) which are well consolidated in the literature for all the variables (Tables 2a to 2d). Scores for the scale were mainly calculated as the mean value of the items (further details about the computation procedure will be given). We also assessed reliability test of all the group of items pertaining to our constructs through confirmatory factor analysis (CFA) and Cronbach's alpha test. Factor analysis was conducted using Principal Component extraction with Varimax Rotation. All the expected constructs were confirmed whether some refinements were necessary and a few number of items were dropped out (i.e. the items with no loadings reported in the following tables).

The internal consistency by Cronbach alpha test for the analyzed constructs was in the range 0.65-0.82. These values are considered acceptable whether two of them (Innovation exploitation and Structural differentiation) have more questionable indexes (Nunnally, 1978). Values are however greater than the critical value of .65 (James, 1982).

Dependent variables

Knowledge ambidexterity. The knowledge ambidexterity is interpreted as a meta-capability for Innovation Ambidexterity and here operationalized through the constructs suggested by Zahra et al. (2000) and Atuahene-Gima (2005).

Table 2a. Knowledge ambidexterity construct

CONSTRUCT	N	VARIABLE DESCRIPTION	LOADINGS
Knowledge exploration (Zahra, Ireland, and Hitt 2000; Atuahene-Gima, 2005) **(α =.82)**	4	Acquired manufacturing technologies and skills entirely new to the firm	.722
		Learned product development skills and processes (such as product design, prototyping new products, timing of new product introductions, and customizing products for local markets) entirely new to the industry	.826
		Acquired entirely new managerial and organizational skills that are important for innovation (such as forecasting technological and customer trends; identifying emerging markets and technologies; coordinating and integrating R&D; marketing, manufacturing, and other functions; managing the product development process	.809

		Strengthened innovation skills in areas where it had no prior experience	
			.850
Knowledge exploitation (Zahra, Ireland, and Hitt 2000; Atuahene-Gima, 2005) **(α =.81)**	5	Improved the skills and knowledge about products and familiar technologies	.738
		Invested in improving skills in the use of mature technologies that serves to improve productivity	.698
		Reinforced skills in finding solutions to customer problems, starting from existing solutions, rather than completely new solutions	.727
		Enhancing skills in the development process of the product / service in which there is already a significant experience	.785
		Invested in improving their skills on mature technologies	.812

Innovation ambidexterity. The construct is identified through the classification of the firms into groups on the base of their level of innovation performance achieved both in exploration and in exploitation. Items are coherent with He and Wong (2004), Lubatkin et al. (2006) and Cao et al. (2009).

Table 2b. Innovation ambidexterity construct

CONSTRUCT	N	VARIABLE DESCRIPTION	LOADINGS
Explorative innovation (He, Wong, 2004; Lubatkin et al. 2006; Cao et al., 2009) **(α =.77)**	4	Introduction of new generations of products	.789
		Extension of product range	.773
		Opening up new markets	.743
		Entering new technological fields	.758
Exploitative innovation (He, Wong, 2004; Lubatkin et al. 2006; Cao et al., 2009) **(α =.65)**	3	Improving existed product	.790
		Cutting production costs	.727
		Expanding existed markets	.773

Knowledge and innovation ambidexterity were measured as a combined dimension of the exploration and exploitation initiatives, thus multiplying the score of the related sub-dimensions of exploitation and exploration. This approach is predominant in quantitative studies on ambidexterity and draws on Gibson and Birkinshaw's (2004) and He and Wong's (2004) operationalizations, which interpret ambidexterity as the ability of simultaneously explore and exploit. Alternative operationalizations of ambidexterity exist in literature. They consider ambidexterity as a balanced focus on exploration and exploitation and they measure this construct as the absolute deviation between exploration and exploitation (see Lubatking et al., 2006; De Visser et al., 2009; Jensen et al., 2009; Revilla et al., 2011). Some studies (i.e. Cao et al., 2009) use both the "combined" view of ambidexterity (based on multiplying exploration and exploitation) with the "balanced" view in an effort to consider more

comprehensively both the magnitude and the balance of exploration and exploitation. However, in the sake of model parsimony and due also to the small sample size, in this study we decided to only use the combined view of ambidexterity.

Firm performance. Firm financial performance takes into account the sales trend over 5 years and controls for the effect of trends in the sector. Data were gathered by the AIDA dataset (2010) in order to obtain the complete time series of firm financial performance until the 2009.

While recognizing that firm performance is a multidimensional concept, we focused only on the logarithmic growth rate of sales revenues between 2006 and 2009 for several reasons. First, unlike profitability measures like ROA, etc., sales growth does not suffer from accounting measurement problems. Second, sustained sales growth has been found to be a reliable proxy indicator of other dimensions of superior firm performance, including long-term profitability and survival (Timmons 1999, Henderson 1999). Moreover, the time horizon that we take under observation consider sales growth over five years, thus considering by itself performance trends on the medium term. Due to these reasons, sales growth is the most common objective performance measures used in previous studies on ambidexterity. To control for industry effects the logarithmic growth rate of firms' sales growth rate was compared to the same ratio for aggregate revenues calculated at the industry level (considering industry at the third digit of Nade codes). This adjusted measure of revenue growth exhibits a further advantage as it also controls indirectly for economic cycles and for other macroeconomic factors such as industry concentration. This advantage is particularly important considering that the economic recession started in 2008 has affected the period where we estimate the impact of ambidexterity on performance.

Independent variables

Organizational context. In this analysis the organizational context is identified on the base of the construct by Birkinshaw and Gibson (2007) and measures the alignment and adaptability of company goals and objectives.

Table 2c. Organizational context construct

CONSTRUCT	N	VARIABLE DESCRIPTION	LOADINGS
Organizational context			
Social Support Context (Birkinshaw and Gibson,2007) **(α =.77)**	4	Managers in my organization devote considerable effort to developing subordinates	.690
		Managers in my organization push decisions down to the lowest appropriate level	.782
		Managers in my organization have access to the information they need to make good decisions	.804
		Managers in my organization treat failure in a good effort as a learning opportunity, not something to be ashamed of	.795
Performance Management Context (Birkinshaw and Gibson,2007) **(α =.76)**	4	Managers in my organization issue creative challenges to their people instead of narrowly defining tasks	.861
		Managers in my organization use business goals and performance measures to run their businesses	.867
		Managers in my organization hold people accountable for their performance	.734
		Managers in my organization encourage and reward hard work through incentive compensation	-

Structural differentiation. The construct takes into account the structural differentiation between processes, structures and incentives for exploration and exploitation activities as suggested by Jansen et al. (2009).

Table 2d. Structural separation construct

CONSTRUCT	N	VARIABLE DESCRIPTION	LOADINGS
Structural separation (Gupta and Govindarajan, 1986; Cao et al., 2009) **(α =.73)**	3	Innovation and production activities are structurally separated within our organization	.890
		Our organization has separate units to enhance innovation and flexibility	.890
		We have units that are either focused on the short term or the long term	-

Organizational context and structural antecedents variables are processed as the mean of the related sub-construct and related items.

Control variables. A number of previous studies highlighted that both firm size, age, R&D spending and environmental dynamism (turbulence) can affect performance since these factor can influence the resources stock available to the firms. With regard to age, younger firms may be less subjected to core rigidities and competency traps and may be easier for them to act ambidextrously. On the other hand, due to a "liability of newness", younger firm may have limited endowment of resources, which may hamper them in pursuing both exploration and exploitation and in acquiring the complementary technological and market resources that are needed to execute ambidextrous strategies.

Following these arguments, we controlled for possible confounding effects by including size (number of employees between 2006 and 2008), the ratio of R&D spending on annual turnover, age and market turbulence as potential control variables. Size, age and R&D spending were considered in logarithmic form to compensate for some degree of skewness in the distribution of these variables. Turbulence was operationalized through a multi-items 5 level Likert scale which is reported in table 2e.

Table 2e. Turbulence construct

CONSTRUCT	N	VARIABLE DESCRIPTION	LOADINGS
Turbulence degree (Birkinshaw et al. 1998, Jaworski and Kohli 1993; Dill 1958, Volberda and Van Bruggen 1997) **(α =.72)**	3	Customers frequently ask for new products and services There are constant changes The amount of products and services change rapidly and frequently	.768 .885 .719

Reliability and validity checks

A number of further tests was assessed on the constructs Knowledge and Innovation Ambidexterity in order to corroborate the reliability and validity since they are considered central in the aim of the present study. Particularly, discriminant validity was checked. Whether the content validity is clearly confirmed by the specific and really differentiated

content of the adopted items (from literature), additional test were considered necessary. An exploratory factor analysis was accomplished on all items belonging to the two constructs. A four factor configuration emerges by using principal component analysis and oblimin rotation. Moreover, we also performed pair wise comparison of the constructs using a two factor CFA model at level of the four sub-constructs (Bagozzi and Phillips, 1982). We estimated each model twice, one constraining the correlation coefficient to unity and the other unconstrained. A Chi-square test was adopted to proof that the significant difference between the constrained and unconstrained model. Table 3 shows results.

Table 3. **Assessment of discriminant validity: chi-square differences between fixed and free models**

	Knowledge ambidexterity
Innovation ambidexterity	25.8***

* significant at the 0.05 level, ** at the 0.01, *** at the 0.001 level (for 1 d.f.).

The overall analysis shows that Knowledge and Innovation ambidexterity constructs are reliable and valid. For all the other construct we used an exploratory factor analysis approaches, as above presented.

3.3 ANALYSIS METHODS

We chose hierarchical regression techniques in Stata 11.0 to test the research hypotheses. Hierarchical regression adds controls, explanatory variables, and joint effect terms incrementally to gauge their relative contributions.

For all the models an additional sensitivity check using bootstrap resampling to generate estimates and robust standard errors was adopted in order to deal with the limited sample size. When using a small sample, standard errors can be underestimated, and the regression coefficients can result statistically significant, although they may not be so in the population bootstrap methods, which do not require the normality assumptions that are relied upon with

large samples provide robust (and thus more "prudent") estimates (Barclay & Litzenberger, 1988).

Concurrently, we adopted the Sobel test in order to confirm mediation of knowledge ambidexterity between the organizational context and the innovation ambidexterity (Sobel, 1982). The Sobel test is usually considered superior to the Baron & Kenny method (Baron & Kenny, 1986) in terms of power, type I error, suppression effects and addressing the significance of the indirect effect whether it still suffers of limitations due to the assumption that the sampling distribution is normal. The Sobel test determines the significance of the indirect effect of the mediator by testing the hypothesis of no difference between the total effect and the direct effect. Bootstrap estimation was also adopted.

4.   FINDINGS

Table 4 gives the means, standard deviation and correlations for the variables. It is interesting to highlight the high correlations between Knowledge and Innovation Ambidexterity and between Organizational structure and Structural separation. While the first two constructs are obviously deeply interconnected (discriminant validity was previously checked), the high correlation between the variables Organizational structure and Structural separation suggest that these two levers to achieve ambidexterity are complementary rather than substitute.

We assessed preliminary tests including correlations and the Harman single-factor test to search for common method bias. Exploratory factor analysis combining items from the dependent and independent variables revealed that several factors were extracted. This evidences that there is no single factor emerging from these variables to suggest common method bias in the data. If common method variance exists among these variables, then the one-factor CFA model should fit the data.

Table 4. Means, standard deviations and correlations of variables

		Mean	Std.dev.	1	2	3	4	5	6	7	8
1	Firm size (log)	2.406	1.009	1.000							
2	Firm age (log)	2.843	0.953	0.105	1.000						
3	R&D Spending (log)	2.017	1.076	-0.099	-0.051	1.000					
4	Turbulence	3.678	0.718	0.093	-0.015	0.243*	1.000				
5	Knowledge Ambidexterity	10.076	3.862	0.055	0.031	0.329*	0.266*	1.000			
6	Innovation Ambidexterity	11.402	4.352	0.040	0.052	0.253*	0.266*	0.779***	1.000		
7	Organizational Context	5.011	1.219	0.156	-0.089	0.011	0.239*	0.263*	0.210*	1.000	
8	Structural Separation	3.103	1.012	0.132	0.029	-0.100	0.065	0.240*	0.290**	0.566***	1.000
9	Financial Performance	0.011	0.335	0.158	-0.137	0.182	0.088	0.341*	0.346***	0.130	0.058

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

4.1 *ANTECEDENTS OF AMBIDEXTERITY*

To test the first three hypotheses we used ordinary least squares hierarchical regression analyses. All variance inflation factor values were well below the recommended threshold of 10 (Kleinbaum et al., 1988). Table 5 shows regression results for the antecedents of Knowledge and Innovation Ambidexterity respectively (including the standard errors estimated with a bootstrap approach based on 1000 samples).

Models 1 and 4 are the base models, with only control variables included in the equations predicting knowledge and innovation ambidexterity, respectively. Results from Models 2 and 5 indicate that the organizational context significantly influences knowledge ambidexterity, but not innovation ambidexterity.

Knowledge Ambidexterity, in turn, strongly affects Innovation Ambidexterity (model 6). These results provide support for hypotheses H1 and H2, thereby highlighting that the impact of the organizational context on innovation ambidexterity is fully mediated by the degree of Knowledge Ambidexterity. The Sobel test further confirms this mediation (see next section for further details).

Table 5. Results from hierarchical regressions (Knowledge and Innovation ambidexterity)

Model specification	Knowledge Ambidexterity			Innovation Ambidexterity		
	1	**2**	**3**	**4**	**5**	**6**
R&D spending [log]	1.059** (.380) [.355]	1.076*** (.372) [.318]	1.136*** (.370) [.320]	.838* (.437) [.424]	.970* (.423) [.396]	.021 (.307) [.324]
Turbulence	1.021* (.569) [.425]	.735 (.571) [.446]	.792 (.567) [.467]	1.293* (.655) [.516]	1.151* (.648) [.569]	.490 (.450) [.443]
Firm age	.170 (.415) [.394]	.264 (.408) [.400]	.208 (.406) [.393]	.284 (.478) [.489]	.264 (.464) [.486]	.091 (.319) [.345]
Firm size	.237 (.396) [.392]	.113 (.392) [.387]	.091 (.388) [.369]	.148 (.456) [.463]	.004 (.444) [.379]	-.072 (.305) [.318]
Const.	3.157 (2.490) [2.088]	.561 (2.708) [2.210]	-.057 (2.711) [2.279]	3.791 (2.867) [2.506]	.498 (3.098) [2.794]	.545 (2.128) [2.257]
Organizational context	-	.723** (.330) [.288]	.368 (.396) [.367]	-	-.0161 (.452) [.400]	-.323 (.312) [.292]
Structural separation	-	-	.734 (.463) [.391]	-	1.300** (.529) [.437]	.687* (.434) [.425]
Knowledge Ambidexterity	-	-	-	-	-	.835*** (.088) [.091]
R²	.151**	.199**	.223**	.114*	.201**	.628***
Adjusted R²	.110	.149	.165	.070	.141	.595
Change in R²	-	. 048*	.024	-	.087*	.417***

* p<0.05; ** p<0.01; ***p<0.001; two-model; standard error in round parenthesis ( );
bootstrap-robust standard errors in squared parenthesis [ ]

In Hypothesis H3 we posited that structural differentiation of exploitative and explorative innovation endeavors have a positive direct effect on the actual degree of ambidexterity. Model 3 shows that structural differentiation has not impact on the level of knowledge ambidexterity. By contrast, model 5 highlights that structural differentiation has a positive and significant impact on the level of innovation ambidexterity. This effect remains significant when the effect of knowledge ambidexterity over innovation ambidexterity is considered (model 6). These results provide support for hypothesis H3.

As concerning the control variables, R&D spending intensity has a very strong impact on Knowledge Ambidexterity, but it is lower on Innovation Ambidexterity. Turbulence tends to

have somewhat an impact but this effect becomes insignificant when Structural separation or Knowledge Ambidexterity are included.

4.2 SOBEL TEST

Based on bootstrap data re-sampling procedures we established the confidence interval for testing the statistical significance of an indirect effect between Organizational Context and Innovation ambidexterity.

Firstly, we established that zero-order relationships among the variables significantly exist in order to suppose a potential mediation. The bootstrap estimates coefficients of direct effects are show in Table 6.

Table 6. Bootstrap estimated direct effects between
Organizational Context, Knowledge and Innovation Ambidexterity
($*p < 0.05$; $** p < 0.01$; $***p < 0.001$)

Effect	Regression result (bootstrap)	
	B	S.E.
c (Organizational Context → Innovation Ambidexterity)	.748*	.301
a (Organizational Context → Knowledge Ambidexterity)	.832**	.306
b (Knowledge Ambidexterity → Innovation Ambidexterity)	.877***	.083

Table 7 shows results of the mediation tests accordingly to Sobel (1982). Assuming we had set our alpha at .01 level, technically, we reject the null hypothesis of no mediation. Mediation of knowledge ambidexterity between the organizational context antecedents and the innovation ambidexterity is confirmed at .01 level. The percentage of the total effect that is mediated is very high (more than 90%). Therefore, mediation is confirmed so that we can argue that Organizational context contributes to the achievement of Innovation ambidexterity through the simultaneous development of new knowledge in both the exploration and the exploitation domains (Knowledge ambidexterity).

Table 7. Mediation test of Knowledge Ambidexterity

Path/effect	Regression result (bootstrap)		Mediation test			
	Weight	S.E.		Test	S.E.	P-Value
a (Organizational Context → Knowledge Ambidexterity)	.832**	.306				
b' (Knowledge Ambidexterity → Innovation Ambidexterity)	.876***	.086	**Sobel**	2.627**	0.277	0.008
(a*b') c' (Organizational Context → Innovation Ambidexterity)	0.22	-				

(b' and c' are the coefficient of a multiple linear regression with Innovation Ambidexterity is the dependent variable and Organizational Context and Knowledge Ambidexterity are the independent variables)

4.3 *PERFORMANCE IMPACT OF AMBIDEXTERITY*

Hypothesis H4 about the performance impact of innovation ambidexterity was estimated with an approach based on hierarchical regression analysis, similarly to the models above illustrated on the antecedents of ambidexterity. Table 8 reports the results of this analysis (including the robustness check based on bootstrap resampling).

Model 9 indicates that innovation ambidexterity has a positive impact on the logarithmic growth rate of sales revenue, thereby providing supporting to hypothesis H4.

Table 8. Results from hierarchical regressions (Financial Performance)

	Performance		
Model specification	7	8	9
Turnover 2005 (log)	-.025 (.028) [.035]	-.027 (.029) [.036]	-.023 (.027) [.035]
R&D spending [log]	.056 [.041] (.034)	.058 [.041] (.035)	.033 (.034) [.042]
Turbulence	.008 [.045] (.051)	-.002 [.042] (.053)	-.031 (.052) [.042]
Firm age [log]	-.044 [.048] (.038)	-.041 [.050] (.039)	.049 (.037) [.048]
Firm size [log of number of employees]	.078 [.055] (.039)	.074 [.060] (.040)	.071 (.038) [.057]
Const.	.061 [.460] (.329)	-.022 [.505] (.346)	-.069 (.330) [.503]
Organizational context		.023 [.040] (.037)	.023 (.035) [.036]
Structural separation		.006 [.039] (.043)	.029 (.043) [.038]
Innovation Ambidexterity	-	-	.026** (.009) [.010]
R²	.095	.103	.196*
Adjusted R²	.039	.024	.113
Change in R²	-	.008	.093*

* p<0.05; ** p<0.01; ***p<0.001; two-model; p value in round parenthesis ( );
bootstrap-robust estimated p-value in squared parenthesis [ ].

4.4   *PERFORMANCE IMPLICATIONS OF THE TYPE OF INNOVATION AMBIDEXTERITY*

In hypothesis H5 we posited that when ambidexterity has been achieved through the structural separation of exploration endeavors from exploitation innovation initiatives the performance impact could have been greater. The lack of a direct effect of the organizational context on innovation ambidexterity seems to provide a preliminary support to this hypothesis. To test this linkage, we dichotomized organizational context, structural separation and innovation

ambidexterity using the median values as cut-off points. In this way, we could *a priori* identify four distinct types of companies. The first group was made by firms without a considerable degree of innovation ambidexterity ("no ambidexterity"). The second group included firms that reported a high level of ambidexterity despite a low level of structural separation and an "inappropriate" organizational context a la Birkinshaw and Gibson (2004) with a considerable level of ambidexterity. The third group included firms that achieved a high level of ambidexterity in the presence of an adequate organizational context (in terms of social support and effort-based performance management) and a low degree of structural separation of exploration initiatives from exploitative innovation (firms in this group were labelled as "pure contextual ambidexterity"). The fourth group included firms that achieved a high level of ambidexterity in presence of a considerable degree of structural separation of exploration from exploitation ("ambidexterity through structural separation").

Table 9. Performance effects due to "structural" and "contextual" ambidexterity (H: High; L: Low)

Group no.	Type of innovation ambidexterity	Innovation ambidexterity	Organi-zational context	Structural separation	Log [Sales Revenue 2009/Sales Revenue 2005]			
					Mean	Median	St. dev.	No. firms
1	no ambidexterity	L	H or L	H or L	-0.041	0.002	0.318	50
2	Ambidexterity without either appropriate organizational contextual or structural separation	H	L	L	-.0568	-0.081	0.131	8
3	"pure" contextual ambidexterity	H	H	L	-.0362	-0.025	0.112	10
4	ambidexterity achieved in presence of structural separation	H	H	H or L	0.202	0.157	0.444	19
Total					0.0234	0.002	0.335	87
Anova test: p-value= 0.04								
Kruskall Wallis non-parametric test: p-value = 0.067								

We compared sales growth rates across these four groups through an Anova analysis and a Kruskall-Wallis non parametric test. Specifically we assessed the difference in sales growth across groups 4 and 3. Table 9 reports the result of this analysis. Non parametric and Anova tests indicates that when ambidexterity is achieved without structural separation and just by

relying on the development of an organizational context *à la* Gibson and Birkinshaw (2004) it reports lower (and negative) growth rates in sales revenue respect to companies that introduce some degree of organizational separation at a certain time in exploration innovation processes. Table 10 presents a robustness check where a paired Student's t-test has been executed with a bootstrap resampling approach based on 1000 sample replications in order to consider robust standard errors. Specifically, the table reports the estimated difference in the logarithmic growth rate of sales revenue between firms that achieved ambidexterity through structural separation and the other three groups of companies. This approach is the equivalent of a Sheffé test, assuming difference in variance of the groups and it confirms that when ambidexterity is achieved through structural separation lead firms to a higher sales growth that when it is pursued solely through an "appropriate" organizational contest. Hypothesis H5 is thus supported.

Table 10. Differences in sales growth rates of firms achieving ambidexterity in presence of structural separation (group 4) and the ones arriving at ambidexterity in presence of other means (groups 1, 2 and 3)

	observed difference	bootstrap std. Error	Normal-based 95% confidence interval	
Sales Growth rates differences: group 4 – group 1 (firms achieving ambidexterity in presence of structural separation vs. non ambidextrous firms)	2.178**	0.847	2.839	0.517
Sales Growth rates differences: group 4 – group 2 (firms achieving ambidexterity in presence of structural separation vs. ambidextrous firms without 'appropriate' organizational context and structural separation)	2.312**	0.832	3.942	0.682
Sales Growth rates differences: group 4 – group 3 (firms achieving ambidexterity in presence of structural separation vs. ambidextrous firms in presence solely of 'appropriate' organizational context)	2.206**	0.832	3.837	0.575

5. DISCUSSION, CONTRIBUTIONS AND IMPLICATIONS

The theoretical insights and the empirical findings discussed in this paper contribute to illustrate the way firms can achieve organizational ambidexterity and the impact that ambidexterity has on performance, depending on the way firms have built this dynamic capability. In so doing the paper highlights three key results.

First, firms that have built an appropriate organizational context *à* la Gibson and Birkinshaw (2004), achieve a higher balance between exploitation and exploration in their dynamics of knowledge development, a condition which in turn positively affects the actual achievement of ambidexterity in innovation performance.

The second key result is that firms that buffer exploration from exploitation endeavours through structural separation of these activities in different units are more likely to achieve innovation ambidexterity. More specifically, hierarchical regression models highlight that structural separation has a direct impact on innovation ambidexterity, whereas the existence of an appropriate organizational context has only an indirect impact on ambidexterity, through the mediation of ambidexterity in knowledge creation processes. These results sound as a confirm that organization with an appropriate blend of trust, support, discipline and stretch may result the right context for the generation of knowledge in both exploration and exploitation initiatives as they require employees to develop dual capacity. However, it seems that if companies want to capitalize on the knowledge elements created by employees in their exploitation and exploration activities and bring them in new radical products and in better established products (in terms of costs and quality) they have to introduce some structural separation at certain point of these innovation processes. This result constitutes the main novelty aspect respect to previous studies and it is further supported by the fact that in (not reported here) OLS regression models R&D expenses result to positively impact the amount of knowledge created in exploration endeavours, whereas they do not affect the knowledge created in learning cycles that are finalized to exploitation. Knowledge exploration thus requires some separation and formalization in more structured R&D projects.

This result thus suggests that firms may build ambidexterity by combining contextual conditions with the structural differentiation of exploration and exploitation endeavours in dual structures, a fact that is further confirmed by the positive correlation between these two

constructs. This is a second novelty aspect which responds to the need of complementarities between the different paths to ambidexterity (Raish and Birkinshaw, 2008).

Under this point of view, our results seem to go into the direction of previous evidence that revealed that a separation of focus on either exploration or exploitation at a given time or location (Adler, Goldoftas, and Levine, 1999) however exist even in firms pursuing contextual ambidexterity as intended by Gibson and Birkinshaw (2004).

The third key result is that firms achieving innovation ambidexterity reports higher growth rates in sales between 2005 and 2009. Despite this time horizon is limited and does not fully allow to measure the long term performance impact of ambidexterity, our result is line with He and Wong (2004) study, which was however based on perceptions formulated by respondents over sales growth and not on archival data on firms' financial report.

Finally, given the existence of a mediation effect of the organizational context on innovation ambidexterity, our results indicate that when companies achieve ambidexterity by maintaining exploration and exploitation in the same unit and by exclusively relying on employees capacities to develop the dual capacity to share their time across these different activities, ambidexterity has a lower impact on sales growth. This is coherent with the fact that radical innovations may open new markets for firms which require the development of new marketing competencies and which ask for some specialization and division of tasks.

The main managerial implication from this result is that organizational contexts that support employees in participating simultaneously in exploration and exploitation initiatives may succeed in creating applicable knowledge in these dual domains. However, the knowledge created in contextual ambidexterity processes is just an intermediate output and capitalizing these outputs by achieving simultaneous success in exploration and exploitation require firms to separate these initiatives into different units. This is coherent with what previous studies combining qualitative and quantitative evidence (Christensen and Bower, 2006) have already

reported. Radical and more incremental innovation initiatives may originate in the same technology base and within the same organizational unit, but when firms go ahead in the stages of innovation processes they may need to develop technological and market competencies and metrics that require separation of the radical innovation initiative into ad-hoc structures.

In raising this evidence the paper suffers of some limitations that may raise some concerns. First, the five point Likert scale used to measure the innovation performance and knowledge constructs – although well consolidated in the literature - may have captured only limited dimensions of the exploration versus exploitation distinction. In this regard, being based on subjective measures our scales fails to capture whether firms pursue ambidexterity in a simultaneous and "harmonic" way (Tushman and O'Reilly, 19979 or by a time-paced sequence of exploration and exploitation (Brown ad Eisenhardt, 1997; Simsek et al. 2009). Furthermore, we focused only on a "combinative" measure of ambidexterity, thereby overlooking the effects due to a balance between exploration and exploitation activities in innovation processes (Cao et al., 2009). Accordingly, we cannot assess whether there are differences in terms of performance implications associated with the use of different models of ambidexterity, as it was done by Venkatraman et al. (2007). Second, the relationship between ambidexterity and performance could be mitigated by environmental conditions such as industry dynamism and competitiveness, or by structural conditions such as firm size or age. However, the limited size of the sample did not allow to test for the possible presence of these moderation effects. Accordingly, the generalizability of our results to different industry and firm size conditions may be analysed better in future research, It can be plausible that the lower the firm size the lower the need to separate in different units explorative from exploitative innovation projects. However, our study confirms the conclusion of some previous studies (e.g. Filippini et al., 2011; Ahuja et al., 2008) that – regardless of the

company size – some sort of structural separation –not necessarily in different departments or units – is desirable to capitalize on the development of ambidextrous knowledge. Future research should address these limitations and the related open issues.

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Table A – OA main measures (OA measure is obtained by: "x" = multiplying; "| - |" = subtracting; "+" = adding the X_1 and X_2 scales)

	TENSIONS		OA TYPE	OA MEASURE	OTHER MEASURES
	X1	X2			
Gibson and Birkinshaw 2004	**Alignment** 1. The management systems in this organization work coherently to support the overall objectives of this organization 2. The management systems in this organization cause us to waste resources on unproductive activities 3. People in this organization often and up working at cross-purposes because our management systems give them conflicting objectives.	**Adaptability** 1. The management systems in this organization encourage people to challenge outmoded traditions/practices/sacred cows 2. The management systems in this organization are flexible enough to allow us to respond quickly to changes in our markets 3. The management systems in this organization evolve rapidly in response to shifts in our business priorities.	Contextual	x	
He, Wong 2004	**Exploration of new possibilities** 1. Introduce new generation of products 2. Extend product range 3. Open up new markets 4. Enter new technology fields	**Exploitation of old certainties** 1. Improve existing product quality 2. Improve production flexibility 3. Reduce production cost 4. Improve yield or reduce material consumption	Realized	x | - |	Median cut-off
Atuahene-Gima 2005	**Exploration competence** 1. Acquired manufacturing technologies and skills entirely new to the firm? 2. Learned product development skills and processes (such as product design, prototyping new products, timing of new product introductions, and customizing products for local markets) entirely new to the industry? 3. Acquired entirely new managerial and organizational skills that are important for innovation (such as forecasting technological and customer trends; identifying emerging markets and technologies; coordinating and integrating R&D; marketing, manufacturing, and other functions; managing the product development process)? 4. Learned new skills in areas such as funding new technology, staffing R&D function, training and development of R&D, and engineering personnel for the first time? 5. Strengthened innovation skills in areas where it had no prior experience?	**Exploitation competence** 1. Upgraded current knowledge and skills for familiar products and technologies? 2. Invested in enhancing skills in exploiting mature technologies that improve productivity of current innovation operations? 3. Enhanced competencies in searching for solutions to customer problems that are near to existing solutions rather than completely new solutions? 4. Upgraded skills in product development processes in which the firm already possesses significant experience? 5. Strengthened our knowledge and skills for projects that improve efficiency of existing innovation activities?	Realized	x	
Lubatkin et al. 2006	**Exploratory orientation** 1. looks for novel technological ideas by thinking "outside the box," 2. bases its success on its ability to explore new technologies, 3. creates products or services that are innovative to the firm, 4. looks for creative ways to satisfy its customers' needs, 5. aggressively ventures into new market segments, 6. actively targets new customer groups	**Exploitation orientation** 1. commits to improve quality and lower cost, 2. continuously improves the reliability of its products and services, 3. increases the levels of automation in its operations, 4. constantly surveys existing customers' satisfaction, 5. fine-tunes what it offers to keep its current customers satisfied, 6. penetrates more deeply into its existing customer base.	Realized	+	

	Exploratory	Exploitative		
Jansen et al. 2005	**Exploratory innovation** 1. Our unit accepts demands that go beyond existing products and services. 2. We invent new products and services. 3. We experiment with new products and services in our local market. 4. We commercialize products and services that are completely new to our unit. 5. We frequently utilize new opportunities in new markets. 6. Our unit regularly uses new distribution channels. 7. We regularly search for and approach new clients in new markets.	**Exploitative innovation** 1. We frequently refine the provision of existing products and services. 2. We regularly implement small adaptations to existing products and services. 3. We introduce improved, but existing products and services for our local market. 4. We improve our provision's efficiency of products and services. 5. We increase economies of scales in existing markets. 6. Our unit expands services for existing clients.	Realized	x
Jansen et al. 2006	**Exploratory orientation** 1. looks for novel technological ideas by thinking "outside the box" 2. bases its success on its ability to explore new technologies 3. creates products or services that are innovative to the firm 4. looks for creative ways to satisfy its customers' needs 5. aggressively ventures into new market segments 6. actively targets new customer groups	**Exploitative orientation** 1. commits to improve quality and lower cost 2. continuously improves the reliability of its products and services 3. increases the levels of automation in its operations 4. constantly surveys existing customers' satisfaction 5. fine-tunes what it offers to keep its current customers satisfied 6. penetrates more deeply into its existing customer base.	Realized	x
Menguc et al. 2008	**Exploration** 1. Research and development expenditures for product development 2. Research and development expenditures for process innovation 3. Rate of product innovations 4. Innovations in marketing techniques (compared with competitors)	**Exploitation** 1. Modernization and automation of production processes 2. Efforts to achieve economies of scale 3. Capacity utilization (compared with competitors)	Realized	x
Morgan and Berthon 2008	**Exploratory innovation strategy** 1. Your business unit follows other companies' ideas within the same industry. 2. A 'pioneering' strategy is pursued by your business unit. 3. Product innovation is 'offensive' (as opposed to 'defensive'). 4. Your products offer unique features not available from competitors' offerings. 5. Your products are highly innovative.	**Exploitative innovation strategy** 1. Products and/or processes are analysed to search for improvements. 2. Your business unit seeks to improve processes to reduce costs. 3. Your business unit seeks to reduce costs to the customer through process improvements. 4. Your business unit seeks to improve processes to reduce the time taken for unit production. 5. Your business unit aims to add value to its products and/or services through process improvements.	Realized	x
Cao et al. 2009	**Exploration** *Same scale as He & Wong (2004)* 1. Introduce new generation of products 2. Extend product range 3. Open up new markets 4. Enter new technology fields	**Exploitation** *Same scale as He & Wong (2004)* 1. Improve existing product quality 2. Improve production flexibility 3. Reduce production cost 4. Enhance existing markets	Realized	x |-|
De Visser M. Et al 2009	**Radical NDP process** 1. functional structure 2. cross functional structure	**Incremental NDP process** 1. functional structure 2. cross functional structure	Structural	+
Jansen et al. 2009	**Exploratory innovation** 1. Our organization accepts demands that go beyond existing products and services 2. We commercialize products and services that are completely new to our organization 3. We frequently utilize new opportunities in new markets 4. Our organization regularly uses new distribution channels	**Exploitative innovation** 1. We frequently make small adjustments to our existing products and services 2. We improve our provision's efficiency of products and services 3. We increase economies of scales in existing markets 4. Our organization expands services for existing clients	Realized	x +

Radhashyam Giridharadas 2009	**Explore** 1. Encourage/protect entrepreneurial action/new ideas 2. Attract top talent from outside 3. Seek external idea 3. Enforce accountability	**Exploit** 1. Apply operational control 2. Exert leadership authority	x	
Sarkees and Hulland 2009	Using a scale of 1-7, whereby 1 represents "not at all" and 7 represents "very much so," rate your firm on each of the following questions: 1.Do you view your firm as a market leader in efficiency (i.e., is your firm highly efficient in serving its current markets)? 2.Do you view your firm as a market leader in innovation (i.e., does your firm take risks and make the investments to create new products or services)? The question will be posed to the key stakeholder.			Assess at a high level the degree of efficiency and the degree of innovation
Boer et al. 2010	**Exploratory strategies** 1. Cost (lower selling price) 2. Time (faster delivery) 3. Quality (superior quality and design) 4.Flexibility (greater order size flexibility) 5. Innovativeness (offer products that are more innovative) (Exploration-only firms score 4 or 5 for flexibility and innovativeness on a five-point Likert scale, and below 4 for quality, time and cost)	**Exploitative strategies** 1. Cost (lower selling price) 2. Time (faster delivery) 3. Quality (superior quality and design) 4.Flexibility (greater order size flexibility) 5. Innovativeness (offer products that are more innovative) (Exploitation-only when they scored at least 4 on a five-point Likert scale concerning time, cost and quality as order winners, but less than 4 on flexibility and innovativeness)	Realized	Firms that scored 4 or above on all five order winners
Kristal et al. 2010	**Supply Chain Exploitation Practices** 1. In order to stay competitive, our supply chain managers focus on reducing operational redundancies in our existing processes. 2. Leveraging of our current supply chain technologies is important to our firm's strategy. 3. In order to stay competitive, our supply chain managers focus on improving our existing technologies. 4. Our managers focus on developing stronger competencies in our existing supply chain processes.	**Supply Chain Exploration Practices** 1. We proactively pursue new supply chain solutions. 2. We continually experiment to find new solutions that will improve our supply chain. 3. To improve our supply chain, we continually explore for new opportunities. 4. We are constantly seeking novel approaches in order to solve supply chain problems.	Realized	x
E. Revilla et al. 2011	**Knowledge exploration strategies** 1. Project does an outstanding job uncovering product problem areas with which customer were dissatisfied. 2. Project does an outstanding job correcting product problem areas with which customer were dissatisfied. 3.Project incorporates new knowledge ,methods and inventions	**Knowledge exploitation strategies** 1. Project integrates new and existing ways of doing things without stifling their efficiency 2. Project put sin operation lessons learned in other areas of the organization 3. Project makes use of existing(technical and market)competences related to products/services that are currently being offered. 4. Project is able to identify valuable knowledge elements, connect and combine them.	Realized	+

Table A – OA main measures (OA measure is obtained by: "x" = multiplying; "| - |" = subtracting; "+" = adding the X1 and X2 scales)