Journal of Business Research xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Journal of Business Research

Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment☆

Alexander S. Alexiev [a,*], Henk W. Volberda [b], Frans A.J. Van den Bosch [b]

[a] VU University Amsterdam, The Netherlands
[b] Erasmus University Rotterdam, The Netherlands

ARTICLE INFO

Article history:
Received 1 November 2013
Received in revised form 1 January 2014
Accepted 1 July 2015
Available online xxxx

Keywords:
Firm innovativeness
Interorganizational collaboration
Environmental turbulence
Market heterogeneity
Competitive intensity
Organizational environment

ABSTRACT

In firm decisions to engage in interorganizational collaboration in the context of innovation, conceptions of the organizational environment play an essential role. In this paper, we develop a multidimensional model of how managers use interorganizational collaboration as an organizational response to particular environmental conditions and an important instrument to boost firm innovativeness. Based on a literature review on the subject, we investigated the role of environmental turbulence, market heterogeneity and competitive intensity as such conditions. The analysis of firm data from a broad range of industries showed that environmental turbulence and market heterogeneity have an indirect association with firm innovativeness through interorganizational collaboration. The relationship of market heterogeneity was fully mediated suggesting that collaboration is unavoidable for firms in heterogeneous markets. Contrary to arguments in the literature, the findings demonstrated that although competitive intensity is associated with less interorganizational collaboration and lower firm innovativeness, the mediation relationship was not significant.

1. Introduction

For many firms, improving innovativeness, or the capacity to introduce new products and services, is an issue of primary concern and a key source for competitive advantage and growth (Crossan & Apaydin, 2010; Damanpour, 1991). Both researchers and practitioners discuss the process of innovation and its extent relative to the boundaries of the organization as one of the main issues in innovation management (Crossan & Apaydin, 2010; Gupta, Tesluk, & Taylor, 2007). While some researchers have explored internal organization of innovation by examining portfolio-based (Faems, Van Looy, & Debackere, 2005) and project-based (Blindenbach-Driessen & Van Den Ende, 2010) approaches, others focus their attention on interorganizational forms of collaboration in the development and commercialization of new products and services (e.g. Ahuja, 2000; Powell, Koput, & Smith-Doer, 1996; Yli-Renko, Autio, & Sapienza, 2001). These studies discuss various outcomes that such strategy could cultivate, including: types of collaborations firms engage in (De Faria, Lima, & Santos, 2010; Un, Cuervo-Cazurra, & Asakawa, 2010), mechanisms for partner selection (Emden, Calantone, & Droge, 2006), value creation (Bhaskaran & Krishnan, 2009; Gadde, Hjelmgren, & Skarp, 2012; Sobrero & Roberts, 2002), and modification or termination of the interorganizational relationship (Young-Ybarra & Wiersema, 1999). These important advances notwithstanding, we still know much less about a firm's decision to engage in interorganizational collaboration and the conditions that motivate this choice (Fiedler & Welpe, 2010; Sriram, Krapfel, & Spekman, 1992).

The strategic choice perspective on organizational decision-making suggests that managers make strategic decisions by considering important dimensions of the organizational environment (Child, 1972, 1997; McCarthy, Lawrence, Wixted, & Gordon, 2010). Interorganizational collaboration is often such a strategic choice, but existing literature has not yet explored how managers' evaluations of different dimensions of the organizational environment are likely to influence it. Few studies investigate the simultaneous role of multiple environmental dimensions, although strategic choice theories suggest that this may be illuminating for key decision processes in organizations (Dess & Beard, 1984; Forbes, 2007; McCarthy et al., 2010).

Based on arguments in the literature, the study here investigates the role of environmental turbulence, market heterogeneity and competitive intensity as three environmental dimensions relevant for the context of interorganizational collaboration aimed at innovation. The study responds to a gap in the literature about more theory and evidence needed to better understand how firms make decisions for

☆ The authors are grateful to the comments on versions of this paper made by an anonymous reviewer, editors Arch Woodside and Roger Baxter, Brian Tjemkes, Oli Mihalache, Elco van Burg, as well as the participants of seminars at VU University Amsterdam, Imperial College London, the University of Lausanne, the Strategic Management Society (SMS) and the European Academy of Management (EURAM) conferences.

* Corresponding author at: VU University Amsterdam, FEWEB, Department of Management & Organization Studies, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands.
E-mail address: a.s.alexiev@vu.nl (A.S. Alexiev).

http://dx.doi.org/10.1016/j.jbusres.2015.09.002
0148-2963/

interorganizational collaboration and which dimensions of the environment managers are evaluating when deciding to collaborate with other organizations. In this paper, the relationships between these environmental characteristics and firm innovativeness are hypothesized and tested. The study proposes also that interorganizational collaboration plays an important role as a mediator of these relationships.

By doing this, the study here delivers three important contributions to the existing literature. First, the study contributes to research on interorganizational collaboration by offering a refined view on the role of the organizational environment in firm innovation strategy making and highlight collaboration as a bridge between the complexities in external conditions and firm innovativeness. This contribution is helpful for uncovering different mechanisms by which important environmental dimensions relate to firm innovativeness and how managers can successfully use interorganizational collaboration to this end. The present study proposes a model where interorganizational collaboration mediates between the decision makers' evaluations about environmental turbulence, market heterogeneity and competitive intensity on the one hand and firm innovativeness on the other. The study extends existing perspectives on the firms' choice to engage in interorganizational collaboration by exploring further how managers consider both the opportunities and threats of collaboration while aiming at reducing the information complexities that these costs and benefits might entail.

Second, the finer and multidimensional conceptualization of the organizational environment advanced in this study, allows to spotlight the different roles these dimensions may assume. Existing empirical research has often favored variables that characterize the environment in terms of turbulence while it has neglected other key strategic dimensions such as market heterogeneity and competition (Ang, 2008; Mehra & Floyd, 1998). Although existing works have studied the role of the environment in interorganizational collaboration, this paper elaborates further on the mechanisms which can show how collaboration can be a strategy to deal with the decision-making demands caused by its different dimensions.

Third, the study here offers empirical evidence for the studied relationships from multiple industries and firms of different sizes. Most existing studies may be limited in explaining only a fraction of a firm's motives for collaboration and in being biased toward larger and R&D-intensive firms (Frishammar & Åke Hörte, 2005; Van De Vrande, De Jong, Vanhaverbeke, & De Rochemont, 2009). However, many firms use collaboration strategies to bridge innovation deficiencies caused by the unavailability of large R&D investments. Furthermore, many organizations do not concentrate development within a separate R&D unit. In many service firms for instance, innovation streams are distributed across the organization and innovation may be based on the combination and exchange of intangible resources and co-production with external parties (Bowen & Ford, 2002; Sundbo, 1997; Van der Aa & Elfring, 2002). This paper provides a broader evidence base for the existing literature discussing interorganizational collaboration as a means to address the need to understand innovation processes beyond firm investments in proprietary R&D capabilities.

2. Theoretical framework

2.1. Interorganizational collaboration and the organizational environment

To elaborate the conceptual model, this study includes reviewing existing literature on the antecedents of interorganizational collaboration and how researchers conceptualize the organizational environment in these works. The definition of interorganizational collaboration adopts a distinction which encompasses the perspectives of innovation as a process and as an output (Crossan & Apaydin, 2010). In this paper, interorganizational collaboration is conceptualized as a feature of the innovation process related to the extent to which other organizations—firms or institutions—take an important part in the innovation process. Innovation activities can be also distributed across the organization and not necessarily concentrated in an R&D department (Den Hertog, 2000) and that interorganizational collaboration can be an aspect of these activities throughout the complete innovation value chain (Love, Roper, & Bryson, 2011; Roper, Du, & Love, 2008; West & Bogers, 2014). The argument in this paper is that an organization-wide conceptualization of the innovation process where interorganizational collaboration can be used at each stage of the innovation value chain (Hansen & Birkinshaw, 2007) allows for a framing of the innovation processes in organizations unbound by structural configurations that involve formalized R&D processes. "Firm innovativeness" is the outcome of the innovation process, defined as the capacity of the firm to develop and introduce new products or services.

The main premise of strategic choice theories (Child, 1972, 1997; Doty, Glick, & Huber, 1993; Venkatraman & Prescott, 1990) is that senior managers' reflection and understanding of the firm environment is what plays a critical role in shaping key organizational choices (Nadkarni & Barr, 2008). Some authors have warned against conflating various effects of the environment under a single construct (e.g. instability) (Atuahene-Gima & Li, 2004; Forbes, 2007). Researchers have argued that the organizational environment has multiple dimensions and that the different kinds of information associated with these dimensions can affect the managerial processes underlying strategic decision-making (Huber & Daft, 1987; McCarthy et al., 2010). As interorganizational collaboration is a strategic decision which involves investments in organizing and coordinating innovation activities as well as initiating and managing relationships with external parties, the conditions in which managers make these choices are of important concern. Based on a review of the literature, this argument in this paper is that the decision for interorganizational collaboration in the pursuit of innovativeness can be theoretically related to three important dimensions of the environment. These are environmental turbulence, market heterogeneity and competitive intensity.

2.2. Environmental turbulence

Environmental turbulence is one aspect of the organizational environment that can be related to firm innovativeness and a firm's choice for interorganizational collaboration. Frequent shifts and multiple changes in markets pose heavy demands on the cognitive capacity of senior managers to process and integrate information in the strategic decision-making process. Managers that recognize this challenge and are aware that a comprehensive gathering of information is unattainable are able to design organizational responses to it. These responses include establishing and maintaining interorganizational collaboration relationships with external parties. When quantity or determinacy of the available information from the environment is low, there is a shift from "making the so-called 'right' decision toward managing the strategy-making process" (Mosakowski, 1997: 414). For managers to build elaborate internal structures to track, analyze and integrate environmental information in their decision-making makes little sense (Forbes, 2007). Nonetheless, the need to stay abreast of environmental changes remains critical as failing to do so may directly threaten the survival of the organization. Increasing innovation is a typical response strategy in such turbulent markets. As managers have to quickly execute decisions without a full understanding of the causal links to important strategic outcomes (Eisenhardt, 1989), they can use interorganizational collaboration to trade their comprehensive understanding and control over the environmental information for an increased responsiveness and adaptability. Building an internal capability for sensing market shifts is therefore less efficient than engaging in collaborations with external parties that might be better able to provide timely and valuable information or offer specialized forecasts of market changes (Burt, 1992, 2004; Nahapiet & Ghoshal, 1998). For example, a firm may collaborate with a market research firm rather than invest in the firm's capability for observing market changes. Although choosing partners under uncertainty is based on heuristics, having access to

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

external information allows managers to address some of the complexities of decision-making that a turbulent environment brings (McCarthy et al., 2010).

Managers would also prefer collaborative form of exchange to arm's length relationships as trusting and close ties are conducive to higher volume and the quality of information exchanged (Hansen, 1999). Joshi and Campbell (2003) have shown that environmental turbulence can have a positive effect on the partnerships between manufacturers and their suppliers as suppliers can learn on the basis of the relational norms and expectations developed in these partnerships. Engaging in collaboration aimed at innovation requires mutual trust which allows both sides to exchange sensitive and elaborate strategic information. Mitchell, Shepherd, and Sharfman (2011) report that in turbulent environments, managers are able to tune out distractions more readily and make more consistent and less erratic decisions, which signals their trustworthiness and increases their chance of being selected as a partner in collaboration. Interorganizational collaboration would thus be utilized as one mechanism to help explain the link between environmental turbulence and firm innovativeness.

Hypothesis 1. Interorganizational collaboration partially mediates the positive relationship between environmental turbulence and firm innovativeness.

2.3. Market heterogeneity

Market heterogeneity is another dimension of a firm's environment with relevance to firm innovativeness. Firms in heterogeneous markets face differences in the customer preferences, in the production possibilities, and in the technological solutions to approach the preferences (Miller & Friesen, 1983). Market heterogeneity accordingly increases the complexity of the organizational environment as managers need to gather and process more information in order to develop distinctive competitive strategies for each target customer segment. As firms develop these distinctive strategies, the cumulative effect on industry level would be that stratification is observed and strategic groups formed (Fombrun & Zajac, 1987; Mehra & Floyd, 1998; Porac & Thomas, 1990). Within a strategic group, firms follow the same or similar strategies and create mobility barriers with respect to other groups (Caves & Porter, 1977; Porter, 1980). These barriers protect the firms inside the group and shifts across market segments are difficult as firms would need to process and integrate heterogeneous market information and deploy resources that match that variety, which is costly. Under such conditions managers are more likely to use collaborative relationships as a way to cope with the lack of knowledge and information about market segments where they are not active. In services for instance, repeated interactions between customers and vendors can influence the perceptions of service quality and the preference for a particular vendor (Ruiz, Castro, & Armario, 2007). For instance, when an IT consultant would like to explore the healthcare market segment but has traditionally serviced government clients, they may seek to collaborate with a party that has strong positions in the desired market segment. Market heterogeneity can therefore motivate a firm to engage in collaboration with others rather than attempt to understand or access a particular market segment alone.

Another aspect of the decision difficulties caused by heterogeneous market conditions has roots in the need to obtain and process information related to the firm's legitimacy in each of the markets it serves (Singh, Tucker, & House, 1986). For example, in geographically segmented markets a multinational organization needs to be aware of aspects of the regulatory environments in each host country that it operates (Kostova & Zaheer, 1999). Coping strategies involve conforming through mimicking, professionalization and formalization or avoidance of a specific segment altogether (Suchman, 1995). These strategies can be costly, difficult to implement or dilute the newness of the innovation under development (Ceci & Masini, 2011). Collaboration with a legitimate partner for that segment can be an effective way to overcome this liability. Firms establish collaboration relationships motivated by the need to overcome the legitimacy barriers for the various market segments. Firms will therefore use interorganizational collaboration to respond to market heterogeneity and increase their innovativeness.

Hypothesis 2. Interorganizational collaboration partially mediates the positive relationship between market heterogeneity and firm innovativeness.

2.4. Competitive intensity

Competitive intensity is a third important environmental aspect. Competition contributes to the complexity of the decision-making process as innovating firms need to create, utilize and recombine knowledge while at the same time consider the threats of competition (Eisenhardt & Brown, 1998; Jaworski & Kohli, 1993; Porter, 1985, 1991). Under intense competition, uncertainty is increased by the chance of opportunism and the lack of protection for a firm's knowledge resources (Madhok, 2002; West & Gallagher, 2006). If firms collaborate with other firms, they need to expose proprietary knowledge to each other in order to achieve fruitful and novel new combinations. If managers sense strong competition in their surrounding environment it could undermine the potential knowledge gains from interorganizational collaboration. The activation of relevant capabilities that is needed for a fruitful interorganizational knowledge exchange and combination would be endangered if competitive intensity is high (Davis & Eisenhardt, 2011; Khanna, Gulati, & Nohria, 1998). Managers would be more likely to see collaboration as a threat and avoid it in competitive environments.

Hypothesis 3a. Interorganizational collaboration partially mediates the negative relationship between competitive intensity and firm innovativeness.

Alternatively, in highly competitive environments it would make sense for managers to intensify interorganizational collaboration. As managers are aware that it is impossible to fully protect their knowledge from the competition, they may choose to selectively reveal information in exchange to access to other relevant information that could potentially provide them with a competitive edge (Alexy, George, & Salter, 2013; Henkel, 2006). In many sectors, appropriability regimes are weak and refusing collaboration may consequently limit the potential for innovation.

Some firms may opt for collaborating with their competitors specifically for strategic advantages. As Ingram and Roberts (2000) exemplify, collaboration among competitors in the Sydney hotel industry improved performance due to the increased information exchange. Co-opting tactics can allow firms to be aware of the next competitor moves. Collaboration can therefore be a conscious strategic choice aimed at mitigating competition as an alternative to isolating the organization and attempting to protect its own proprietary knowledge. Managers would therefore increase interorganizational collaboration in an organizational environment characterized with competitive intensity. That, in turn, will increase firm innovativeness.

Hypothesis 3b. Interorganizational collaboration partially mediates the positive relationship between competitive intensity and firm innovativeness.

3. Method

3.1. Data collection and sample

To test the hypotheses, the study uses a sampling frame of firms with more than 25 full-time employees from multiple industries in The

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

Netherlands. In this way, the research design captures a wider variation of interorganizational collaboration compared to a single-industry sampling frame. A sample of four thousand firms was drawn randomly from the REACH electronic database and data was collected through a survey as well as secondary sources. To measure senior managers' beliefs about the organizational environment the questionnaire was addressed to executives with a CEO, general manager or senior management function. The database contained addresses of the firms' senior management teams. The survey was administered by mail accompanied by a letter explaining the purpose of the study and encouraging participation by promising a report with a summary of the results. Participation was also stimulated by a reminder note and follow-up telephone calls two weeks after the initial letter was sent. Survey responses were obtained from 405 firms (10.1% response rate) and after excluding incomplete surveys, usable responses covered 391 firms. Classified based on their industry codes, the firms represented manufacturing (51.7%), construction (16.6%), business services (10.2%), financial services (8.4%), transportation (6.6%), trade (5.4%), and other (1.0%) industries. The firms had on average 690 full-time employees, ranging between 25 and 63,386 employees. The average age of the firms was 39.5 years, ranging between 1 and 204 years since founding. The respondents in the final sample included executives with functions such as CEO (35.3%), General Manager (21.2%), Managing director (3.7%) and other senior management (39.8%). The majority of the executives held a higher education degree (47.1% having bachelors, 37.1% having master, 13.5% having lower degree). Their average age was 46.6 years, and the average tenure in the organization was 13.7 years with 18 years average industry experience.

To test for a non-response bias differences were examined between respondent and non-respondent firms. A t-test showed no significant differences ($p > 0.05$) between the two groups based on the number of full-time employees and years since the firm's founding. The study compared early and late respondents in terms of demographic characteristics and model variables. These comparisons did not reveal any significant differences ($p > 0.05$), indicating that differences between respondents were not related to a non-response bias. To tackle a single informant bias, the firms were asked to provide one additional respondent to fill in the survey. The validation survey had a response rate of 48 completed questionnaires (11.9% of the sample) from firms that were comparable in size and age to the full sample. An inter-rater agreement score r_{wg} was computed for each multi-item variable (James, Demaree, & Wolf, 1993). The measurement varies from 0 ("no agreement") to 1 ("perfect agreement"). Median inter-rater agreement in the sample ranged between 0.89 and 0.94, which suggests high agreement. The examination of intra-class correlations also revealed a strong level of inter-rater reliability: correlations were consistently significant at the 0.001 level (Jones, Johnson, Butler, & Main, 1983).

The analyses included examining the potential for occurrences of common method bias by performing Harman's one-factor test on items included in the model to examine whether common method bias augmented relationships. The test found multiple factors with the first factor not accounting for the majority of variance. Furthermore, a test was performed to assess whether the addition of a single latent method factor connected with all the item scales would significantly improve the fit over a model with the studied constructs as latent factors (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Widaman, 1985). The overall chi-square fit statistics for the model with the common method factor was significant (χ^2/d.f. = 2.055, CFI = 0.91, RMSEA = 0.05) however the incremental fit index had a rho of 0.001, which suggests non-significant improvement. Additionally, the factor loadings for the studied constructs remained significant even after the method effect was considered. These results suggest that although method bias may be present, it does not cause considerable concern about the study's findings and the respondents were able to differentiate well between the concepts.

3.2. Model

A structural equation modeling approach (SEM) and maximum likelihood method were used to estimate the model with AMOS 18. This technique allows for simultaneous estimation of relationships among latent constructs and other observable variables. Structural modeling also accounts for the biasing effect of random measurement error in the latent constructs and is a common technique to address important measurement and structural issues in survey-designed research (Shook, Ketchen, Hult, & Kacmar, 2004).

The test for the mediating hypotheses included two steps. First, models estimated how environmental turbulence, market heterogeneity and competitive intensity relate to interorganizational collaboration. The control variables were the firm age and size, as well as its breadth and depth of knowledge base (Laursen & Salter, 2006). The model controlled additionally for individual differences stemming from the respondent by including measures for the executive's age and tenure. Second, nested models were built that included the relationship between the three environment variables and interorganizational collaboration with firm innovativeness. By comparing the fit of the nested models, the presence of a mediation relationship was assessed. The model estimated whether interorganizational collaboration would also mediate the relationships between the covariates and firm innovativeness.

3.3. Measures

The core concepts in the model were measured through multi-item perceptual scales in the survey instrument. For the established concepts, the measurements were derived from existing literature while the measurements for interorganizational collaboration were constructed. The scales were subjected to validation and reliability analyses.

3.3.1. Interorganizational collaboration

Existing measurements of interorganizational collaboration are often focused on collaboration engagements with specific categories of partners such as between R&D labs and universities. Within certain industries partnerships in innovation can be easily classified and this can adequately capture interorganizational collaboration. However, in a multi-industry sample, which includes many service organizations, such classification would not include the broad variety of collaboration practices firms might employ. To deal with this issue, the study operationalizes interorganizational collaboration as the degree of importance of other organizations for the various stages of the innovation process of the firm (West & Bogers, 2014). For the measure, multiple items on a seven-point scale were generated. The respondents were asked to assess directly the role of external parties at key stages of the innovation value chain such as product or service development, production, marketing, distribution and supply. The scale was pre-tested through interviews with managers and other researchers. Interviewees were asked to identify questions that were ambiguous or that might yield inconsistent responses. They could also suggest possible refinements to the wording of each question or propose new questions that might be added to the scale. This procedure helped improve the wording and eliminate unclear items from the scale. The resulting scale included six items, which are listed in Appendix A. An exploratory factor analysis into the dimensionality of the items showed that they loaded on a single dimension with item loadings ranging from 0.75 to 0.83.

3.3.2. Firm innovativeness

The scale for firm innovativeness is based on previous studies (Abernathy & Clark, 1985; Benner & Tushman, 2003; Danneels, 2002; Jansen, Van Den Bosch, & Volberda, 2006; Love & Roper, 2001) by measuring innovation as an organizational outcome, that is, the degree to which a firm has succeeded in introducing new products, services, processes or has reached out to new markets. Four items capture

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

these characteristics (also listed in Appendix A). Factor loadings for this scale ranged between 0.78 and 0.88.

3.3.3. Organizational environment

For the variables measuring the senior managers' evaluations of the organizational environment, the scales were adopted from existing studies (Dill, 1958; Jaworski & Kohli, 1993). The scale for "environmental turbulence" measured the degree of instability and changes that senior managers observe in the marketplace. It includes three items that asked respondents whether they agreed if: a. changes in the marketplace were very intensive; b. customers regularly demanded completely new products and/or services; and c. changes in the marketplace were continuously occurring. For "market heterogeneity", the respondents were asked to rate three items in whether: a. their organization operated in distinctive customer segments; b. significant differences could be observed in customer needs; and c. the nature of competition varied widely in different market segments. "Competitive intensity" was measured with three items that tapped into the extent to which the firms of the respondents experienced competition in their industry. The respondents were asked whether they agreed if: a. their competitors were very strong; b. competition in their market environment was severe; and c. price competition was the hallmark of their industry.

3.3.4. Controls

The control variables were measured with data from the survey and secondary data available through the electronic database. The models included three variables related to the knowledge perspective on collaboration, which have been shown in previous literature to be relevant in this context (Laursen & Salter, 2006; Rosenkopf & Nerkar, 2001). "Knowledge search" was measured with two items: "Knowledge is gathered by our organization in various ways" and "Our organization collects information through informal channels". "Depth" and "breadth of knowledge base" were measured by prompting respondents to evaluate knowledge in the organization in general on 7-point scales anchored in "simple-advanced", "uncomplicated-complex", "superficial-deep" for depth and "narrow-broad", "specialized-varied", "homogenous-diverse" for breadth. "Firm size" was measured with the logarithm of the number of full-time employees as larger companies might have a larger capacity to engage in open collaborations. "Firm age" represented a proxy for the accumulated organizational experience and was measured by the logarithm of the number of years since founding. For personal characteristics of the executive, "tenure" and "age" were used.

4. Results

4.1. Measurement model

With the measurement model, latent variables were constructed from measured observable items that reflect the theoretical concepts in this study. In total there are eight latent variables and 27 individual underlying items. For the model as a whole, several indexes were used to assess its overall fit. These indexes included chi-squared (χ^2), the incremental fit index (IFI), the Tucker–Lewis index (TLI), comparative fit index (CFI) and the root-mean-square error of approximation (RMSEA). When a model fits well with the data from the sample, the IFI, TLI, and CFI are expected to equal 1.0, and RMSEA is expected to equal 0.0. Although standard criteria for these indexes are difficult to establish, it is suggested that values above 0.90 for IFI, TLI, and CFI and below 0.08 for RMSEA represent an adequate fit (Hu & Bentler, 1999). The indexes that the measurement model produced suggest an adequate fit ($\chi^2 = 847.5$, d.f. $= 410$, $p < 0.001$, IFI $= 0.91$, TLI $= 0.90$, CFI $= 0.91$, RMSEA $= 0.05$).

Having accepted the measurement model, each construct's indicator loadings as well as its internal consistency and discriminant validity were evaluated (see Table 1). All of the indicator loadings for the constructs were statistically significant ($p < 0.001$). Three widely-used measures indicated internal consistency: Cronbach's alpha, composite reliability, and average variance extracted (AVE) (Fornell & Larcker, 1981; Nunnally & Bernstein, 1994) (Table 1). Cronbach's alpha was calculated using standardized item scores. All latent variables had alpha scores above the common threshold of 0.70 except for knowledge search and breadth of knowledge base which have alphas of 0.65 and 0.68 respectively. Composite reliability (ρ_c) for each latent variable was calculated by dividing the squared sum of the individual standardized loadings by the sum of the variance of their error terms and the squared sum of the individual standardized loadings (Fornell & Larcker, 1981). The values for all latent variables exceeded the threshold value of 0.70, again except for knowledge search and breadth of knowledge base which have composite reliabilities of 0.65 and 0.68 respectively. The Cronbach's alpha and composite reliability tests show that the latent variables have adequate internal consistency. Although the measures for the two control variables, knowledge search and breadth of knowledge base, are slightly lower than 0.70, they are very close to the threshold level and the slight inconsistency can be related to the fact that the search may comprise a wide range of activities (e.g. Jansen, Van Den Bosch, & Volberda, 2005; Sidhu, Commandeur, & Volberda, 2007) which makes it difficult to capture it with a small number of items. Average variance extracted (AVE) (ρ_{ave}) was calculated by

Table 1
Results of measurement model.

	Latent variables	Mean	s.d.	Number of items	Cronbach's alpha	Composite reliability	Average variance extracted	Correlations between latent variables (square root of average variance extracted in the diagonal)							
								(η_1)	(η_2)	(ξ_1)	(ξ_2)	(ξ_3)	(ξ_4)	(ξ_5)	(ξ_6)
	Dependent variables														
(η_1)	Interorganizational collaboration	3.58	1.36	6	.88	.88	.56	.75							
(η_2)	Firm innovativeness	4.30	1.25	4	.84	.84	.57	.39	.75						
	Organizational environment														
(ξ_1)	Environmental turbulence	4.23	1.34	3	.82	.83	.62	.29	.49	.79					
(ξ_2)	Market heterogeneity	4.85	1.24	3	.74	.74	.49	.33	.32	.35	.70				
(ξ_3)	Competitive intensity	5.66	1.18	3	.90	.90	.75	.02	.04	.33	.20	.87			
	Controls														
(ξ_4)	Knowledge search	5.17	1.03	2	.65	.65	.48	.18	.36	.29	.22	.36	.69		
(ξ_5)	Depth of knowledge base	4.92	1.06	3	.86	.86	.68	.20	.24	.31	.19	.08	.27	.82	
(ξ_6)	Breadth of knowledge base	4.48	1.12	3	.68	.68	.41	.15	.16	.43	.24	.33	.26	.38	.64

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

Table 2
Summary of fit indexes for contrasts based on the hypothesized model.

Model	d.f.	χ^2	CFI	IFI	TLI	RMSEA	Comparison	$\Delta\chi^2$	Δ d.f.	R^2 in firm innovativeness
Covariates only										
Model 1	410	686.40***	.94	.94	.94	.04				.155
Covariates plus										
Model 2: environmental turbulence, market heterogeneity, and competitive intensity to interorganizational collaboration	407	654.09***	.95	.95	.94	.04	Model 2 vs. 1	32.31***	3	
Model 3 (full mediation): Model 2 + interorganizational collaboration to firm innovativeness	406	613.46***	.96	.96	.95	.04	Model 3 vs. 2	40.63***	1	.245
Model 4a (partial mediation environmental turbulence): Model 3 + environmental turbulence to firm innovativeness	**405**	**570.59*** **	**.97**	**.97**	**.96**	**.03**	**Model 4a vs. 3**	**42.87*** **	**1**	**.342**
Model 4b (partial mediation market heterogeneity): Model 3 + market heterogeneity to firm innovativeness	405	603.22***	.96	.96	.95	.04	Model 4b vs. 3	10.24**	1	.264
Model 4c (partial mediation competitive intensity): Model 3 + competitive intensity to firm innovativeness	405	612.30***	.96	.96	.95	.04	Model 4c vs. 3	1.16	1	.254
Model 5a (partial mediation environmental turbulence & market heterogeneity): Model 3 + environmental turbulence to firm innovativeness + market heterogeneity to firm innovativeness	404	568.52***	.97	.97	.96	.03	Model 5a vs. 3	44.94***	2	.343
Model 5b (partial mediation environmental turbulence & competitive intensity): Model 3 + environmental turbulence to firm innovativeness + competitive intensity to firm innovativeness	**404**	**561.84*** **	**.97**	**.97**	**.96**	**.03**	**Model 5b vs. 3**	**51.62*** **	**2**	**.376**
Model 5c (partial mediation market heterogeneity & competitive intensity): Model 3 + market heterogeneity to firm innovativeness + competitive intensity to firm innovativeness	404	600.18***	.96	.96	.95	.04	Model 5c vs. 3	13.28**	2	.282
Model 6 (partial mediation environmental turbulence, market heterogeneity & competitive intensity): Model 3 + environmental turbulence to firm innovativeness + market heterogeneity to firm innovativeness + competitive intensity to firm innovativeness	**403**	**558.50*** **	**.97**	**.97**	**.96**	**.03**	**Model 6 vs. 3**	**54.96*** **	**3**	**.379**

** $p < .01$.
*** $p < .001$.

dividing the sum of the squared individual standardized loadings by the sum of the variance of their error terms and the squared sum of the individual standardized loadings. AVE measures the amount of variance retained by the latent construct relative to the variance remaining from measurement error. When the former exceeds the latter, i.e. AVE is above 0.50, it can be concluded that the latent variable captures a larger portion of the available variance (Fornell & Larcker, 1981) which indicates adequate convergent validity. All latent variables showed satisfactory convergent validity while market heterogeneity, knowledge search and breadth of knowledge base resided slightly lower than the threshold AVE (Table 1).

To evaluate discriminant validity, i.e. the extent to which the latent variables are distinct constructs, the variances among the constructs were compared with the variances shared by the constructs and their respective individual items (the AVE). In Table 1, the correlations among the latent variables are juxtaposed with the square root of AVE for each of them, shown on the diagonal in the table. The latent constructs demonstrate adequate discriminant validity as no diagonal element is smaller than the off-diagonal elements in the corresponding rows and columns.

4.2. Structural models and hypothesis testing

Next, a series of nested structural models were evaluated in order to establish which structure best accounts for the observed variation among the latent constructs in the hypothesized model. The focus was on two elements of criteria. First, the goodness-of-fit was evaluated from the series of nested models by the means of various fit indexes. Second, the significance of the standardized estimates of the path coefficients were examined as tests for the hypotheses. The series consists of 6 nested models wherein constraints in each subsequent model were reduced by allowing for additional paths among the latent constructs. Table 2 displays the various fit indexes for each of these models. Models 4 and 5 consist of three sub-models depending on which additional paths were introduced.

The first structural model (Model 1, Table 2) is a covariates model consisting only of the paths from the control variables to the two endogenous variables. This model accounts for 16% of the variance in firm innovativeness and 7% of the variance in interorganizational collaboration. In Model 2, the paths from environmental turbulence, market heterogeneity, and competitive intensity in interorganizational collaboration were added. These paths were significant: environmental turbulence was positively related (0.17, $p < 0.05$), market heterogeneity was positively related (0.27, $p < 0.001$), while competitive intensity was negatively related (−0.15, $p < 0.05$) to interorganizational collaboration. The three paths contributed for a 10% increase in the variance explained in interorganizational collaboration. In Model 3, the path between interorganizational collaboration and firm innovativeness was added. This relationship was positively significant (0.36, $p < 0.001$) as it contributed a 9% increase in the variance explained in firm innovativeness. To investigate the nature of the mediation role of interorganizational collaboration for the relationships between the three environment variables and firm innovativeness, Models 4, 5, and 6 were built. In Models 4a, 4b, and 4c, one additional constraint was eliminated by adding direct paths from environmental turbulence, market heterogeneity and competitive intensity respectively to firm innovativeness. In Models 5a, 5b, and 5c, two direct paths to firm innovativeness were added. All three direct paths were present in Model 6. To evaluate these models, each of them was contrasted with the fully-mediated model (Model 3). Models 4a, 5b, and 6 showed the largest significant improvement at each step relative to the fully-mediated model (Model 3). Next, these three models were compared among each other. Model 5b demonstrated a significantly better fit than Model 4a ($\Delta\chi^2 = 8.75$, d.f. = 1, $p < 0.01$), while Model 6 did not have a significantly better fit ($\Delta\chi^2 = 3.34$, d.f. = 1, $p > 0.05$). As a result, Model 5b was

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

used to interpret the result of the mediation hypotheses. Table 3 presents the path coefficients in the structural model.

In Model 5b, the relationships between market dynamism and firm innovativeness, along with between competitive intensity and firm innovativeness are partially mediated by interorganizational collaboration. The relationship between market heterogeneity and firm innovativeness is fully mediated by interorganizational collaboration. Hypothesis 2, Hypothesis 3a and Hypothesis 3b do not receive support while Hypothesis 1 receives support. The resulting structural model appears in Fig. 1.

In addition to the analyses of the nested structural models, bootstrapping Sobel tests were performed on the coefficients in the mediated relationships in order to see to what extent the indirect effects were significant (Hayes, 2009). The fully mediated indirect effect of market heterogeneity and the partially mediated effect of environmental turbulence were significant ($p < 0.05$). The partially mediated indirect effect of competitive intensity was not significantly different from zero ($p > 0.05$). Although interorganizational collaboration is significantly negatively related to competitive intensity, this does not play a role in its relationship with firm innovativeness.

4.3. Post-hoc analyses

To control for the robustness of the model, several post-hoc analyses were conducted. First, the model was estimated with additional control variables: prior performance and R&D investments as percentage of revenue. In addition, industry effects were examined by re-estimating the model through splitting the sample between manufacturing and service firms as well as building regression models with industry dummies. None of these improved the models or altered the significance of the studied relationships. Second, regression models were built where the interactions between the environment variables were tested. None of these had significant effects. Finally, also through regression models, curvilinear effects of the environment variables with interorganizational collaboration and with firm innovativeness were examined. Two relationships were significant. First, competitive intensity had an inverted-U relationship with interorganizational collaboration. Slope analysis showed that the peak of the curve was at very low values of competitive intensity. In essence, at low values the effect was flat while at high values the slope was decreasing. The relationship is thus in essence negative for the observable part of the scale and this supports the hypothesis. Second, market heterogeneity had a significant curvilinear relationship as well. It was also inverted-U-shaped peaking at very high levels of market heterogeneity, demonstrating a positive relationship with decreasing returns between market heterogeneity and interorganizational collaboration.

Structural equation modeling and multiple regression analysis (MRA) are fitting approaches and suffer severe limitations with respect to validity if they are used for predictions (Messick, 1995). A possible remedy to such limitations is complementing the fitting approach with algorithms (Woodside, 2011; Woodside, 2013). To examine the suitability of the model for prediction, several steps were taken. First, the sample was split in two sub-samples based on a random selection of cases. The first sample had 195 observations and the second had 196 observations. The estimated parameters of the model retained their strength with the exception of the relationships between environmental turbulence and interorganizational collaboration in the first subsample and between competitive intensity and interorganizational collaboration in the second sub-sample. Both remained positive but were not significant ($p > 0.10$). Second, to further explore the variation in the correlations, a bootstrapping algorithm was implemented. The algorithm included drawing 2000 random sub-samples from the data, with replacement, and estimating 95% confidence intervals for the parameters using the bias-corrected percentile method. For all estimates of the hypothesized relationships, the confidence intervals obtained by the bootstrap did not include the zero point, which indicates stability of the conclusions across the bootstrap samples. In the case of the relationships of environmental turbulence and competitive intensity with interorganizational collaboration, however, a large variation of the correlations was observed. These results provide additional evidence for the weak or no mediation relationship respectively, which was concluded previously. On the other hand, the confidence interval for the relationship of market heterogeneity with interorganizational collaboration was much narrower and distant from the zero point. This supports the conclusion for a full mediation.

5. Discussion

Although the study of the role of the organizational environment for firm strategy has a long-standing tradition in the literature, it is only

Table 3
Structural model paths.

Hypothesis		Independent variables			Dependent variable	Unstandardized regression weight	Standard error	Critical ratio	p-Value	Standardized regression weight
Hypothesis 1	(ξ_1)	Environmental turbulence	→	(η_1)	Interorganizational collaboration	.18	.07	2.53	.01	.18
Hypothesis 2	(ξ_2)	Market heterogeneity	→	(η_1)	Interorganizational collaboration	.30	.07	4.10	***	.28
Hypothesis 3a and Hypothesis 3b	(ξ_3)	Competitive intensity	→	(η_1)	Interorganizational collaboration	−.19	.08	−2.28	.02	−.15
Hypothesis 1, Hypothesis 2, Hypothesis 3a, Hypothesis 3b	(η_1)	Interorganizational collaboration	→	(η_2)	Firm innovativeness	.21	.05	4.35	***	.25
Hypothesis 1	(ξ_1)	Environmental turbulence	→	(η_2)	Firm innovativeness	.40	.06	6.79	***	.46
Hypothesis 3a, Hypothesis 3b	(ξ_3)	Competitive intensity	→	(η_2)	Firm innovativeness	−.19	.07	−2.95	.00	−.18
Additional controls										
	(ξ_4)	Knowledge search	→	(η_1)	Interorganizational collaboration	.14	.10	1.35	.18	.10
	(ξ_5)	Depth of knowledge base	→	(η_1)	Interorganizational collaboration	.12	.08	1.43	.15	.09
	(ξ_6)	Breadth of knowledge base	→	(η_1)	Interorganizational collaboration	.01	.12	.07	.95	.01
	(ξ_7)	Firm size	→	(η_1)	Interorganizational collaboration	−.02	.05	−.39	.70	−.02
	(ξ_8)	Firm age	→	(η_1)	Interorganizational collaboration	.02	.07	.30	.77	.02
	(ξ_9)	Executive age	→	(η_1)	Interorganizational collaboration	.02	.01	1.79	.07	.11
	(ξ_{10})	Executive tenure	→	(η_1)	Interorganizational collaboration	−.01	.01	−1.28	.20	−.08
	(ξ_4)	Knowledge search	→	(η_2)	Firm innovativeness	.36	.09	3.85	***	.30
	(ξ_5)	Depth of knowledge base	→	(η_2)	Firm innovativeness	.02	.06	.28	.78	.02
	(ξ_6)	Breadth of knowledge base	→	(η_2)	Firm innovativeness	−.09	.09	−.94	.35	−.07
	(ξ_7)	Firm size	→	(η_2)	Firm innovativeness	−.02	.04	−.44	.66	−.02
	(ξ_8)	Firm age	→	(η_2)	Firm innovativeness	.01	.05	.17	.86	.01
	(ξ_9)	Executive age	→	(η_2)	Firm innovativeness	.00	.01	−.32	.75	−.02
	(ξ_{10})	Executive tenure	→	(η_2)	Firm innovativeness	.00	.01	.29	.77	.02

***$p < .001$.

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

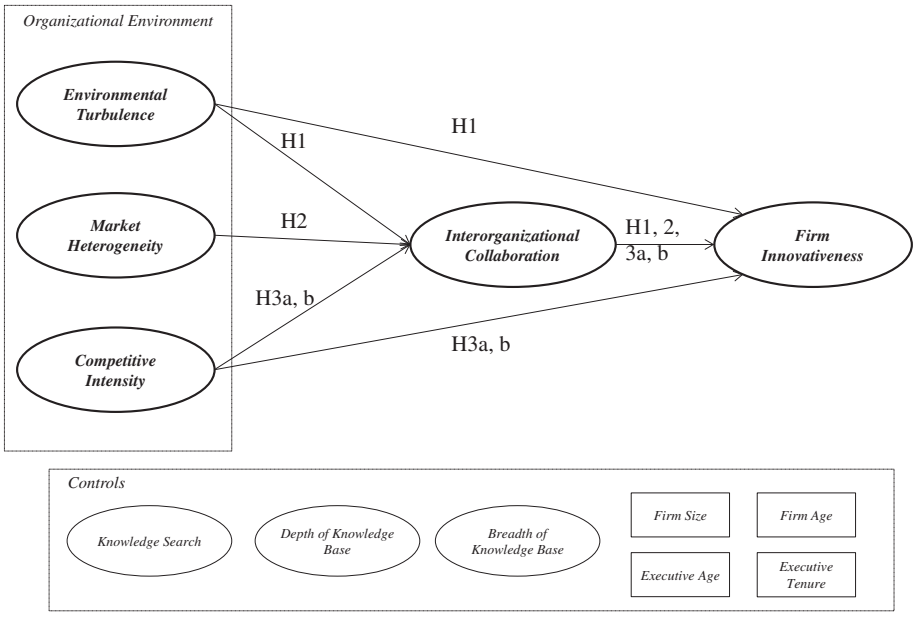

Fig. 1. Structural model[a] [a]Some linkages in the path diagram are omitted in the figure for visual clarity. Control variables are linked to both dependent variables. The structural model also estimated the covariances among the exogenous latent constructs which are also not displayed in the figure.

recently that researchers have focused on distinguishing the effects of different environmental dimensions on the choices that firms make (McCarthy et al., 2010). By integrating insights from information processing and strategic choice theory, the study builds a conceptual model that emphasizes interorganizational collaboration as an important intervening mechanism between managers' concerns about their organization's environment and firm innovativeness. The findings raise several important issues for theory and management practice.

First, within the innovation management literature, this study reaffirms the role of interorganizational collaboration for achieving important organizational objectives. Despite the increase in attention to external relationships, firm-level empirical evidence on the effects of open forms of organizing innovation is scant (Chesbrough, Vanhaverbeke, & West, 2006; West & Bogers, 2014). The findings in the present study show that when firms used interorganizational collaboration in their innovation process they excelled in firm innovativeness as well. This additional evidence in the consequences of interorganizational collaboration for the firm can further strengthen the legitimacy of this growing field of research. This study adds to other research that has attempted to show systematically and rigorously the performance effects of processes and configurations related to firm openness (Faems et al., 2005; Un et al., 2010; Van De Vrande et al., 2009).

Second, the study here provides insights into the decisions of firms to extend their innovation process beyond their organizational boundaries. The theory adds to existing views that have predominantly focused on the broad or deep knowledge search trajectories complementary to an organization's investments in R&D (Cassiman & Veugelers, 2006; Cohen & Levinthal, 1990; Rosenkopf & Nerkar, 2001). The findings show that managers can also have strategic considerations regarding whether or not to engage in interorganizational collaborations based on their evaluations of the firm environment. The study here contributes by identifying specific mechanisms by which these evaluations of the organizational environment can play a role. By focusing on multiple dimensions of the environment, the study renders a more holistic view in which market and competition knowledge are as important as environmental turbulence when managers discuss interorganizational collaboration as a strategic option.

In particular, the findings here show that interorganizational collaboration fully mediates the link between market heterogeneity and firm innovativeness, suggesting that firms face considerable difficulties to innovate alone when markets are fragmented. They need to turn to interorganizational collaboration in order to overcome mobility barriers existing between strategic groups and establish cognitive legitimacy of their offerings in new market segments (Fombrun & Zajac, 1987; Mehra & Floyd, 1998; Porac & Thomas, 1990). The findings for the role of environmental turbulence were of a partial mediation relationship. This shows that interorganizational collaboration is not the only mechanism that firms use to address decision difficulties caused by instability in the market environment. Future studies need to explore other strategies that managers of such firms use in this respect. Simerly and Li (2000) suggest that firms can use capital structure, that is, by seeking more equity finance to allow themselves make concealed strategic moves in order to outsmart their competition. These moves are risky and are aimed at utilizing blind spots and may include aggressive innovation and product proliferation. Innovation is then an instrument for creating competitive uncertainty rather than an outcome aimed at ensuring the long-term survival and adaptability of the firm. Interorganizational collaboration is then not necessary nor instrumental for achieving that goal. The analysis of competitive intensity showed that it is related to less interorganizational collaboration and innovativeness while demonstrating that there is no mediation relationship. This finding is somewhat surprising as it counters the information processing argument made in Hypothesis 3b. For many firms, competition remains a major threat to innovativeness yet the managers sampled in this study were less concerned with the information benefits of initiating and maintaining collaboration linkages. Under competitive intensity, relations between organizations are more often seen as a zero-sum game, whereby organizations vie for the same pool of resources (Barnett, 1997). Mitchell et al. (2011) found that in competitive environments, managers make more erratic decisions which can also decrease their trustworthiness as partners. Nonetheless, interorganizational collaboration is not associated as a mediating variable in the relationship between competitive intensity and firm innovativeness. Lack of interorganizational collaboration is therefore not a mechanism that can explain why firms have less innovative output when they face intensive

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

competition. Future research can delve more into these findings in order to provide further explanation.

Finally, this study provides some additional evidence that perceptions of competition, market structure and environmental change are important in organizational choice and decision-making. Besides knowledge and learning entities (Kogut & Zander, 1992, 1996), firms also have strategic considerations when they follow their innovation and learning strategies. These strategic considerations are highly personalized and subjective, counter to what positioning and industrial organization (IO) views on strategy argue (e.g. Porter, 1980). Future studies could focus on the question to what extent there is an objective component that allows for systematic gathering and analysis of knowledge about the environment and to what extent the managers' evaluations of environment characteristics are intertwined with their own experience and intuition (e.g. Kaplan, Murray, & Henderson, 2003). Future studies can investigate the origins of perceptions about the environment by focusing on the question of why managers frame specific facts about the organizational environment both as a competitive threat and an enabling opportunity. This study has shown that multiple theoretical mechanisms are at play with regard to the relationship between competitive intensity, interorganizational collaboration and firm innovativeness. Further research could look at personality, social and institutional factors that can explain why some managers develop their cognitive frames so that certain dimensions of the environment become more salient than others.

Future studies could advance the theoretical line of this research but also address some of the limitations inherent in the method used in this study. Although with a multi-industry sample sampling bias could be reduced, the study is cross-sectional and it could not tap into variation that occurs within firms. Longitudinal, process-oriented studies can look into how senior managers react to uncertainty originating from the different environmental dimensions. Investigating the decision-making process at a project level can also help uncover even more refined causal mechanisms that link a particular dimension with the choice for interorganizational collaboration in a particular innovation project. The development process can go through different phases and future research could study whether collaboration at some stages is more important than in others when managers are trying to address a particular type of uncertainty. In addition, researchers can explore the role of various partner types as well (e.g. De Faria et al., 2010). Do firms choose a particular partner type for a type of uncertainty and avoid the others? When is collaboration with competitors preferred? Within-industry studies can explore whether perceptions of the environment can impact the type selection of partners. Finally, the relationship with short-term financial performance should not be underestimated. Although interorganizational collaboration can substitute the need to invest in proprietary R&D capabilities, maintaining and coordinating external relationships requires management time and attention, which can be costly. Studies can look into the extent to which firms still need to accumulate discretionary slack that can enable them to achieve firm innovativeness through interorganizational collaboration (Nohria & Gulati, 1996; Voss, Sirdeshmukh, & Voss, 2008). Recognizing the effect of framing of environmental forces on decision-making can be a useful insight for managers as well. Reframing the environment as less competitive and more heterogeneous during strategy discussions creates opportunities for collaboration and innovation.

In conclusion, we view the multidimensional conceptualization of the environment as highly promising for understanding the intricacies and tensions that managers must resolve when deciding when to use interorganizational collaboration as a firm strategy. Simultaneously considering their perceptions of environmental turbulence, market heterogeneity and competitive intensity may offer important insights in that respect. Future research focused on further delineation of the underlying forces that shape these choices can enhance our understanding of innovation processes and outcomes.

Appendix A. Measurement scales used for this study

Items were measured on a seven-point scale, anchored by 1 = strongly disagree and 7 = strongly agree.

Interorganizational collaboration.

In the past three years, to what extent has your organization …

a. … worked together with other organizations for product and/or service innovations.
b. … worked together with other organizations in order to put new products and services to market.
c. … allied with other organizations in order to introduce new products and/or services.
d. … implemented joint promotional activities for new products and/or services.
e. … maintained joint distribution and service agreements for new products and services.
f. … signed contracts with other companies and institutions for product development.

Firm innovativeness

a. We invent new products and services.
b. We experiment with new products and services in our local market.
c. We commercialize products and services that are completely new to our organization.
d. We frequently utilize new opportunities in new markets.

Environmental turbulence

a. Environmental changes in our industry are intensive
b. Our clients regularly ask for new products and services
c. In our business, changes are taking place continuously

Market heterogeneity

a. Our organization operates in distinctive customer segments
b. We can observe significant differences in customer needs
c. The nature of competition varies widely in different market segments

Competitive intensity

a. Our organization has relatively strong competitors
b. Competition in our industry is extremely high
c. Price competition is a hallmark of our industry

Knowledge search

a. Knowledge is gathered by our organization in various ways
b. Our organization collects information through informal channels

Depth of knowledge base

Knowledge in our organization is generally …

a. simple-advanced
b. uncomplicated-complex
c. superficial-deep

Breadth of knowledge base

Knowledge in our organization is generally …

a. narrow-broad
b. specialized-varied
c. homogenous-diverse

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

References

Abernathy, W. J., & Clark, K. (1985). Mapping the winds of creative destruction. *Research Policy*, *14*, 3–22.

Ahuja, G. (2000). Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, *45*, 425–455.

Alexy, O., George, G., & Salter, A. (2013). Cui bono? The selective revealing of knowledge and its iimplications for innovative activity. *The Academy of Management Review*, *38*(2), 270–291. http://dx.doi.org/10.5465/amr.2011.0193.

Ang, S. H. (2008). Competitive intensity and collaboration: Impact on firm growth across technological environments. *Strategic Management Journal*, *29*(10), 1057–1075. http://dx.doi.org/10.1002/smj.695.

Atuahene-Gima, K., & Li, H. (2004). Strategic decision comprehensiveness and new product development outcomes in new technology ventures. *The Academy of Management Journal*, *47*(4), 583–597.

Barnett, W. P. (1997). The dynamics of competitive intensity. *Administrative Science Quarterly*, *42*(1), 128–160.

Benner, M. J., & Tushman, M. L. (2003). Exploration, exploitation, and process management: The productivity dilemma revisited. *The Academy of Management Review*, *28*, 238–256.

Bhaskaran, S. R., & Krishnan, V. (2009). Effort, revenue, and cost sharing mechanisms for collaborative new product development. *Management Science*, *55*(7), 1152–1169. http://dx.doi.org/10.1287/mnsc.1090.1010.

Blindenbach-Driessen, F., & Van Den Ende, J. (2010). Innovation management practices compared: The example of project-based firms. *Journal of Product Innovation Management*, *27*(5), 705–724. http://dx.doi.org/10.1111/j.1540-5885.2010.00746.x.

Bowen, J., & Ford, R. C. (2002). Managing service organizations: Does having a "thing" make a difference? *Journal of Management*, *28*(3), 447–469.

Burt, R. S. (1992). *Structural holes: The social structure of competition.* Cambridge, MA: Harvard University Press.

Burt, R. S. (2004). Structural holes and good ideas. *The American Journal of Sociology*, *110*, 349–399.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science*, *52*, 68–82.

Caves, R. E., & Porter, M. E. (1977). From entry barriers to mobility barriers: Conjectural decisions and contrived deterrence to new competition. *Quarterly Journal of Economics*, *91*(2), 241–261.

Ceci, F., & Masini, A. (2011). Balancing specialized and generic capabilities in the provision of integrated solutions. *Industrial and Corporate Change*, *20*(1), 91–131. http://dx.doi.org/10.1093/icc/dtq069.

Chesbrough, H. W., Vanhaverbeke, W., & West, J. (Eds.). (2006). *Open innovation: Researching a new paradigm.* Oxford: Oxford University Press.

Child, J. (1972). Organizational structure, environment and performance: The role of strategic choice. *Sociology*, *6*(1), 1–22. http://dx.doi.org/10.1177/003803857200600101.

Child, J. (1997). Strategic choice in the analysis of action, structure, organizations and environment: Retrospect and prospect. *Organization Studies*, *18*(1), 43–76. http://dx.doi.org/10.1177/017084069701800104.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128–152.

Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154–1191.

Damanpour, F. (1991). Organizational innovation — A meta-analysis of effects of determinants and moderators. *The Academy of Management Journal*, *34*, 555–590.

Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, *23*, 1095–1121.

Davis, J. P., & Eisenhardt, K. M. (2011). Rotating leadership and collaborative innovation. *Administrative Science Quarterly*, *56*(2), 159–201. http://dx.doi.org/10.1177/0001839211428131.

De Faria, P., Lima, F., & Santos, R. (2010). Cooperation in innovation activities: The importance of partners. *Research Policy*, *39*(8), 1082–1092. http://dx.doi.org/10.1016/j.respol.2010.05.003.

Den Hertog, P. (2000). Knowledge-intensive business services as co-producers of innovation. *International Journal of Innovation Management*, *4*(4), 491.

Dess, G. G., & Beard, D. W. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly*, *29*, 52–73.

Dill, W. R. (1958). Environment as an influence on managerial autonomy. *Administrative Science Quarterly*, *2*(4), 409–443.

Doty, D. H., Glick, W. H., & Huber, G. P. (1993). Fit, equifinality, and organizational effectiveness: A test of two configurational theories. *The Academy of Management Journal*, *36*(6), 1196.

Eisenhardt, K. M. (1989). Making fast strategic decisions in high-velocity environments. *The Academy of Management Journal*, *32*(3), 543–576.

Eisenhardt, K. M., & Brown, S. L. (1998). Competing on the edge: Strategy as structured chaos. *Long Range Planning*, *31*(5), 786–789.

Emden, Z., Calantone, R. J., & Droge, C. (2006). Collaborating for new product development: Selecting the partner with maximum potential to create value. *Journal of Product Innovation Management*, *23*(4), 330–341. http://dx.doi.org/10.1111/j.1540-5885.2006.00205.x.

Faems, D., Van Looy, B., & Debackere, K. (2005). Interorganizational collaboration and innovation: Toward a portfolio approach. *Journal of Product Innovation Management*, *22*(3), 238–250. http://dx.doi.org/10.1111/j.0737-6782.2005.00120.x.

Fiedler, M., & Welpe, I. M. (2010). Antecedents of cooperative commercialisation strategies of nanotechnology firms. *Research Policy*, *39*(3), 400–410. http://dx.doi.org/10.1016/j.respol.2010.01.003.

Fombrun, C. J., & Zajac, E. J. (1987). Structural and perceptual influences on intraindustry stratification. *The Academy of Management Journal*, *30*(1), 33–50.

Forbes, D. P. (2007). Reconsidering the strategic implications of decision comprehensiveness. *The Academy of Management Review*, *32*, 361–376.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50.

Frishammar, J., & Åke Hörte, S. (2005). Managing external information in manufacturing firms: The impact on innovation performance. *Journal of Product Innovation Management*, *22*(3), 251–266. http://dx.doi.org/10.1111/j.0737-6782.2005.00121.x.

Gadde, L. -E., Hjelmgren, D., & Skarp, F. (2012). Interactive resource development in new business relationships. *Journal of Business Research*, *65*(2), 210–217. http://dx.doi.org/10.1016/j.jbusres.2010.11.027.

Gupta, A. K., Tesluk, P. E., & Taylor, M. S. (2007). Innovation at and across multiple levels of analysis. *Organization Science*, *18*(6), 885–897.

Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, *44*, 82–111.

Hansen, M. T., & Birkinshaw, J. M. (2007). The innovation value chain. *Harvard Business Review*, *85*(6), 121–130.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs*, *76*(4), 408–420. http://dx.doi.org/10.1080/03637750903310360.

Henkel, J. (2006). Selective revealing in open innovation processes: The case of embedded Linux. *Research Policy*, *35*(7), 953–969. http://dx.doi.org/10.1016/j.respol.2006.04.010.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling-a Multidisciplinary Journal*, *6*(1), 1–55. http://dx.doi.org/10.1080/10705519909540118.

Huber, G. P., & Daft, R. L. (1987). The information environments of organizations. In F. Jablin, L. Putnam, K. Roberts, & L. Porter (Eds.), *Handbook of organization communication* (pp. 130–164). Beverly Hills, CA: Sage.

Ingram, P., & Roberts, P. (2000). Friendships among competitors in the Sydney hotel industry. *The American Journal of Sociology*, *106*, 387–423.

James, L. R., Demaree, R. G., & Wolf, G. (1993). r_{wg}: An assessment of within-group interrater agreement. *The Journal of Applied Psychology*, *78*, 306–309.

Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: How do organizational antecedents matter? *The Academy of Management Journal*, *48*, 999–1015.

Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2006). Exploratory innovation, exploitative innovation, and performance effects of organizational antecedents and environmental moderators. *Management Science*, *52*, 1661–1674.

Jaworski, B. J., & Kohli, A. K. (1993). Market orientation — Antecedents and consequences. *Journal of Marketing*, *57*(3), 53–70.

Jones, A. P., Johnson, L. A., Butler, M. C., & Main, D. S. (1983). Apples and oranges: An empirical comparison of commonly used indices of interrater agreement. *The Academy of Management Journal*, *26*, 507–519.

Joshi, A., & Campbell, A. (2003). Effect of environmental dynamism on relational governance in manufacturer–supplier relationships: A contingency framework and an empirical test. *Journal of the Academy of Marketing Science*, *31*(2), 176–188. http://dx.doi.org/10.1177/0092070302250901.

Kaplan, S., Murray, F., & Henderson, R. (2003). Discontinuities and senior management: Assessing the role of recognition in pharmaceutical firm response to biotechnology. *Industrial and Corporate Change*, *12*, 203–233.

Khanna, T., Gulati, R., & Nohria, N. (1998). The dynamics of learning alliances: Competition, cooperation, and relative scope. *Strategic Management Journal*, *19*(3), 193–210.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*, 383–397.

Kogut, B., & Zander, U. (1996). What firms do? Coordination, identity and learning. *Organization Science*, *7*(5), 502–518.

Kostova, T., & Zaheer, S. (1999). Organizational legitimacy under conditions of complexity: The case of the multinational enterprise. *The Academy of Management Review*, *24*(1), 64–81.

Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, *27*(2), 131–150. http://dx.doi.org/10.1002/smj.507.

Love, J. H., & Roper, S. (2001). Location and network effects on innovation success: Evidence for UK, German and Irish manufacturing plants. *Research Policy*, *30*(4), 643–661. http://dx.doi.org/10.1016/s0048-7333(00)00098-6.

Love, J. H., Roper, S., & Bryson, J. R. (2011). Openness, knowledge, innovation and growth in UK business services. *Research Policy*, *40*(10), 1438–1452.

Madhok, A. (2002). Reassessing the fundamentals and beyond: Ronald Coase, the transaction cost and resource-based theories of the firm and the institutional structure of production. *Strategic Management Journal*, *23*(6), 535–550. http://dx.doi.org/10.1002/smj.247.

McCarthy, I. P., Lawrence, T. B., Wixted, B., & Gordon, B. R. (2010). A multidimensional conceptualization of environmental velocity. *The Academy of Management Review*, *35*(4), 604–626.

Mehra, A., & Floyd, S. W. (1998). Product market heterogeneity, resource imitability and sfrategic group formation. *Journal of Management*, *24*(4), 511–531. http://dx.doi.org/10.1177/014920639802400403.

Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *The American Psychologist*, *50*(9), 741.

Miller, D., & Friesen, P. H. (1983). Strategy-making and environment: The third link. *Strategic Management Journal*, *4*(3), 221–235. http://dx.doi.org/10.1002/smj.4250040304.

Mitchell, J. R., Shepherd, D. A., & Sharfman, M. P. (2011). Erratic strategic decisions: When and why managers are inconsistent in strategic decision making. *Strategic Management Journal*, *32*(7), 683–704. http://dx.doi.org/10.1002/smj.905.

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002

Mosakowski, E. (1997). Strategy making under causal ambiguity: Conceptual issues and empirical evidence. *Organization Science*, *8*(4), 414–442.

Nadkarni, S., & Barr, P. S. (2008). Environmental context, managerial cognition, and strategic action: An integrated view. *Strategic Management Journal*, *29*(13), 1395–1427. http://dx.doi.org/10.1002/smj.717.

Nahapiet, J., & Ghoshal, S. (1998). Social capital, intellectual capital, and the organizational advantage. *The Academy of Management Review*, *23*, 242–266.

Nohria, N., & Gulati, R. (1996). Is slack good or bad for innovation? *The Academy of Management Journal*, *39*(5), 1245–1264.

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3 ed.). New York: McGraw-Hill.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *The Journal of Applied Psychology*, *88*, 879–903.

Porac, J. F., & Thomas, H. (1990). Taxonomic mental models in competitor definition. *The Academy of Management Review*, *15*(2), 224–240.

Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competition*. New York: The Free Press.

Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.

Porter, M. E. (1991). Toward a dynamic theory of strategy. *Strategic Management Journal*, *12*, 95–117.

Powell, W. W., Koput, K. W., & Smith-Doer, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, *41*, 116–145.

Roper, S., Du, J., & Love, J. H. (2008). Modelling the innovation value chain. *Research Policy*, *37*(6–7), 961–977. http://dx.doi.org/10.1016/j.respol.2008.04.005.

Rosenkopf, L., & Nerkar, A. (2001). Beyond local search: Boundary-spanning, exploration and impact in the optical disc industry. *Strategic Management Journal*, *22*, 287–306.

Ruiz, D. M., Castro, C. B., & Armario, E. M. (2007). Explaining market heterogeneity in terms of value perceptions. *Service Industries Journal*, *27*(8), 1087–1110. http://dx.doi.org/10.1080/02642060701673760.

Shook, C. L., Ketchen, D. J., Hult, G. T. M., & Kacmar, K. M. (2004). An assessment of the use of structural equation modeling in strategic management research. *Strategic Management Journal*, *25*(4), 397–404. http://dx.doi.org/10.1002/Smj.385.

Sidhu, J. S., Commandeur, H. R., & Volberda, H. W. (2007). The multifaceted nature of exploration and exploitation: Value of supply, demand, and spatial search for innovation. *Organization Science*, *18*(1), 20–38.

Simerly, R. L., & Li, M. (2000). Environmental dynamism, capital structure and performance: A theoretical integration and an empirical test. *Strategic Management Journal*, *21*(1), 31–49. http://dx.doi.org/10.1002/(sici)1097-0266(200001)21:1<31::aid-smj76>3.0.co;2-t.

Singh, J. V., Tucker, D. J., & House, R. J. (1986). Organizational legitimacy and the liability of newness. *Administrative Science Quarterly*, *31*(2), 171–193.

Sobrero, M., & Roberts, E. B. (2002). Strategic management of supplier–manufacturer relations in new product development. *Research Policy*, *31*(1), 159–182. http://dx.doi.org/10.1016/s0048-7333(00)00157-8.

Sriram, V., Krapfel, R., & Spekman, R. (1992). Antecedents to buyer–seller collaboration: An analysis from the buyer's perspective. *Journal of Business Research*, *25*, 303–320.

Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional responses. *The Academy of Management Review*, *20*, 571–610.

Sundbo, J. (1997). Management of innovation in services. *Service Industries Journal*, *17*(3), 432–455. http://dx.doi.org/10.1080/02642069700000028.

Un, C. A., Cuervo-Cazurra, A., & Asakawa, K. (2010). R&D collaborations and product innovation. *Journal of Product Innovation Management*, *27*(5), 673–689.

Van De Vrande, V., De Jong, J. P. J., Vanhaverbeke, W., & De Rochemont, M. (2009). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, *29*(6–7), 423–437.

Van der Aa, W., & Elfring, T. (2002). Realizing innovation in services. *Scandinavian Journal of Management*, *18*(2), 155–171. http://dx.doi.org/10.1016/s0956-5221(00)00040-3.

Venkatraman, N., & Prescott, J. E. (1990). Environment-strategy coalignment: An empirical test of its performance implications. *Strategic Management Journal*, *11*(1), 1–23. http://dx.doi.org/10.1002/smj.4250110102.

Voss, G. B., Sirdeshmukh, D., & Voss, Z. G. (2008). The effects of slack resources and environmental threat on product exploration and exploitation. *The Academy of Management Journal*, *51*(1), 147–164.

West, J., & Bogers, M. (2014). Leveraging external sources of innovation: A review of research on open innovation. *Journal of Product Innovation Management*, *31*(4), 814–831. http://dx.doi.org/10.1111/jpim.12125.

West, J., & Gallagher, S. (2006). Challenges of open innovation: The paradox of firm investment in open-source software. *R&D Management*, *36*(3), 319–331. http://dx.doi.org/10.1111/j.1467-9310.2006.00436.x.

Widaman, K. F. (1985). Hierarchically nested covariance structure models for multitrait-multimethod data. *Applied Psychological Measurement*, *9*(1), 1.

Woodside, A. G. (2011). Responding to the severe limitations of cross-sectional surveys: Commenting on Rong and Wilkinson's perspectives. *Australasian Marketing Journal*, *19*(3), 153–156.

Woodside, A. G. (2013). Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research*, *66*(4), 463–472. http://dx.doi.org/10.1016/j.jbusres.2012.12.021.

Yli-Renko, H., Autio, E., & Sapienza, H. J. (2001). Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic Management Journal*, *22*, 587–613.

Young-Ybarra, C., & Wiersema, M. (1999). Strategic flexibility in information technology alliances: The influence of transaction cost economics and social exchange theory. *Organization Science*, *10*(4), 439–459. http://dx.doi.org/10.1287/orsc.10.4.439.

Please cite this article as: Alexiev, A.S., et al., Interorganizational collaboration and firm innovativeness: Unpacking the role of the organizational environment, *Journal of Business Research* (2015), http://dx.doi.org/10.1016/j.jbusres.2015.09.002