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The effect of an ambidextrous supply chain strategy on combinative competitive capabilities and business performance

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ABSTRACT

This study investigates the influence of an ambidextrous supply chain strategy on manufacturers' combinative competitive capabilities – the ability to excel simultaneously on competitive capabilities of quality, delivery, flexibility, and cost – and, in turn, on business performance. Drawing upon March's (1991) notions of exploration and exploitation, an ambidextrous supply chain strategy is conceptualized as a simultaneous pursuit of both explorative and exploitative supply chain practices. We operationalize this concept as a second-order latent construct that captures the co-variation between exploration and exploitation within the context of a manufacturer's supply chain management strategy. Using survey-based data gathered from 174 U.S. manufacturers, we find that an ambidextrous supply chain strategy coincides with combinative competitive capabilities and business performance. Our empirical finding contradicts conventional wisdom that argues for tradeoffs between exploration and exploitation. Instead, our empirical results are in line with an emerging complementarity view advocating that supply chain managers build practices to gain operational efficiency while simultaneously searching for opportunities to gain operational advantages. In addition, we provide insights regarding the role of combinative capabilities in mediating the relationship between an ambidextrous supply chain strategy and business performance.

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1. Introduction

This paper addresses the notion of an ambidextrous strategy within the context of a manufacturer's supply chain strategy. The general concept of ambidexterity strategy – a simultaneous pursuit of both exploration and exploitation – has recently been advanced in other disciplines such as organizational theory, networks, innovation, and inter-organizational relationships (Gupta et al., 2006; Kauppila, 2007; He and Wong, 2004; Im and Rai, 2008). Following March (1991), Im and Rai (2008, p. 1281) propose that "exploitation refers to the use and refinement of existing knowledge, and exploration refers to the pursuit of new knowledge and opportunities." Originally, because of the scarcity of firm resources and limitations of managerial scope, exploitation and exploration were considered to be substitutes (or trade-offs). In other words, conventional wisdom posits that organizations would be better off if they *either* honed and extended their existing supply chain competencies *or* focused on the acquisition of new ones. To the contrary, others suggest that exploitation and exploration are complementary competencies (Katila and Ahuja, 2002; Gupta et al., 2006; Im and Rai, 2008; Knott, 2002; Levinthal, 1997). This notion of complementarities is consistent with March's (1991) assertion that organizational "adaptation requires *both* exploitation and exploration to achieve persistent success" (March, 1991, p. 205, italics added by the authors).

To capture the complementary view of exploration and exploitation, Duncan (1976) proposes the construct of an ambidexterity strategy. The basic argument is this: exploitation and exploration *alone* are inadequate to support manufacturers competing in a hypercompetitive and dynamic environment. Likewise, we define an *ambidextrous supply chain strategy* (hereafter, ambidextrous SC strategy) from a manufacturer's perspective, as a manufacturing firm's strategic choice (i.e., managerial emphasis) to simultaneously pursue both supply chain exploitation and exploration (hereafter, SC exploitation/exploration) practices. We operationalize exploitation within supply chain management as the set of practices that refine and extend existing skills and resources. In contrast, exploration pertains to practices that develop new supply chain competencies

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through experimentation and acquisition of new knowledge and resources. For manufacturers, the supply chain exploitation practices typically involve leveraging their current supply chain competencies to achieve lower costs and reliability; whereas with exploration, practitioners would continuously seek new knowledge and ideas within supply chain relationships. Take, for example, the development of new advanced information and communications technologies (ICT) (Sanders, 2008). ICT has significantly expanded manufacturers' operational resources into their supply chain. Illustrating a SC exploitation practice is the use of information technology to automate cross-organizational tasks (e.g., automated billing, report preparation, inventory management, and financial analysis) with the explicit goal of enhancing efficiency. In contrast, supply chain exploration may employ systems for cross-entity business intelligence information gathering that supports organizational decision-making and the exchange of new ideas, such as understanding the new trends in sales and customer preferences as well as supply network innovations.

Drawing upon the complementarity premise versus trade-offs, manufacturers that prioritize supply chain exploitation are likely to be trapped in suboptimal stable equilibrium, and therefore, would be less able to adapt quickly to environmental changes. On the other hand, manufacturers that rely on constant supply chain exploration practices are prone to find themselves losing efficiency because they cannot garner the benefits of too many underdeveloped new ideas. These two divergent views – trade-off versus complementarity – lead to our first research question: In practice, can we classify a group of manufacturers that follow an ambidextrous strategy in the context of supply chain management?

There is some anecdotal evidence that successful ambidextrous organizations are more prosperous, lending the credence to complementary view of exploration and exploitation (Tushman and O'Reilly, 1996; Kauppila, 2007). While empirical investigations of ambidexterity strategy have attracted more attention, most studies emanate from organizational theory and strategic management literatures (Gibson and Birkinshaw, 2004; Lubatkin et al., 2006; Holmqvist, 2004; Siggelkow and Levinthal, 2003). Yet, with a few exceptions (Adler et al., 1999; Lin et al., 2007; Im and Rai, 2008), empirical investigations of ambidexterity within operations and/or supply chain management performance implications are scant. To address this void in the literature, we empirically scrutinize a sample of 174 manufacturers regarding their implementation of SC exploitation and exploration practices. Notably, support for our evaluation of SC ambidexterity using a manufacturer's perspective is given by Kauppila (2007, p. 3), who conceptualizes innovation in a network as follows: "Our main conclusion is that although the network is a major driver and facilitator of ambidexterity, it is more advantageous to create ambidexterity in companies, not in the network." Kauppila (2007), however, provides no empirical tests of his assertions or conceptual framework.

Our second research question is: Given that ambidextrous SC strategy is a viable approach, does an ambidextrous SC strategy coincide with combinative competitive capabilities and business performance? Drawing upon three theories—dynamic capabilities, the knowledge-based view (KBV), and the law of requisite variety, we hypothesize that ambidextrous SC strategy has a direct and positive influence on combinative competitive capabilities, which in turn, improve business performance, namely, market share and profit level. Combinative competitive capabilities reflect an organization's ability to achieve low cost, high flexibility, dependability, and quality (Roth, 1996a,b; Giffi et al., 1990; Hayes and Wheelwright, 1984; Rosenzweig et al., 2003; Skinner, 1978; Menor et al., 2001).

Our empirical research, which extends ambidexterity research into supply chain management, generates three important contributions. Our study is among the first to measure empirically ambidextrous SC strategy by developing and validating multi-item measurement scales, while tapping into SC exploration and exploitation constructs. We model ambidextrous supply chain strategy as a second-order latent construct reflected by two first-order constructs—SC exploration and SC exploitation practices. Modeling co-variation in this way has been established as an appropriate statistical method for testing complementarity (Venkatraman, 1989). Our measurement model is a parsimonious representation of ambidextrous SC strategy because it reflects the co-variation (i.e., common variances) between supply chain exploration and exploitation. Thus, our measure directly captures the synchronous pursuit of supply chain exploration and exploitation as dictated by theory. Having metrics with good psychometric properties is highly valuable for testing and advancing theory (Roth et al., 2008).

Second, we develop a numerical taxonomy using metrics tapping into constructs of SC exploitation and SC exploration as taxons. Our empirical results show that over one-third of the manufacturers in the study follow an ambidextrous SC strategy (i.e., placing high emphasis in both SC exploration and exploitation). Counter to conventional wisdom, we find no evidence of significant trade-offs in SC exploration and exploitation. Rather, we observe a tendency towards high, medium, and low ambidextrous SC strategies. Arguably, finding a group of manufacturers with significant investment on both types of SC practices provides some empirical evidence for the existence of ambidextrous SC strategy in practice, which is an important first step for advancing supply chain research in this emerging theoretical arena.

Third, our empirical findings highlight the theoretical and practical benefits of applying an ambidextrous SC strategy. The benefits of simultaneous emphases on SC exploitation and exploration appear to be quite synergistic in that they influence the manufacturer's ability to achieve relatively high levels of operational combinative competitive capabilities (e.g. quality, delivery, flexibility and low cost) that are necessary for adapting and competing in target markets. Moreover, the observed relationship between ambidextrous SC strategy and business performance is better understood because of the moderating effect of combinative competitive capabilities (Giffi et al., 1990; Hayes and Wheelwright, 1984; Rosenzweig et al., 2003; Skinner, 1978; Menor et al., 2001; Roth, 1996a). The practical insight is that more successful manufacturers take an increasingly holistic view by placing relatively high levels of managerial emphasis on both SC exploitation and exploration practices. In turn, they can reap benefits by exploiting current capabilities while simultaneously build new competencies for future use. In effect, as in the classical theoretical sense of learning organizations (Senge, 1992), the holistic deployment of these SC practices are self-reinforcing and act to achieve *economies of knowledge* (Roth, 1996b) by which operational capabilities are enhanced dynamically.

The rest of the paper is structured as follows: Section 2 lays out the theoretical foundations of our conceptual model and hypotheses based on a synthesis of literature associated with organizational learning, dynamic capabilities, operations strategy, and supply chain management. Section 3 presents the research methodology and analysis, and the results are given in Section 4. Section 5 concludes with a discussion of the theoretical and managerial implications of our findings, the limitations of our study, and a description of future research opportunities.

2. Theoretical framework and hypotheses

The concept of ambidexterity has recently become a subject of debate in organizational theory and strategic management literature, revolving around the question of whether both

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exploitation and exploration activities can be pursued at the same time. Early literature suggests that exploitation and exploration are fundamentally incompatible (March, 1991; Gupta et al., 2006; Kauppila, 2007); therefore, trade-offs have to be made. Two key assumptions are implicit in this general argument for manufacturing. First, a manufacturer's SC exploitation and exploration practices may compete for scarce resources. Second, the mindsets, organizational activities, and routines needed for these two types of activities are different and often conflict with each other (Burgelman, 2002). Thus, extending a focused-factory (Skinner, 1978) metaphor to supply chain strategies, the operational competencies required should be incompatible.

Counter to conventional wisdom, a second school of thought has recently emerged, positing that ambidexterity is an attainable strategy. Accordingly, exploitation and exploration are viewed as complementary rather than competing competencies (Katila and Ahuja, 2002; Gupta et al., 2006; Schulze et al., 2008). While this concept seems appealing, there are few empirical studies on ambidexterity within operations and supply chain management (Adler et al., 1999; He and Wong, 2004; Lin et al., 2007; Im and Rai, 2008). By linking the concept of strategic supply chain practices for exploration and exploitation to operational capabilities, we further subject the influence of an ambidextrous SC strategy on business performance to rigorous empirical scrutiny (see Fig. 1). In the following sections, the hypothesized relationships are discussed. The first two hypotheses pertain to the formal measurement of ambidextrous SC strategy and combinative capabilities constructs; and the subsequent hypotheses pertain to our theory as depicted by structure of the nomological net of relationships among the constructs.

2.1. Ambidextrous supply chain strategy

In the supply chain management context, the development of advanced technologies, especially information and communication technologies (ICT), has significantly expanded manufacturers' operational competencies and prowess. Sanders (2008) underscores the potential of two complementary patterns of ICT usage within the supply chain management context—one for exploitation (i.e., improving current problem solving methods, such as the joint adoption of an electronic data integration (EDI) system to reconcile inventory and payments), and the other for exploration (i.e., uncovering new problem solving methods and innovations by enabling buyer–supplier engagement and collaboration through a custom Internet portal). Manufacturers also often have access to external resources from their supply chain partners, such as added production capacity, six sigma teams, and benchmarking. Several theoretical streams, including the resource-dependence theory and organizational learning theory, have highlighted the importance of offsetting resource dependence and introducing new knowledge through formation of supply chain alliances (Takeishi, 2001). The opportunity of accessing external resources effectively eases the internal resource constraints needed for both exploration and exploitation. Finally, from a learning organization point of view, Baum et al. (2000) and Benner and Tushman (2002) argue

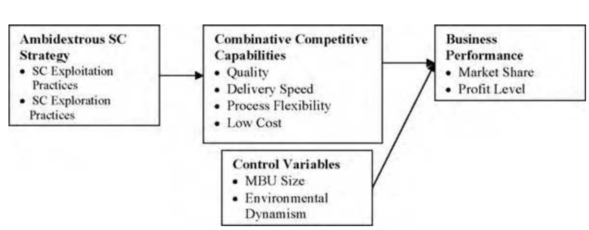

Fig. 1. Conceptual model.

that exploitation and exploration are different parts of learning and innovation; hence, they may require different types of resources.

Supply chain management generally deals with multiple diverse and loosely coupled subsystems; therefore, SC exploration and exploitation could coexist with a low degree of conflict among mind-sets and organizational routines. For example, a manufacturing business unit with multiple various and loosely connected subsystems might be able to configure their processes differently with each pursuing either explorative or exploitative supply chain practices. Thus, inherent tension between SC exploration and exploitation at the subsystem level is mitigated due to synergistic joint effects at the system level (Duncan, 1976; Benner and Tushman, 2002; Tushman and O'Reilly, 1996; Gupta et al., 2006). This view is consistent with the argument of Dyer et al. (1998) that effective supply chain management should strategically segment suppliers and manage them differently in order to capture simultaneously multiple benefits. The extant literature uses the term, "structural separation," to describe this approach as an effective way to acquire ambidexterity (Gibson and Birkinshaw, 2004; O'Reilly and Tushman, 2004).

In sum, an ambidextrous SC strategy is posited to be a viable strategic response for manufacturing firms. To answer our first research question, we hypothesize the existence of a group of manufacturers that can be characterized by their holistic management focus and emphasis placed on the combination of SC exploration and exploitation practices. More formally, in order to directly capture the duality of emphases on both SC exploration and exploitation that connote an ambidextrous SC strategy, we propose:

H1. Ambidextrous supply chain strategy is a multidimensional, second-order construct reflected by SC exploitation and exploration practices.

2.2. Combinative competitive capabilities

The concept of operational competitive capabilities is embodied within the classical manufacturing strategy literature (Skinner, 1978; Giffi et al., 1990; Miller and Roth, 1994; Hayes and Wheelwright, 1984). Distinguished from "intended" capabilities or priorities in manufacturing, competitive capabilities capture a manufacturer's "actual" or "realized" competitive strength relative to its primary competitors in the target markets (Roth and Jackson, 1995). Since the 1990s, the notion of *combinative* competitive capabilities (hereafter combinative capabilities) has come to the limelight (Ferdows and DeMeyer, 1990; Rosenzweig et al., 2003; Roth, 1996b; Flynn and Flynn, 2004; Corbett and van Wassenhove, 1993). Combinative competitive capabilities are operationally defined as a manufacturer's ability to excel simultaneously on quality, delivery, flexibility, and low cost (Menor et al., 2001; Roth, 1996a,b). The construct of combinative capabilities indicates a paradigmatic departure from the classical operations strategy literature that contends firms should trade off their individual competitive capabilities (e.g., cost versus quality) to achieve success (Hayes et al., 2005; Skinner, 1978).

Proponents of combinative capabilities argue that firms with combinative capabilities have the requisite internal competencies, which enable them to move smoothly from one short-term advantage to another at any given point in time. In a hypercompetitive environment characterized by continuous and unanticipated changes, combinative capabilities emerge as a strategic capability that allows firms, who are able to handle variability to compete effectively (Yusuf et al., 1999; Menor et al., 2001).

More recent studies find the global development and dissemination of advanced manufacturing technologies often extend the production frontier, which allows manufacturers to achieve superior performance on multiple capabilities simultaneously (Flynn and Flynn, 2004; Corbett and van Wassenhove, 1993; Schmenner and Swink, 1998), and provide empirical support for the notion of combinative capabilities. In addition, the theoretical rationale underpinning combinative capabilities is also found in Roth's (1996a) competitive progression theory (CPT). According to Roth's CPT, the process variance and knowledge related to any single capability co-varies with the others. Due to the shared variances and the organizational knowledge created with the interplay of competitive capabilities—quality, delivery, flexibility, and low cost, the resultant synergies create slack resources that extend a manufacturer's operational bandwidth (e.g. production frontier or innovation cycle) (Rosenzweig and Roth, 2004). In summary, the theoretical notion of combinative capabilities can be viewed as the holistic combination of individual capabilities that build on each other and are mutually reinforcing (Ferdows and DeMeyer, 1990; Boyer and Lewis, 2002; Noble, 1995; Roth and Miller, 1992). More formally,

H2. The construct of combinative capabilities is a multidimensional, second order construct reflected by first-order capabilities of quality, delivery speed, process flexibility, and low cost, *ceteris paribus*.

2.3. Linking ambidextrous SC strategy to combinative competitive capabilities

We conceptualize ambidextrous SC strategy as a strategic managerial emphasis on two different types of practices for organizational learning (SC exploration and exploitation), and combinative competitive capabilities as simultaneous excelling in four common manufacturing capabilities. We further argue that ambidextrous SC strategy facilitates the development of combinative capabilities because it adds to waste reduction and learning as posited by Roth's (1996a) CPT. The posited performance implications of ambidextrous SC strategy can be explained from three distinct, but overlapping theoretical lenses—dynamic capabilities, knowledge-based view (KBV), and the law of requisite variety.

2.3.1. Dynamic capabilities

The notion of combinative capabilities is related to the dynamic capabilities concept (Teece et al., 1997; Eisenhardt and Martin, 2000). Anacona et al. (2001, p. 658) state that dynamic capabilities "are rooted in the streams of innovation—in simultaneously exploiting and exploring." This connection between combinative capabilities and ambidexterity becomes clear when examining the temporal orientations involved in combinative capabilities and ambidextrous SC strategy. Combinative capabilities require a manufacturing firm to have two temporal orientations – the present and the future – and demand advancement on multiple capabilities to prepare for today and tomorrow's changing competitive landscapes (e.g., price wars, quality wars, flexibility wars, etc.).

In the extant literature, exploitation has a temporal orientation of present (Im and Rai, 2008). In our context, SC exploitation focuses managerial attention towards leveraging current manufacturer's capabilities by improving existing SC competencies processes and technologies, as well as rationalizing and reducing supply costs. As a result, SC exploitation will strengthen a firm's current core competitive advantages. However, excessive exploitation is also likely to turn its internal competencies into core rigidities (Leonard-Barton, 1992). Numerous case studies have provided industry examples of large, fallen companies that were once very successful. They became entangled in the so-called "competence traps," and thus, were unable to adapt to changing competitive landscapes (Levitt and March, 1998; Lee, 2004; O'Reilly and Tushman, 2004). Researchers have argued the need for manufacturers to use exploration to counter-balance exploitation in order to stay out of "competence traps" (Lewin et al., 1999; Lewin and Volberda, 1999).

In contrast to exploitation, a temporal orientation towards the future dominates SC exploration, often with unpredictable returns (Im and Rai, 2008). SC exploration is typically involved with developing new supply chain competencies and useable external knowledge through complex searching, experimenting, and acquiring of new supply chain processes, resources, and technologies. Taken together, exploration holds the promise of effectively increasing a manufacturer's operational bandwidth for adapting to changing environments and creating new opportunities. Manufacturers with an excessive focus on exploration, however, can be caught in a *failure trap*- "... failure leads to search and change, which lead to failure which leads to even more search, and so on" (Levinthal and March, 1993 p.105). In this case, manufactures will increase their vulnerability to the current competition.

In sum, an emerging school of thought advocates the combinative pursuit of exploitation and exploration to break the dynamics of excessive exploration (e.g. failure traps) and excessive exploitation (e.g. competence traps) (Lewin et al., 1999; Lewin and Volberda, 1999). The interplay between SC exploration and exploitation forms a dynamic path of absorptive capacity (He and Wong, 2004; O'Reilly and Tushman, 2004), allowing an ambidextrous manufacturer to avoid these entrapments, as previously described.

2.3.2. Knowledge-based View (KBV)

There is a growing need for utilizing organizational theories in supply chain management (Ketchen and Hult, 2007). From the knowledge-based view (KBV) perspective, exploitation and exploration entail two different knowledge creation processes (Floyd and Lane, 2000; Im and Rai, 2008). On one hand, SC exploitation involves internalizing and combining the existing knowledge bases to refine current processes and technologies within supply chain management (Huang et al., 2007). On the other hand, SC exploration mainly facilitates the generation of tacit knowledge within supply chain management through externalization, combination, and socialization (Huang et al., 2007). Other researchers theorize that it is the dynamic interactions of these different kinds of organizational knowledge (e.g. tacit and explicit knowledge) and learning processes (i.e., internalization, combination, externalization, and socialization) that foster knowledge creation within organizations (Grant, 1996; Nonaka, 1994; Spender, 1996). For instance, Katila and Ahuja (2002) contend that exploitation of existing capabilities is often needed to explore new capabilities, while exploration of new capabilities also enhances a firm's existing knowledge base.

Specifically, Hult et al. (2004) state that a knowledge-based view enables manufacturers to create unique capabilities that reflect on competitive capabilities. Similar to our concept of SC exploitation practices, Hult et al. (2004) use the concept of organizational memory, which refers to the familiarity and experience within current supply chain operations. Hult et al. (2004) assert that organizational memory forms the starting point of manufacturers' actions toward achieving higher levels of competitive capabilities. On the other hand, similar to SC exploration practices, Hult et al. (2002) and Hult et al. (2003), use the concept of "cultural competitiveness", which is defined as the degree to which supply chains detect the gaps between their own operations and the changing competitive environment. Ketchen and Hult (2007) state that cultural competitiveness enables manufacturers to develop agile operations through "cultural competitiveness" since they are more attuned to the needs of their customers. In summary, ambidextrous SC strategy

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enables interaction of different learning processes and knowledge creation as predicted by KBV, and thereby becomes embedded within the manufacturers' internal and external competencies and processes, which in turn, fosters the development of combinative capabilities (Ketchen and Hult, 2007).

2.3.3. Law of requisite variety

Ashby's (1958) "law of requisite variety" provides further theoretical argument highlighting the importance of ambidexterity in a competitive environment. According to the law of requisite variety, manufacturers must keep sufficient diversity inside organizations in order to sense the variety present in the environment and enable them to survive (Weick and Westley, 1996). By applying this law to operations management, Menor et al. (2001) note that having sufficient diversity inside an organization translates into having multiple and diverse competencies and resources (e.g., organizational slack). This diversity translates into a broader set of competitive capabilities while minimizing the risk of becoming obsolete. From this theory, an ambidextrous manufacturer that invests in combinative SC exploitation and exploration practices will normally evolve and generate expanded internal competences, as well as gain access to a broader set of external supply chain resources. Thus, manufacturers adopting an ambidextrous SC strategy are posited to be better positioned for adaptation to hypercompetitive environments by contributing to the development of combinative capabilities.

Overall, the emerging paradigm indicates that SC exploration and exploitation are complementary, as the joint pursuit allows dual temporal orientations deemed important by the dynamic capabilities view, KBV, and the law of requisite variety. The interaction between SC exploration and exploitation creates dynamics in a manufacturer's knowledge and resource bases, and enhances its absorptive capacity. This interaction ultimately prepares the manufacturer for a broad spectrum of competition. Despite the growing theoretical support for the positive relationship between ambidexterity and organizational performance (Gupta et al., 2006), empirical evidence is limited and largely anecdotal. The empirical examination of the relationships between SC ambidexterity and combinative capabilities within the supply chain management context is nonexistent. To address the gap, we offer the following hypothesis:

H3. Ambidextrous SC strategy has a direct and positive influence on combinative competitive capabilities.

2.4. Linking combinative competitive capabilities to business performance

Many studies empirically show that operational competitive capabilities contribute to a competitive advantage due to their positive impact on business performance (Ferdows and DeMeyer, 1990; Flynn et al., 1999; Roth, 1996a; Roth and Miller, 1992; Menor et al., 2001; Swamidass and Newell, 1987; Vickery et al., 1997; Ward et al., 1998). Operations strategists argue that this positive impact of operational effectiveness on business performance can be explained by the resource-based view (RBV) of the firm (Hayes et al., 2005). Moreover, RBV requires operational effectiveness to be deemed a valuable resource that is also inherently difficult to imitate. Combinative capabilities fit into this category due to the resultant organizational knowledge that accumulates through learning and waste reduction (Roth, 1996b; Rosenzweig and Roth, 2004). Combinative capabilities are built upon the inherent synergies of organization-level operating abilities that are embedded in operational competencies, routines, and processes; and therefore, making them difficult to develop or imitate. As both RBV and KBV predict, we posit that operationally-based, combinative capabilities lead to the achievement of superior business performance. Specifically, we propose:

H4a. Combinative competitive capabilities positively influence profit level.

H4b. Combinative competitive capabilities positively influence market share.

2.5. The mediating role of combinative competitive capabilities

Taken together, H3 and H4a–b imply that combinative capabilities mediate the relationship between an ambidextrous SC strategy and a manufacturer's overall business performance. This mediation model is in accordance with the resources-capabilities-performance relationship underlying both the RBV and the KBV (Menor et al., 2007; Eisenhardt and Santos, 2002; Garud, 1997; Kogut and Zander, 1992). The logic behind the mediation argument is this: While we expect an ambidextrous SC strategy to positively impact business performance, there are many difficulties associated with attaining and maintaining a proper balance between SC exploration and exploitation (March, 1991). A manufacturer must receive the benefits of ambidextrous SC strategy in the form of competitive capabilities to achieve superior performance (Roth, 1996a,b). Thus, it is through these combinative capabilities that the potential of SC ambidexterity, which continuously expands the operational bandwidth and moves out the performance frontier, is realized in achieving business performance (Eisenhardt and Santos, 2002; Roth and Miller, 1992; Garud, 1997; Kogut and Zander, 1992; Rosenzweig and Roth, 2004). Therefore:

H5a. Combinative competitive capabilities mediate the relationship between an ambidextrous SC strategy and market share.

H5b. Combinative competitive capabilities mediate the relationship between an ambidextrous SC strategy and profit level.

3. Methods

3.1. Data collection and sample

This study is part of a larger research program to investigate factors associated with supply chain adaptivity and learning (Kristal et al., 2008). The database and sample details are paraphrased here. The sampling frame of 3200 names was obtained from the Institute for Supply Management (ISM) membership directory. For this paper, we focused on manufacturing-intense business units. Targeted respondents were classified by ISM as having positions Titled 1 and 2 with executive level titles of president, vice president, director, general manager, supply chain manager, and purchasing manager in their respective organizations.

In order to increase the response rate, we followed a strategy based upon Dillman's (2000) and Frohlich's (2002) recommendations. After pre-validating our measures with a separate Q-sort study (Stage 1), which will be detailed in the measurement section, the survey instrument was constructed using items deemed to have tentative reliability and validity from Stage 1. The sampling frame was randomly divided into two groups, 800 and 2400 names, respectively. The first set was used for pilot testing of the survey instrument, which employed 78 supply chain professional respondents (i.e., 10% return). Next, an initial invitation was emailed to the second set of 2,400 targeted ISM respondents requesting their participation. After two days, the potential respondents were e-mailed with a link to our web-based survey. A week later, a reminder e-mail with the survey link was sent; and followed up by another round of e-mails a week later. Lastly, 500 randomly chosen individuals from the list of 2400 potential respondents were telephoned in order to secure cooperation and representation. Out of these 500, 72 potential respondents could be reached for our telephone interview. In total, 214 responses were received, resulting in an effective response rate of 9%, which is consistent with others using a complex survey instrument (Hult et al., 2007, 10.7% response rate; Braunscheidel and Suresh, 2009, 7.4% response rate; Tan and Vonderembse, 2006, 6.4% response rate). Of the total, 40 respondents from nonmanufacturing businesses were deemed to be ineligible for this study, resulting in a usable sample of 174.

We tested for non-response bias in two ways. First, we conducted intensive phone interviews with our 72 telephone respondents after the fourth round of e-mails. We concluded that the main reason for the failure to reply was the length of the survey (18 web pages). Given that our survey took approximately 45 min to complete, the 9 percent response rate was not unusual (Dillman, 2000) for this or other studies using the same ISM database. We found no differences between the web and telephone respondents, in terms of the following variables: number of employees, profit level, market share and environmental dynamism. Second, from the list of non-respondents, we sampled 50 firms whose data on current assets, profit before taxes, and net sales were available on the COMPUSTAT database. We compared this group to a group of 50 firms that were randomly sampled from the list of 174 responding companies whose company data were also available on COMPUSTAT. There were no statistically significant differences on current assets, profit level before taxes, and net sales, between the two groups. As a result, we conclude that our data does not show any evidence of non-respondent bias.

For purposes of this research, we analyzed the manufacturing sub-sample of 174 observations. Our respondents worked primarily for medium to large sized manufacturing firms. Approximately 35% of these manufacturers had more than 1,000 employees; and more than 57% of the manufacturers had a market share larger than 32%. The profile of respondents and their respective manufacturing business units are presented in Table 1.

Table 1
Sample profile.

	N	Percentage (%)
Business unit represented		
Entire Company	90	51.72
Division or Group Level	56	32.18
Plant Level	26	14.94
Other	2	1.15
Total	174	100.00
Respondent job title		
President/Vice President	22	12.64
Director	37	21.26
General Manager	10	5.75
Supply Chain Manager	38	21.84
Purchasing Manager	59	33.91
Other	8	4.60
Total		100.00
Primary Industry		
Automotive	14	8.05
High Tech	35	20.11
Chemical	27	15.52
Aerospace and Defence	10	5.75
Pharmaceutical	10	5.75
Consumer Goods	59	33.91
Food Manufacturing	5	2.87
Health Care Devices Manufacturing	3	1.72
Other*	11	6.32
Total	174	100.00%

* Includes industries such as appliance manufacturing; hydraulic valves manufacturing; manufacturing of electrical distribution and automated products; office equipment manufacturing; printing ink and cartridges; plastics moulding; and food and beverage manufacturing.

By and large, our respondents were knowledgeable about overall supply chain strategies, with 17% reported were "very knowledgeable" about the survey; 38% had "above average knowledge," 35% were "knowledgeable." None of the respondents indicated that they were "not knowledgeable."

3.2. Measures

Since the constructs of SC exploration and exploitation are relatively new within the context of supply chain literature, we applied Menor and Roth's (2007) rigorous, two-stage approach for new multi-item measurement scale development (see Roth et al., 2008). Other OM examples that use this measurement approach are given in Stratman and Roth (2002), Froehle and Roth (2004), Rosenzweig and Roth (2007), and Menor and Roth (2007). In the first stage, theory-based operational definitions for the SC exploration and exploitation constructs, as well as the item pool tapping into each, were formed from literature and the structured executive interviews. While using the supply chain context, items were strongly tied to the theoretical foundation laid by March (1991). Next, with independent panels of expert judges, we refined our measures and constructs of SC exploration and exploitation through an iterative Q-sorting process. Through this process, tentative reliability and validity of the SC exploration and exploitation measures were established *prior to* the field survey implementation.

For the Q-sorting exercises, we employed supply chain management experts from companies such as IBM, DuPont, Johnson and Johnson, and HP. Each judge had supply chain management experience, knowledge about the research topic, and more importantly, was a general representation of the respondent sample being asked to complete the Stage 2 field survey instrument. To measure inter-rater reliability, we utilized Perrault and Leigh (1989) measure of interjudge agreement (I_r), and Cohen's κ statistic (Cohen, 1960) I_r that captures the observed proportion of agreement between all possible judge pairs for each round of Q-sorts, while taking into account the number of construct categories. Its values range between 0 and 1, where a score of 0 indicates that the observed agreement is by chance, and a score of 1 indicates perfect interjudge agreement. Scores that are greater than 65% are generally considered to demonstrate an acceptable level of agreement (Menor and Roth, 2007; Stratman and Roth, 2002; Moore and Benbasat, 1991). A Cohen's κ statistic that is greater than 0.65 also indicates adequate interjudge agreement (Moore and Benbasat, 1991). Our stage 1 results were 0.82 for I_r and 0.67 for Cohen's κ, indicating satisfactory reliability results for the Q-sort analyses.

In the second stage, using responses from the ISM field survey database, the psychometric properties of each multi-item measurement scale were confirmed. This included the items for the newly developed SC exploitation and exploration scales obtained in stage 1, as well as measures of all other constructs in our hypothesized model that were based on prior literature. The constructs of SC exploitation and exploration practices were captured on self-anchored, five-point Likert-type scales, ranging from 1 = strongly disagree, 3 = neutral, to 5 = strongly agree (see Appendix A for exact questions and item wording).

With respect to competitive capability measures, we employed items that were used in prior research (Rosenzweig et al., 2003; Roth, 1996a). We operationalized quality as conformance to specifications and fitness for use, delivery speed as the capability to deliver products in a short time, and process flexibility as the ability to adjust or modify operational processes to speedily accommodate changes (production volumes or product mix) (Miller and Roth, 1994; Roth and Miller, 1992). Lastly, we defined low cost as the manufacturer's ability to compete on cost (Miller and Roth, 1994; Roth, 1996a). Managers were asked to compare their manufacturing business unit performance with their competitors' performance on

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each competitive capability indicator for quality, cost, delivery speed, and process flexibility, using a 5-point Likert scale ranging from 1 = relatively weak, 3 = average, to 5 = market leader.

Business performance was captured in terms of two widely adopted measures: profit level and market share (Rosenzweig et al., 2003). Respondents were asked to rate their business performance (i.e., market share and profitability) compared to their competition, using a self-anchored five-point Likert scale, ranging from 1 = relatively weak, 3 = average, to 5 = market leader (Prescott et al., 1986; Venkatraman and Prescott, 1990). Due to the difficulty of obtaining objective data on business performance (Narasimhan and Das, 2001), we relied on the senior managers' perceptions of their business performance. Subjective measures of business performance have been adopted by various researchers in other management disciplines (e.g., Venkatraman and Prescott, 1990; Prescott et al., 1986). We present the list of items used in the study in Appendix A; and in Section 3.4, their psychometric properties.

3.3. Control variables

Two control variables are employed in this study—manufacturing business unit size and environmental dynamism. Consistent with Ward and Duray (2000), we define environmental dynamism as the degree of turbulence in products, technologies, and product demand within a market. This dynamism arises when a decision maker cannot forecast future events based on the information he or she has on hand. A highly dynamic environment imposes great challenges to manufacturers. When the level of environmental dynamism increases, it becomes more difficult for manufacturers to achieve superior performance. Several researchers, including Anderson and Tushman (2001) regard environmental dynamism as the most important competitive environment variable affecting the survival of business units. In light of its potential impact on performance, we introduced it as a control variable in our analyses. We used existing measures from the management literature (Ward and Duray, 2000), and respondents rated the relative degree of turbulence in products, technologies, and product demand within their respective markets (see Appendix A).

Our second control variable is manufacturing business unit (MBU) size. It is identified in a number of research streams as an important organizational characteristic that can affect business unit performance (Chen and Hambrick, 1995; Mintzberg, 1979). Usually, larger business units tend to have larger market size and greater control over the competitive environment (Dean et al., 1998); however, they also tend to be more bureaucratic and contain more management levels than smaller business units (Daft, 1995). In addition, business unit size is a commonly adopted proxy for organization resources (Lin et al., 2007). Several researchers argue that organization resources may affect its capability to achieve an ambidextrous organization (Kyriakopoulos and Moorman, 2004; Venkatraman et al., 2007). Raisch and Birkinshaw (2008) state that wealthier firms have resources that can be exploited and explored simultaneously; whereas firms with fewer resources may be unable to afford such strategies. In order to single out the effect of ambidexterity on business performance from the possible effects of resource availability and manufacturers market power; we include the MBU size as a control variable, measured as the number of employees working within the MBU.

3.4. Measurement properties

Little's (1988) missing completely at random (MCAR) test points out that the missing data patterns for each item do not deviate from a MCAR pattern (χ^2 = 627.48, df = 623, p = .44); therefore, we utilized the Full Information Maximum Likelihood (FIML) approach to missing values. This technique is particularly favourable, as it uses all the available data to generate the maximum likelihood-based statistics (Arbuckle, 2005; Little and Rubin, 2002).

Confirmatory factor analysis (CFA) implemented in Amos 16 was employed to evaluate construct reliability and validity (Anderson and Gerbing, 1988; see Appendix B). To assess the reliability of the study constructs, we used the statistics of composite reliability and average variance extracted (AVE) (Fornell and Larcker, 1981; Hair et al., 1998; Williams et al., 2003). All of our composite reliability values are greater than 0.70 and AVE values greater than or at the level of 0.50 (see Appendix B), indicating acceptable reliability levels (O'Leary-Kelly and Vokurka, 1998; Fornell and Larcker, 1981).

The overall fit of the CFA model is good (Bollen, 1989) (χ^2 = 507.63, df = 367; p = 0.01, χ^2/df = 1.38; IFI = 0.95; NNFI = 0.93; CFI = 0.95, RMSEA = 0.05). Each individual measure is significantly associated with its latent construct, with a coefficient greater than twice of standard errors (see Appendix B). Hence, unidimensionality and convergent validity are supported (Anderson and Gerbing, 1988). Additionally, we used proportion of variance explained (R^2) as another indicator of reliability. Previous studies in the OM literature (e.g., Carr and Pearson, 1999) consider values of R^2 greater than 0.40 as acceptable. As shown in Appendix B, our CFA results indicate that all these criteria are met, and thus, the indicator items within each scale are significantly related to their underlying theoretical constructs.

In order to assess discriminant validity, we formed all possible pairs of latent constructs and tested each pair first by allowing the pair to freely correlate, and then by setting the correlation between them to 1.00. A significant chi-square difference between the two nested models indicates that the two constructs are distinct. In our tests, all the chi-square differences are statistically significant ($p < 0.001$), indicating discriminant validity among the theoretical constructs (O'Leary-Kelly and Vokurka, 1998; Stratman and Roth, 2002; Bagozzi et al., 1991).

We also assessed the criterion-related validity of the profitability measures. Prior studies demonstrate statistically significant correlations between perceptual and corresponding objective measures of performance (Dess and Robinson, 1984; Vickery et al., 1997; Ward et al., 1998; Menor et al., 2001; Roth et al., 2008). Together these studies indicate that perceptual ratings of performance can be considered as reliable indicators. Our research finds the same regarding the criterion-related validity of the subjective profitability measures. Following Bollen (1989), we identified 78 companies from the list of respondents whose profit-related, survey data were also available in COMPUSTAT database. We collected data for the profit before taxes, which is calculated as the ratio of pre-tax income (COMPUSTAT Annual Data Item #170) to net sales (COMPUSTAT Annual Data Item #12) and current assets (COMPUSTAT Annual Data Item #4). We then divided the profit before taxes by current assets to obtain a measure of return on current assets. Finally, we correlated this measure with the composite measure of profitability used in our survey instrument (i.e., we averaged the three items of profitability used in our survey [see Appendix A]). This procedure is only a rough approximation of an ideal assessment of criterion-related validity, because the COMPUSTAT measure is 'absolute' profits with no adjustment to industry and competition, and the subjective measure connotes profits 'relative to competitors.' Nonetheless, the Pearson correlation between the two measures is moderately significant (r = .26, $p < .10$), providing some evidence of criterion validity of the profitability measures.

Finally, since common methods variance is typically a concern when collecting data from single respondents, we addressed this issue in two ways. First, when implementing the survey, we randomized the sequence of items, sought knowledgeable respondents, guaranteed respondents complete anonymity, which was required by our university's Institutional Review Board, and

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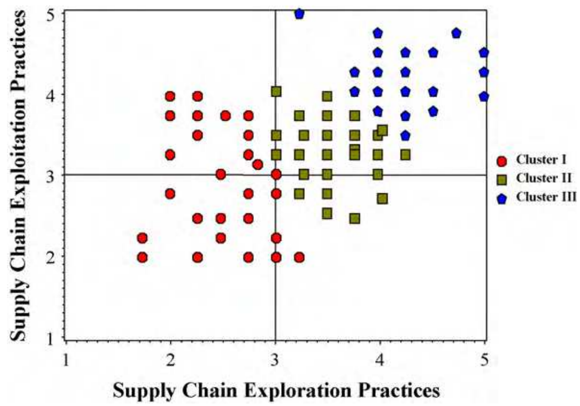

Fig. 2. Cluster analysis results.

asked respondents to answer the questions as best they could (Dillman, 2000). Second, after the survey, we statistically assessed common method bias by introducing "method" as an additional latent factor in the measurement models, and allowing it to lead to all observed indicators (Podsakoff et al., 2003; Siemsen et al., in press). If common method bias exists, after introducing the method factor into the measurement models, the item loadings of the theoretical constructs would become insignificant. Our analysis showed no such changes, indicating that our data do not demonstrate a significant amount of common methods bias. In Table 2, we present the correlation matrix among the observed indicator items and control variables.

4. Results and discussion

4.1. Cluster analysis

To answer our first research question, whether there is any empirical evidence indicating that manufacturers follow an ambidextrous SC strategy, we performed cluster analyses on the entire sample. We averaged the 5-point Likert indicator items tapping into our SC exploitation and exploration constructs, respectively, as depicted in Appendix A. These two theoretically important variables were used as taxons in a two-step cluster analysis, where the ACECLUS and FASTCLUS procedures were implemented in SAS 9.1.3 (Miller and Roth, 1994; Bendoly et al., 2007).

As presented in Fig. 2, our analyses led to a 3-cluster solution, with 35 manufacturers classified into Cluster I; 76, in Cluster II; and 63, in Cluster III (Table 3). The cluster analyses confirmed that 63 (36.0%) manufacturers in Cluster III indeed do follow an ambidextrous SC strategy, with significantly higher mean scores ($p < 0.01$) relative to their Clusters I and II counterparts on both the SC exploration and exploitation practice variables. The manufacturers falling into the Cluster II group showed moderate levels of both SC exploration and exploitation practices. Finally, those belonging to Cluster I (relative to Clusters II and III) demonstrated the lowest average SC exploration and exploitation practices' scores. Interestingly, the competitive capabilities within each cluster display similar rankings to Roth's (1996a) CPT within clusters—findings confirmed empirically by Rosenzweig and Roth's (2004) structural model; and also observed more generally in Rosenzweig and Eastman's (2009) rigorous meta analysis.

To further ensure the validity of our clusters, following Miller and Roth (1994), we used discriminant analyses by calculating the percentage of observations correctly classified among the three clusters, by using a linear discriminant function. Our analysis indicated a 99% success classification rate (see Table 4), which further validates our 3-cluster solution (Hair et al., 1998). In the next section, we continue to test the multivariate performance effects of an ambidextrous SC strategy.

4.2. Structural model

Fig. 3 summarizes the structural representation of the nomological net of hypothesized relationships as posited in

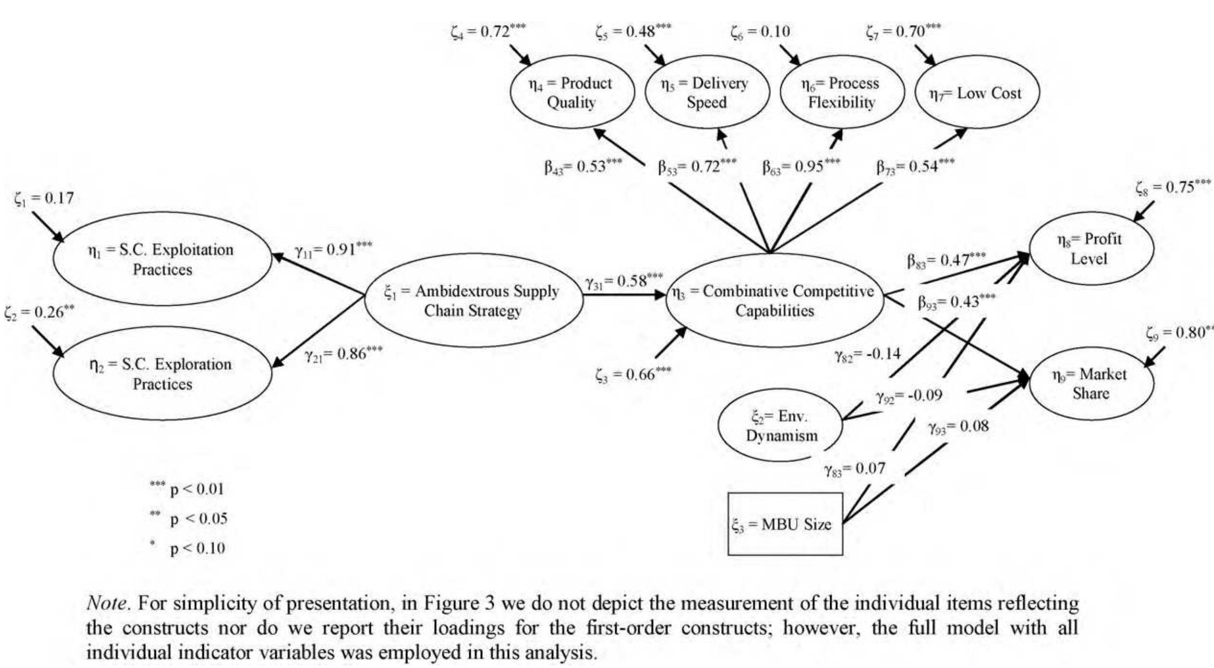

Fig. 3. Structural equation modeling results with standardized parameter estimates. *Note*. For simplicity of presentation, in Figure 3 we do not depict the measurement of the individual items reflecting the constructs nor do we report their loadings for the first-order constructs; however, the full model with all individual indicator variables was employed in this analysis.

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Table 2
Pearson correlations among the observed items.

Item	A1	A2	A3	A4	EA1	EA2	EA3	EA4	PQ1	PQ2	PQ3	PQ4	PF1	PF2	PF3	PF4	C1	C2	DS1	DS2	DS3	ED1	ED2	ED3	MS1	MS2	MS3	P1	P2	P3
A1	1																													
A2	0.42***	1																												
A3	0.44***	0.43***	1																											
A4	0.49***	0.51***	0.48**	1																										
EA1	0.36***	0.40***	0.31**	0.34***	1																									
EA2	0.35***	0.35***	0.36**	0.27***	0.53***	1																								
EA3	0.56***	0.46***	0.42**	0.57***	0.54***	0.60***	1																							
EA4	0.35***	0.33***	0.36**	0.35***	0.50***	0.50***	0.65***	1																						
PQ1	0.18**	0.10	0.29**	0.12	0.16**	0.18**	0.30***	0.33***	1																					
PQ2	0.19***	0.09	0.12	0.01	0.19**	0.14*	0.29***	0.25***	0.63***	1																				
PQ3	0.10	0.15*	0.12	0.10	0.20**	0.14*	0.25***	0.23***	0.56***	0.60***	1																			
PQ4	0.23***	0.09	0.20*	0.14*	0.22***	0.20**	0.29***	0.15**	0.57***	0.44***	0.43***	1																		
PF1	0.15*	0.15**	0.10	0.16**	0.14*	0.10	0.20***	0.11	0.30***	0.27***	0.36***	0.20***	1																	
PF2	0.20***	0.10	0.05	0.20***	0.13	0.14*	0.29***	0.11	0.28***	0.27***	0.39***	0.19**	0.72***	1																
PF3	0.22***	0.14*	0.17*	0.21***	0.15*	0.17**	0.22***	0.09	0.30***	0.34***	0.40***	0.21***	0.74***	0.74***	1															
PF4	0.32***	0.14*	0.21**	0.26***	0.08	0.15*	0.34***	0.24**	0.324**	0.22***	0.21***	0.24***	0.45***	0.39***	0.34***	1														
C1	0.36***	0.32***	0.32**	0.33***	0.25***	0.22***	0.29***	0.29***	0.30***	0.21***	0.22***	0.21***	0.50***	0.38***	0.43***	0.54***	1													
C2	0.24***	0.24***	0.23**	0.24***	0.08	0.25***	0.34***	0.33***	0.26***	0.18**	0.28***	0.12	0.47***	0.46***	0.44***	0.46***	0.50***	1												
DS1	0.22***	0.31***	0.24**	0.29***	0.10	0.27***	0.36***	0.29***	0.27***	0.20***	0.31***	0.17**	0.40***	0.42***	0.41***	0.40***	0.48***	0.76***	1											
DS2	0.19**	0.13	0.19*	0.17**	0.11	0.27***	0.24***	0.19**	0.05	0.00	0.06	−0.04	0.24***	0.22***	0.28***	0.16**	0.34***	0.38***	0.35***	1										
DS3	0.28***	0.19**	0.25**	0.23**	0.16**	0.17**	0.27***	0.19**	0.16**	0.10	0.19***	0.01	0.21***	0.23***	0.22***	0.26***	0.36***	0.37***	0.36***	0.66***	1									
ED1	−0.04	0.08	−0.16**	0.07	0.05	−0.02	−0.06	−0.10	−0.20***	−0.20***	−0.17**	−0.11	−0.01	−0.05	−0.14*	−0.04	0.05	−0.06	−0.01	0.06	0.03	1								
ED2	0.07	0.19**	−0.03	0.12	0.08	0.04	0.11	0.04	0.07	−0.01	0.15**	0.13	0.18**	0.14*	−0.03	0.17**	0.16**	0.16**	0.20***	0.05	0.14*	0.59***	1							
ED3	−0.09	0.06	0.01	0.01	−0.01	0.03	−0.04	−0.02	0.01	−0.08	−0.03	−0.08	0.04	−0.02	−0.12	0.04	0.16**	0.07	0.06	0.11	0.15*	0.57***	0.57***	1						
MS1	0.21**	0.15*	0.09	0.17**	0.13	0.12	0.20**	0.16*	0.25***	0.19**	0.27***	0.17**	0.16*	0.18**	0.18**	0.24***	0.27***	0.11	0.20**	0.04	0.25***	−0.03	0.13	0.01	1					
MS2	0.25***	0.13	0.04	0.14	0.02	0.07	0.19**	0.12	0.26***	0.32***	0.33***	0.17**	0.21**	0.25***	0.28***	0.16*	0.18**	0.10	0.15*	0.01	0.19**	−0.19**	0.08	−0.09	0.73***	1				
MS3	0.11	0.12	0.09	0.12	−0.02	0.08	0.12	0.08	0.37***	0.33***	0.36***	0.30***	0.25***	0.18**	0.250**	0.14	0.27***	0.09	0.16*	−0.05	0.06	−0.13	0.09	−0.08	0.68***	0.75***	1			
P1	0.13	0.12	0.11	0.07	0.07	0.05	0.20**	0.15*	0.24***	0.20**	0.29***	0.20**	0.30***	0.25***	0.27***	0.22***	0.25***	0.19**	0.22***	0.13	0.25***	−0.15*	0.13	−0.09	0.55***	0.51***	0.60***	1		
P2	0.09	0.13	0.06	0.07	−0.05	−0.01	0.16*	0.08	0.15*	0.12	0.16*	0.10	0.27***	0.20**	0.29***	0.16*	0.29***	0.18**	0.19**	0.19**	0.23***	−0.13	0.03	−0.14	0.51***	0.52***	0.57***	0.78***	1	
P3	0.11	0.18**	0.16	0.08	0.07	0.07	0.18**	0.11	0.20**	0.12	0.29***	0.16*	0.32***	0.25***	0.30***	0.17**	0.27***	0.21**	0.29***	0.13	0.26***	−0.14	0.09	−0.08	0.59***	0.48***	0.61***	0.80***	0.73***	1
MBU	−0.03	0.11	−0.03	−0.04	0.11	−0.08	−0.04	−0.01	−0.03	−0.04	0.03	−0.10	−0.15*	−0.08	−0.13	0.02	0.01	0.06	0.06	0.02	0.10	0.07	0.19**	0.25***	0.08	-0.01	0.01	0.07	−0.10	0.08

Note. The correlations are calculated based on list-wise deletion, MBU: Manufacturing Business Unit Size captured by Number of Employees.

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$.

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Table 3
Cluster Analysis results: comparison of competitive capabilities and supply chain practices means by cluster.

	Cluster I (N = 35)	Cluster II (N = 76)	Cluster III (ambidextrous group) (N = 63)	F-statistic
Supply chain practices				
SC Exploration[1]	2.51 (II, III)[2]	3.55 (I, III)	4.23 (I, II)	282.11***
SC Exploitation[1]	2.90 (II, III)	3.37 (I, III)	4.06 (I, II)	103.52***
Competitive capabilities				
Product Quality	3.68 (II, III)	4.05 (I)	4.22 (I)	11.08***
Delivery	3.55 (III)	3.78	3.97 (I)	3.97**
Process Flexibility	3.10 (II, III)	3.40 (I, III)	3.81 (I, II)	17.58***
Low Cost	2.61 (II, III)	3.07 (I)	3.33 (I)	9.24***
Combinative Competitive Capabilities	3.24 (II, III)	3.58 (I, III)	3.83 (I, II)	19.38***

[1] These scales are used as taxons for the cluster analysis. See Appendix A.
[2] Numbers in the parentheses indicate the results of pairwise comparisons among the cluster means with Bonferonni correction ($p < 0.10$).
** $p < 0.05$.
*** $p < 0.01$.

Table 4
Percent of cluster classifications correctly classified and cross-validation.

Actual classification/predicted classification	Cluster I	Cluster II	Cluster III (ambidextrous group)	Cluster totals
Cluster I	35 (100%)	0 (0%)	0 (0%)	35 (100%)
Cluster II	1 (1.32%)	74 (97.37%)	1 (1.32%)	76 (100%)
Cluster III (ambidextrous group)	0 (0%)	0 (0%)	63 (100%)	63 (100%)
Error rates from Cross Validation	0.00	0.03	0.00	0.01
Posterior probabilities	20.69	42.53	36.78	

Note. The numbers in parenthesis are the percentages of correctly classified "hits" as predicted by the discriminant analysis to the number of actual observations from the cluster analysis (or cluster totals) (Example: 97.37% = 74/76).

Section 2. To evaluate our hypotheses, we first analyzed the fit of the proposed model using structural equation modeling (SEM). Overall fit indices of the structural model indicate that our theoretical model fits the data well (Bollen, 1989) (χ^2 = 602.43; df = 419; $p < 0.01$; IFI = .93; NNFI = .91; CFI = .93; RMSEA = 0.05; see Appendix C). Along with the satisfactory overall fit of the model, the positive and significant path loadings linking ambidextrous SC strategy to SC exploitation practices (γ_{11} = .91, $p < 0.01$) and to SC exploration practices (γ_{21} = .86, $p < 0.01$) lend support for Hypothesis 1. Consistent with the literature on manufacturing strategy (Ferdows and DeMeyer, 1990; Flynn and Flynn, 2004; Rosenzweig and Roth, 2004; Roth, 1996a) that contends a bundle of competitive capabilities can be acquired in a holistic sense, our results support Hypothesis 2 that links combinative capabilities to quality (β_{43} = .53, $p < 0.01$), delivery speed (β_{53} = .72, $p < 0.01$), process flexibility (β_{63} = .95, $p < 0.01$), and low cost (β_{73} = .54, $p < 0.01$). In addition, we find support for Hypothesis 3 that relates ambidextrous SC strategy to combinative capabilities (γ_{31} = .58, $p < 0.01$), and Hypotheses 4a and b which relate combinative capabilities to profit level (β_{83} = .47, $p < 0.01$) and market share (β_{93} = .43, $p < 0.01$). Notably, neither environmental dynamism nor MBU size was found to have significant effects on business performance, which suggests that the results are not driven by MBU size or environmental dynamism as we operationalized them.

We conducted an additional analysis to test Hypotheses 5a and 5b, which indicates that combinative capabilities mediate the relationship between ambidextrous SC strategy and business performance. Mediation occurs when the dependent variable is regressed on both independent and mediating variables; as a result, the direct effect of the independent variable on the dependent variable diminishes (i.e., indicating partial mediation), or disappears (i.e., indicating full mediation) (Judd and Kenny, 1981). In order to test the effect of ambidextrous SC strategy on firm business performance, we added two direct paths to our original model—one linking ambidextrous SC strategy to market share; and one linking ambidextrous SC strategy to profit level. We refer to this model as the mediation model. In order to analyze the *mediation model*, we followed the approaches of Bollen (1987) and James et al. (2006) to decompose the *mediation model* effects into direct effects (i.e., D.E.: influence of a predictor variable on a dependent variable that is unmediated by the intervening variable), indirect effects (i.e., I.E.: the effect of a predictor variable on a dependent variable that is mediated by the intervening variable), and total effects (i.e., T.E.). Table 5 gives the path loadings relevant for testing Hypotheses 5a and 5b.

The *mediation model's* overall fit indices indicate that it is consistent with the data (χ^2 = 600.97; df = 417; $p < 0.01$; IFI = .93; NNFI = .91; CFI = .93; RMSEA = 0.05). Ambidextrous SC strategy influences both profit level (T.E. = .20, $p < 0.05$) and market share (T.E. = .25, $p < 0.01$). It also indirectly affects profit level (I.E. = .33, $p < 0.01$) and market share (I.E. = .26, $p < 0.01$) via combinative capabilities. Given that our hypothesized model (depicted in Fig. 3) and mediation model are nested models, we also tested the chi-

Table 5
Mediation model: direct, indirect and total effects of ambidextrous sc strategy on combinative competitive capabilities and firm performance (N = 174).

	Combinative competitive capabilities	Profit level	Market share
Ambidextrous SC strategy			
Total Effect (T.E)	0.59***	0.20**	0.25***
Direct Effect (D.E)	0.59***	−0.13	−0.01
Indirect Effect (I.E)	–	0.33***	0.26***
Combinative Competitive Capabilities			
Direct Effect (D.E)	–	0.57***	0.45***

Note. Statistical significance was calculated following the approaches of Sobel (1982) and Goodman (1960). * $p < 0.10$
** $p < 0.05$.
*** $p < 0.01$.

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square difference between these two models. The chi-square difference is 1.46 with 2 degrees of freedom, which is statistically insignificant. Combined with insignificant direct effects of ambidextrous SC strategy on profit levels (D.E = -0.13, $p > 0.10$) and on market share (D.E. = -0.01, $p > 0.10$), as well as the insignificant change in the fit statistics, the results indicate combinative capabilities fully mediate the relationship between ambidextrous SC strategy and business performance (James et al., 2006). This result highlights the important role as indicated by theory that combinative capabilities play in the relationship between ambidextrous SC strategy and business performance. A test of the robustness of these results was performed by estimating the model paths using the two-stage least squares procedure implemented in SAS 9.1.3, Proc 2SLS procedure. Two-stage least squares is a robust procedure in the sense that it is distribution free, and that the asymptotic standard errors are appropriate for significance testing–even under conditions of nonnormality or excessive multivariate kurtosis of the observed variables (Bollen, 1996; Bollen and Biesanz, 2002). Only minor differences in effect sizes were observed; otherwise the conclusions are the same.

5. Conclusion

This study empirically investigates the value of ambidextrous SC strategy on a manufacturer's combinative capabilities and business performance. Specifically, we operationalize ambidextrous SC strategy as a second-order latent construct in order to capture the co-variation between SC exploitation and exploration. Building upon dynamic capabilities theory, the knowledge-based view (KBV), and Ashby's (1958) law of requisite variety, we developed a mediation model where we formally hypothesized that an ambidextrous SC strategy would have a positive effect on combinative capabilities. This in turn, contributes to high profit level and market share. Our empirical research confirms this perspective: An ambidextrous SC strategy is a viable strategic choice by which manufacturers can leverage sources of external supply chain knowledge to build internal competencies and capabilities. Counter to the tradeoffs view of exploration and exploitation in the innovation literature, we provide empirical evidence of the complementary view of exploration and exploitation within the supply chain management context. Importantly, the notion of complementarity supports the emerging theory in which a balance between SC exploration and SC exploitation is associated with favourable performance effects. Thus, our model connotes a holistic view of ambidextrous SC strategy by examining the co-alignment (Venkatraman, 1989) of SC exploitation and SC exploration; and when taken separately, each is deemed insufficient in describing an ambidextrous SC strategy.

The parallels in other literatures that also embrace a holistic view of operations strategy are noteworthy. Take for example, a body of quality management and operations strategy literature that emphasizes theoretically and shows empirically, the importance of implementing a set of manufacturing practices simultaneously to build operational competencies and capabilities (Giffi et al., 1990). Cua et al. (2001) illustrate this point when they applied a holistic view to the implementation of TQM, JIT and TPM. The authors found that the joint implementation of common practices and basic techniques of TQM, JIT and TPM leads to improved manufacturing performance.

As in all research, this study has its limitations. One such limitation is the issue of single respondents. This issue – along with common method variance, a result of single-respondent research – has been discussed widely in various areas (Podsakoff and Organ, 1986; Siemsen et al., in press). To overcome this problem, we used the help of the Institute for Supply Management and identified respondents who are experts on the issues of interest. We also performed statistical tests for common method bias and did not find any significant effects. In future studies we will further address this limitation by using multiple knowledgeable respondents from each manufacturer.

We built our structural model on theoretical grounds and used the guidance of supply chain experts. However, future research would benefit from longitudinal data to capture the dynamics in the evolution of the supply chains, and observe how these supply chains implement ambidexterity over time. This limitation also presents a new avenue for our future research by following the manufacturers that responded to our survey, and examine how they learn and adapt to their competitive environments over time. We plan to continue working with our respondents to collect longitudinal data that will enable us to draw an evolution trajectory of these manufacturers' ambidextrous SC strategy.

Finally, our study analyzes ambidextrous strategy from a single manufacturer's perspective. An interesting future research project could be to analyze the impact of an ambidextrous SC strategy in the context of an entire supply chain network, such as proposed by Kauppila (2007). Additional performance metrics, for instance, inter-organizational relationship performance can also be included in future investigations to enrich understanding of the antecedents and consequences of ambidextrous SC strategy from a network perspective.

In conclusion, this research makes several major contributions to the existing literature. First, although ambidexterity has been studied in other disciplines, its applicability to SCM and OM is largely missing. Leveraging theories from other disciplines allows us to investigate the enablers of operations capabilities from a fresh angle, that of an ambidextrous SC strategy. This research is one of the initial efforts to extend and empirically test the notion of ambidexterity in the supply chain management context, as well as develop metrics with good psychometric properties for this notion.

Second, the confirmation of hypotheses pertaining to the performance implications of an ambidextrous SC strategy enriches our theoretical understanding of how operations capabilities can be acquired through supply chain management. The finding that combinative capabilities act as a mediator between an ambidextrous SC strategy and business performance offers a theoretical explanation of its observed total and positive joint effects. Potentially adding to the operations frontier notion (Schmenner and Swink, 1998) and Roth's (1996a) CPT, an ambidextrous strategy that draws upon supply chain knowledge and resources may extend a manufacturer's operational bandwidth; thus, creating slack resources that push the frontier and enable combinative capabilities.

Third, the study provides insights into managerial practices. Specifically, the importance of an ambidextrous SC strategy for managers implies that even under constant pressures to achieve short-term performance and cost-cutting incentives, supply chain managers should not shirk from continuously exploring their supply chains for new ideas, processes, practices and technologies. Such exploration reinforces and fosters organizational learning needed for building multiple, dynamic capabilities. As Lee (2004) notes in numerous examples, top performing supply chains all exhibit simultaneous mastering of combinative capabilities. Thus, supply chain managers should continuously leverage their existing supply chain capabilities as well as search for new sources of supply chain competence.

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Appendix A. Constructs and scale items

A.1. SC ambidexterity constructs and metrics

Wording of Question Headings: Listed below are supply chain management practices that may affect firms' ability to compete in an industry. Please indicate your level of agreement with these statements about your business unit's supply chain practices over the past 12 months (1 = strongly disagree, 3 = neutral, 5 = strongly agree).

SC Exploitation Practices (A): A manufacturer's efforts to refine and extend its existing resources (representative references: March, 1991; Levinthal and March, 1993; Lewin et al., 1999; Lewin and Volberda, 1999).

A1: In order to stay competitive, our supply chain managers focus on reducing operational redundancies in our existing processes.
A2: Leveraging of our current supply chain technologies is important to our firm's strategy.
A3: In order to stay competitive, our supply chain managers focus on improving our existing technologies.
A4: Our managers focus on developing stronger competencies in our existing supply chain processes.

SC Exploration Practices (EA): A manufacturer's efforts to develop new supply chain competencies through experimenting and acquisition of new knowledge and resources (representative references: March, 1991; Levinthal and March, 1993; Lewin et al., 1999; Lewin and Volberda, 1999).

EA1: We proactively pursue new supply chain solutions.
EA2: We continually experiment to find new solutions that will improve our supply chain.
EA3: To improve our supply chain, we continually explore for new opportunities.
EA4: We are constantly seeking novel approaches in order to solve supply chain problems.

A.2. Combinative competitive capabilities constructs and metrics

Wording of Question Headings: Listed below are the critical success factors for competing in an industry. Please indicate your assessment of the strength of your business unit for each capability relative to your competitors' in the same markets over the past 12 months. Please think of your primary product(s) while answering these questions (1 = relatively weak, 3 = average, 5 = market leader).

Product Quality (PQ): A manufacturer's capability to consistently achieve conformance to specifications, fitness for use.

PQ1: Conformance quality (i.e., the degree to which a product's operating characteristics meet established standards).
PQ2: Product durability (i.e., the amount of time or use before the product breaks down and replacement is preferred to continued repair).
PQ3: Product reliability (i.e., the probability of a product malfunctioning or failing within a specified time period).
PQ4: Performance quality (i.e., a product's primary operating characteristics).

Delivery Speed (DS): A manufacturer's capability to deliver products in a short time.

DS1: Being able to provide fast-response deliveries from order to end customer.
DS2: Order fulfillment lead time.
DS3: Delivery lead time.

Process Flexibility (PF): A manufacturer's capability to adjust or modify the operational processes to speedily accommodate changes, for example, in production volumes or product mix with minimal penalties in efficiency (representative references: Menor et al., 2007; Rosenzweig et al., 2003; D'Souza and Williams, 2000; Roth, 1996a; Roth et al., 1989; Roth and Miller, 1988).

PF1: Ability to rapidly change production volumes.
PF2: Manufacture broad product mix within same facilities.
PF3: Ability to rapidly modify methods for materials.
PF4: Ability to rapidly modify methods for components.

Low Cost (C): A manufacturer's capability to compete on cost.

C1: Offering lower-priced products.
C2: Manufacturing similar products at a lower cost than our competitors.

A.3. Business performance

Wording of Question Headings: How do you perceive your business unit's performance relative to your competitors (1 = relatively weak, 3 = average, 5 = market leader).

Market Share (MS): Relative sales and market growth (representative references: Dess and Robinson, 1984; Vickery et al., 1997; Ward et al., 1998; Roth et al., 2008).

MS1: Your position on your sales growth rate compared to your competitors'.
MS2: Your satisfaction with your sales growth rate compared to your competitors'.
MS3: Your market-share gains relative to your competitors'.

Profit Level (P): Relative profit performance (representative references: Dess and Robinson, 1984; Vickery et al., 1997; Ward et al., 1998; Roth et al., 2008).

P1: Return on corporate investment position relative to competition.
P2: Net profit position relative to competition.
P3: ROI position relative to competition.
P4: Return on sales position relative to competition.

A.4. Control variables

Wording of Question Headings: Listed below are critical business-environment factors for competing in an industry. Please indicate your perceptions regarding the following aspects of business environment change (1 = very slow, 3 = average, 5 = very rapid).

Environmental Dynamism (ED): The degree of turbulence in products, technologies, and product demand in a market (representative references: Ward and Duray, 2000).

ED1: The rate at which products and services become outdated.
ED2: The rate of innovation of new products and services.
ED3: The rate of change of tastes and preferences of customers in your industry.

A.5. Manufacturing Business Unit (MBU) size

What is your business unit's number of employees?

[] Under 50 [] 50–99 [] 100–499 [] 500–999 [] 1000–2499 [] Over 2500.

Appendix B. Measurement model (CFA) results

Items	Predictor	Parameter	Standardized parameter estimates	S.E.	C.R.	*p*-value	R^2	Composite reliability	Average variance extracted
A1 (y_1)	SC Exploitation Practices (η_1)	y_{11}	0.72	0.13	7.12	***	0.51	0.78	0.47
A2 (y_2)		y_{21}	0.67	0.18	6.78	***	0.45		
A3 (y_3)		y_{31}	0.62	–	–	a	0.38		
A4 (y_4)		y_{41}	0.73	0.14	7.40	***	0.53		
EA1 (y_5)	SC Exploration Practices (η_2)	y_{52}	0.64	0.12	7.53	***	0.41	0.83	0.55
EA2 (y_6)		y_{62}	0.67	–	–	a	0.45		
EA3 (y_7)		y_{72}	0.90	0.14	9.67	***	0.81		
EA4 (y_8)		y_{82}	0.72	0.15	8.31	***	0.52		
PQ1 (y_9)	Product Quality (η_4)	y_{94}	0.80	–	–	a	0.65	0.82	0.54
PQ2 (y_{10})		y_{104}	0.78	0.09	9.81	***	0.61		
PQ3 (y_{11})		y_{114}	0.74	0.09	9.28	***	0.54		
PQ4 (y_{12})		y_{124}	0.62	0.13	7.52	***	0.38		
DS1 (y_{13})	Delivery Speed (η_5)	y_{134}	0.87	0.07	13.56	***	0.75	0.89	0.74
DS2 (y_{14})		y_{144}	0.84	0.08	13.00	***	0.71		
DS3 (y_{15})		y_{154}	0.87	–	–	a	0.75		
PF1 (y_{16})	Process Flexibility (η_6)	y_{166}	0.64	0.13	7.04	***	0.41	0.78	0.48
PF2 (y_{17})		y_{176}	0.76	0.14	8.06	***	0.58		
PF3 (y_{18})		y_{186}	0.69	–	–	a	0.48		
PF4 (y_{19})		y_{196}	0.66	0.06	15.15	***	0.44		
C1 (y_{20})	Low Cost (η_7)	y_{207}	0.78	–	–	a	0.61	0.80	0.67
C2 (y_{21})		y_{217}	0.86	0.16	6.77	***	0.73		
P1 (y_{22})	Profit Level (η_8)	y_{228}	0.91	–	–	a	0.82	0.91	0.78
P2 (y_{23})		y_{238}	0.86	0.08	13.93	***	0.73		
P3 (y_{24})		y_{248}	0.88	0.07	14.75	***	0.78		
MS1 (y_{25})	Market Share (η_9)	y_{259}	0.81	–	–	a	0.66	0.88	0.72
MS2 (y_{26})		y_{269}	0.85	0.10	11.03	***	0.72		
MS3 (y_{27})		y_{279}	0.88	0.09	11.37	***	0.77		
ED1 (x_1)	Environmental Dynamism (ξ_2)	x_{12}	0.77	–	–	a	.61	0.80	0.57
ED2 (x_2)		x_{22}	0.75	0.12	7.93	***	.58		
ED3 (x_3)		x_{32}	0.75	0.13	7.92	***	.57		

[a] This regression weight was fixed at 1.0. The S.E., C.R. and *p-value* were not estimated in these cases. However, by fixing a different parameter, we determined that the estimates of these scaled values are also statistically significant with $p < .01$.

[***] $p < .01$.

Appendix C. Structural loadings for Fig. 3

Outcomes	Predictor	Hypotheses	Parameter	Standardized parameter estimates[a]	S.E.	C.R.	*p*-value
SC Exploitation Practices (η_1)	Ambidextrous SC Strategy (ξ_1)	H1 Supported	γ_{11}	0.91	–	–	b
SC Exploration Practices (η_2)			γ_{21}	0.86	0.21	4.94	***
Combinative Competitive Capabilities (η_3)		H3 Supported	γ_{31}	0.58	0.10	3.88	***
Product Quality (η_4)	Combinative Competitive Capabilities (η_3)	H2 Supported	β_{43}	0.53	–	–	a
Delivery Speed (η_5)			β_{53}	0.72	0.32	4.94	***
Process Flexibility (η_6)			β_{63}	0.95	0.37	5.00	***
Low Cost (η_7)			β_{73}	0.54	0.32	3.91	***
Profit Level (η_8)		H4a Supported	β_{83}	0.47	0.32	3.93	***
Market Share (η_9)		H4b Supported	β_{93}	0.43	0.26	3.61	***
Profit Level (η_8)	Environmental Dynamism (ξ_2)	Control Variables	γ_{82}	−0.14	0.10	−1.50	*
Market Share (η_9)			γ_{92}	−0.09	0.09	−0.98	*
Profit Level (η_8)	Firm Size (ξ_3)		γ_{83}	0.08	0.05	0.95	
Market Share (η_9)			γ_{93}	0.08	0.04	0.87	

[**] $p < 0.05$.

[a] Because the individual item loading do not differ substantively from the measurement model presented in Appendix B, we did not report them for sake of brevity.

[b] Item loading is fixed to 1.

[*] $p < 0.10$.

[***] $p < 0.01$.

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