

**UNDERSTANDING VARIATION IN MANAGERS' AMBIDEXTERITY:
INVESTIGATING DIRECT AND INTERACTION EFFECTS
OF FORMAL STRUCTURAL AND PERSONAL COORDINATION MECHANISMS**

Tom J.M. Mom*

Rotterdam School of Management, Erasmus University
Department of Strategic Management and Business Environment
P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
Tel: +31 (0)10 408 2005; Fax: +31 (0)10 408 9013; E-mail: tmom@rsm.nl

Frans A.J. Van Den Bosch

Rotterdam School of Management, Erasmus University
Department of Strategic Management and Business Environment
P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
Tel: +31 (0)10 408 2005; Fax: +31 (0)10 408 9013; E-mail: fbosch@rsm.nl

Henk W. Volberda

Rotterdam School of Management, Erasmus University
Department of Strategic Management and Business Environment
P.O. Box 1738, 3000 DR Rotterdam, The Netherlands
Tel: +31 (0)10 408 2005; Fax: +31 (0)10 408 9013; E-mail: hvolberda@rsm.nl

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*Corresponding author.

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Understanding variation in managers' ambidexterity: Investigating direct and interaction effects of formal structural and personal coordination mechanisms

ABSTRACT

Previous research focuses on firm and business unit level ambidexterity. Therefore, conceptual and empirically validated understanding about ambidexterity at the individual level of analysis is very scarce. This paper addresses this gap in the literature by investigating managers' ambidexterity, delivering three contributions to theory and empirical research on ambidexterity. First, by proposing three related characteristics of ambidextrous managers. Second, by developing a model and associated hypotheses on both the direct and interaction effects of formal structural and personal coordination mechanisms on managers' ambidexterity. And third, by testing the hypotheses based on a sample of 716 business unit level and operational level managers.

Findings regarding the formal structural mechanisms indicate that a manager's decision making authority positively relates to this manager's ambidexterity whereas formalization of a manager's tasks has no significant relationship with this manager's ambidexterity. Regarding the personal coordination mechanisms, findings indicate that both participation of a manager in cross-functional interfaces and connectedness of a manager to other organization members, positively relate to this manager's ambidexterity. Furthermore, results show positive interaction effects between the formal structural and personal coordination mechanisms on managers' ambidexterity. The paper's theoretical contributions and the empirical results increase our understanding about managers' ambidexterity and about how different types and combinations of coordination mechanisms relate to variation in managers' ambidexterity.

Keywords: ambidexterity, manager level, coordination mechanisms, interaction effects

As current literature focuses on ambidexterity at the business unit and firm level of analysis, conceptual and empirically validated understanding about ambidexterity at the individual level of analysis is very scarce (Raisch & Birkinshaw, 2008). Hence, scholars like Gupta et al. (2006: 703) and Raisch & Birkinshaw (2008: 397) suggest investigating ambidexterity at the individual level of analysis as a promising direction for future research. This paper addresses this gap in the literature by investigating managers' ambidexterity. Existing studies refer to ambidexterity as a firm's or business unit's ability to combine exploration and exploitation related activities (e.g. Gibson & Birkinshaw, 2004; O'Reilly & Tushman, 2004). Based on these literatures, we define ambidexterity at the manager level, as a manager's behavioral orientation toward combining exploration and exploitation related activities within a certain period of time (cf. Gibson & Birkinshaw, 2004: 210; O'Reilly & Tushman, 2004: 81; Tushman & O'Reilly, 1996: 24).

The relevance of investigating managers' ambidexterity is emphasized by studies which discuss a firm's ability to become ambidextrous in terms of, for instance, managers' decision making processes (Rivkin & Siggelkow, 2003), the extent to which managers engage in routine and/ or non-routine activities (Adler et al., 1999), or in terms of managers' collective and creative actions (Sheremata, 2000). In line with these authors, O'Reilly and Tushman (2004: 81) conclude that 'one of the most important lessons is that ambidextrous organizations need ambidextrous senior teams and managers'. These examples illustrate the importance to increase understanding about what is ambidexterity at the manager level of analysis, and about what drives variation in managers' ambidexterity.

Although some studies provide valuable examples of managers' ambidextrous behavior (e.g. O'Reilly & Tushman, 2004; Tushman & O'Reilly, 1996), ambidexterity research at this level of analysis would benefit from further conceptualization. We contribute to this by proposing and clarifying three related characteristics of ambidextrous managers; i.e. ambidextrous managers host contradictions (Smith & Tushman, 2005; Tushman & O'Reilly, 1996), they are multitaskers (Birkinshaw & Gibson, 2004; Floyd & Lane, 2000), and they both refine and renew their knowledge, skills, and expertise (Floyd & Lane, 2000; Hansen et al., 2001; Sheremata, 2000).

The paper also delivers a contribution to our understanding about what drives variation in managers' ambidexterity, by developing a model and testing hypotheses on the relations between two generic types of coordination mechanisms and managers' ambidexterity; i.e. formal structural and personal coordination mechanisms. Previous research indicates the importance of these two types of coordination mechanisms as key organizational elements which influence managers' behavior by shaping their relations and their interactions with other individuals, groups, or organization-units (e.g. Martinez & Jarillo, 1989; Van De Ven et al., 1976). The importance of both types of coordination mechanisms is also reflected in the literature on ambidexterity (Raisch & Birkinshaw, 2008). Whereas some highlight the importance of formal structural mechanisms for a firm's pursuit of ambidexterity (e.g. Benner & Tushman, 2003; Duncan, 1976), others illustrate the importance of more personal relationships among organization members (e.g. Gibson & Birkinshaw 2004; Sheremata, 2000). Studies on coordination indicate that different types of coordination mechanisms may differently affect organization members' behavior (e.g. Daft & Lengel, 1986; Van De Ven et al., 1976). However, much more remains to be understood about whether and how the two different types of coordination mechanisms differently relate to managers' ambidexterity (Jansen et al., 2006).

Several studies on ambidexterity argue that combining different organizational elements may stimulate organization members' ambidexterity, like combining 'hard elements' and 'soft elements' (Gibson & Birkinshaw, 2004: 213), or combining 'centrifugal' and 'centripetal' elements (Sheremata, 2000). However, both conceptual and empirically validated insight on the combined effect of such different organizational elements on ambidexterity is scarce (Raisch & Birkinshaw, 2008; Rivkin & Siggelkow, 2003). To contribute to this issue both theoretically and empirically, we will not only develop and test hypotheses on the direct relations between both types of coordination mechanisms and managers' ambidexterity, but also on the interaction effects between the two types of mechanisms. With respect to the interaction effects, Raisch & Birkinshaw (2008: 399) explicitly suggest that: 'Future research could formally develop and test propositions on how different antecedents interact and complement one another in a firm's pursuit of organizational ambidexterity'.

Summarizing, this paper aims to deliver *three contributions* to the literature on ambidexterity. First, by proposing and clarifying three related characteristics of ambidextrous managers by

integrating insights from previous studies. Second, by developing a model and associated hypotheses on both direct and interaction effects of formal structural and personal coordination mechanisms on managers' ambidexterity. And third, by testing the hypotheses based on a sample of 716 managers. In the next section, we elaborate on the concept of managers' ambidexterity and develop the model and associated hypotheses. The methods section provides details about the sample, data collection, and the development and validation of the measurement instrument. Next, we present the empirical findings and conclude with a discussion of the results, implications, and issues for further research.

THEORY AND HYPOTHESES

Managers' Ambidexterity

Based on reviewing and integrating insights from previous studies we propose the following *three related characteristics* of ambidextrous managers: First, *ambidextrous managers host contradictions* (Smith & Tushman, 2005; Tushman & O'Reilly, 1996). That is, they have the motivation and ability to be sensitive to, to understand, and to pursue a range of seemingly conflicting opportunities, needs, and goals (O'Reilly & Tushman, 2004). Related to this, previous research points out the need for ambidextrous managers to deal with conflict (Duncan, 1976; Floyd & Lane, 2000), and to engage in paradoxical thinking (Gibson & Birkinshaw, 2004; Smith & Tushman, 2005). Examples from the literature, which illustrate this characteristic, indicate that ambidextrous managers search for new market needs and technological opportunities, while also being sensitive to reinforce existing product-market positions (Burgelman, 2002; Tushman & O'Reilly, 1996); they both elaborate on existing goals, beliefs, and decisions and reconsider these (cf. Ghemawat & Ricart I Costa, 1993; Rivkin & Siggelkow, 2003); and they have both a short-term and a long-term orientation towards identifying and pursuing opportunities (O'Reilly and Tushman, 2004).

Second, *ambidextrous managers are multitaskers*; i.e. they fulfill multiple roles and conduct multiple different tasks within a certain period of time (Birkinshaw & Gibson, 2004: 45; Floyd & Lane, 2000). Related to this, authors indicate that ambidextrous managers are more generalists rather than more specialists (Birkinshaw & Gibson, 2004; Leana & Barry, 2000). The literature illustrates

this characteristic by indicating that ambidextrous managers fulfill multiple roles related to both competence deployment and competence definition activities (Floyd & Lane, 2000; Sanchez et al. 1996), conduct both routine and non-routine activities (Adler et al., 1999), carry out both creative and collective actions (Sheremata, 2000), and typically act outside the narrow confines of their own job (Adler et al., 1999; Gibson & Birkinshaw, 2004).

Third, *ambidextrous managers both refine and renew their knowledge, skills, and expertise* (Floyd & Lane, 2000; Hansen et al., 2001; Sheremata, 2000). Related to this, prior research indicates the importance for ambidextrous managers to acquire and process different kinds of knowledge and information (Floyd & Lane, 2000; Sheremata, 2000). Examples from the literature illustrate that ambidextrous managers engage in both reliability enhancing and variety increasing learning activities (Holmqvist, 2004; McGrath, 2001), process and acquire both explicit and tacit knowledge (Lubatkin et al., 2006; Nonaka & Konno, 1998), and engage in both local and distant search for knowledge and information within their network of contacts (Hansen et al., 2001; Subramaniam & Youndt, 2005).

Direct Impact of Formal Structural Coordination Mechanisms on Managers' Ambidexterity

Formal structural coordination mechanisms are one of the most important mechanisms for coordinating activities. We focus in this study on decentralization and formalization, as these emerge most consistently in studies of the components of the formal structure (Miller & Dröge, 1986). Furthermore, by focusing on decentralization and formalization, we follow other studies which also investigate formal structural coordination mechanism (e.g. Jansen et al., 2006; Zmud, 1982). To investigate decentralization at the manager level of analysis, we focus on a manager's decision making authority (Ghoshal et al., 1994; Sheremata, 2000). To investigate formalization at the manager level of analysis, we focus on the extent of formalization of a manager's tasks; i.e. on the degree to which rules and codes describe a particular task, and the degree to which the manager has to conform to the task description (Hage, 1965; Pugh et al., 1963).

A manager's decision making authority. A manager's decision making authority is about the extent to which a manager has decision making authority referring to how and which tasks the manager performs, to solve problems, and to set goals (Atuahene-Gima, 2003; Dewar et al., 1980).

Increasing managers' decision making authority increases their sense of responsibility with respect to how they conduct their tasks and with respect to the performance of these tasks (Tushman & O'Reilly, 1996; Zmud, 1982). This stimulates their willingness to become aware and recognize a larger diversity of organizational, market, and technological opportunities and needs, and to become more sensitive to understanding how to act upon these different opportunities and needs (Miller, 1987; Pierce & Delbecq, 1977; Tushman & O'Reilly, 1996). For instance, studies indicate that increasing managers' decision making authority triggers them to not only focus on short term needs and associated benefits, but to also increasingly attend to opportunities that will define the future (Pierce & Delbecq, 1977; Zmud, 1982) and to the associated long term benefits (Miller, 1987; O'Reilly & Tushman, 2004). Related to this, others indicate that increasing managers' decision making authority increases their urge to seek solutions to problems both within and outside the framework of the existing strategy and beliefs (Ghemawat & Ricart I Costa, 1993; Sheremata, 2000).

Furthermore, increased decision making authority increases managers' self control and ownership of tasks and decisions (Hage & Aiken, 1967; Tushman & O'Reilly, 1996), which enables them to act upon the recognized diversity of opportunities and needs; to actively pursue a range of diverse goals (O'Reilly & Tushman, 2004: 81), i.e. to act ambidextrously. That is, as Gibson & Birkinshaw (2004: 211) put it, increased self control and ownership augments managers' ability 'to make their own choices as to how they divide their time between alignment- and adaptability-oriented activities', and it increases their aspiration to attain to both efficiency and flexibility related goals (Adler et al., 1999). Finally, due to increased decision making authority, managers have to rely more on their own skills and expertise, rather than on rules or the skills and expertise of superiors (Hage & Aiken, 1967). This increases these managers' motivation to refine their existing skills and expertise, as well as to develop new skills and expertise (Crossan & Berdrow, 2003; McGrath, 2001; Floyd & Lane, 2000). These arguments suggest the following hypothesis:

Hypothesis 1 A manager's decision making authority will be positively related to this manager's ambidexterity

Formalization of a manager's tasks. Formalization of a manager's tasks refers to the degree to which rules and codes describe a particular task, provide guides for decision making, provide guides for conveying decisions, instructions, and information, and the degree to which the manager has to conform to the task description (Hage, 1965; Pugh et al., 1963). Increasing formalization of managers' tasks increases the possibility that these managers become less receptive to decision making stimuli which are not monitored by formal systems (Cyert & March, 1963). Hence, higher levels of formalization are associated with singleness of purpose (Pierce & Delbecq, 1977); it decreases the range of different opportunities and goals managers are likely to pursue (Hage, 1965; Miller, 1987). This is negatively associated with their level of ambidexterity; ambidextrous managers pursue a range of different goals (Tushman & O'Reilly, 1996) and 'have the ability to understand and be sensitive to the needs of very different kinds of business' (O'Reilly & Tushman, 2004: 81).

Moreover, for being able to pursue a range of different goals and to deal with associated conflicts (Floyd & Lane, 2000), ambidextrous managers need to cooperate and to 'combine their efforts' with other organization members (Birkinshaw & Gibson, 2004: 49; Duncan, 1976: 181). However, increasing formalization of tasks increases managers' sense of isolation resulting from associated difficulties to comprehend the relationship of their tasks to a larger purpose (Organ & Greene, 1981). This may result in a reduced motivation to cooperate and combine efforts with others (Hage & Aiken, 1969; Pierce & Delbecq, 1977). Increasing formalization of managers' tasks also necessitates them to develop more expertise in a limited area (Hage, 1965); it augments these managers' level of specialization and their depth of knowledge within the confines of the formalized tasks (Daft & Lengel, 1986; Zander & Kogut, 1995). This reduces these managers' ability to act ambidextrously; it reduces their ability to act outside the narrow confines of their jobs (Adler et al., 1999), and it makes it more difficult for them to broaden their range of skills (Daft & Lengel, 1986); i.e. to be 'more generalist' rather than 'more specialist' (Birkinshaw & Gibson, 2004). These arguments suggest the following hypothesis:

Hypothesis 2 *Formalization of a manager's tasks will be negatively related to this manager's ambidexterity*

Direct Impact of Personal Coordination Mechanisms on Managers' Ambidexterity

Besides formal structural coordination mechanisms, the literature emphasizes the importance of 'personal types' (Cray, 1984: 87) of coordination mechanisms. Such coordination mechanisms comprise personal relationships between organization members which typically cut across organizational units and hierarchical levels, and include 'direct contact, liaison roles, task forces, and teams' (Galbraith, 1973: 89; see also Egelhoff, 1991; Martines & Jarillo, 1989). Liaison roles, task forces, and teams are more formal personal coordination mechanisms (Gupta & Govindarajan, 2000) as compared to direct contacts, which are more informal and voluntary modes of personal coordination (Tsai, 2002). In this study, we consider both types of personal relationships by investigating participation in cross-functional interfaces by a manager; i.e. liaison roles, task forces, and teams (cf. Gupta & Govindarajan, 2000), and a manager's direct contacts in terms of the manager's connectedness to other organization members (cf. Jaworski & Kohli, 1993).

Participation in cross-functional interfaces by a manager. Cross-functional interfaces encompass lateral integration mechanisms such as liaison personnel, task forces, and teams (Galbraith, 1973; Gupta & Govindarajan, 2000). Participation of managers in cross-functional interfaces increases their cooperation with other managers of different functions, units, and hierarchical levels (Galbraith, 1973; Miller, 1987). These other managers are likely to differ in their relationship to the firm's existing strategy, goals, interests, time horizon, core values, and emotional tone (Floyd & Lane, 2000; Whetten, 1978). Hence, besides bringing in their own specialized expertise, and besides representing the interest of their own specific group, managers who participate in cross-functional interfaces also have to think and act outside the narrow confines of their own job and position; i.e. they have to understand and take into consideration the interests, perspectives, beliefs, and values of other managers (Duncan, 1976; Floyd & Lane, 2000; Miller, 1987).

Furthermore, cross-functional interfaces increase trust between managers of differentiated units (Adler et al., 1999; Galbraith, 1973), which is 'a critical contextual factor' for managers to 'shift the tradeoff between efficiency and flexibility' (Adler et al., 1999: 63). It creates a supportive context for managers with different backgrounds to cooperate and learn from each other (Gibson &

Birkinshaw, 2004). Related to this, Duncan (1976) points out that participation in cross-functional interfaces enables managers' ambidextrous behavior by allowing them to confront and resolve conflicts regarding different goals, needs and interests between differentiated organizational units and hierarchical levels. Managers' participation in cross-functional interfaces also positively relates to their ambidexterity by offering opportunities to exchange knowledge (Egelhoff, 1991; Gupta & Govindarajan, 2000). Cross-functional interfaces offer opportunities for managers to refine their existing knowledge by acquiring knowledge which is related to their own knowledge base. These interfaces serve, for instance, as mechanisms to exchange knowledge and information regarding best practices of related technologies, processes, or markets, allowing managers to increase or refine their skills and expertise in a limited or specialized area (Henderson & Cockburn, 1994; Jansen et al., 2005). At the same time, by participating in cross-functional interfaces, managers renew their knowledge base by acquiring new or unrelated knowledge from managers with different expertise (Egelhoff, 1991; Ghoshal & Bartlett, 1988). These arguments suggest the following hypothesis:

Hypothesis 3 Participation in cross-functional interfaces by a manager will be positively related to this manager's ambidexterity

Connectedness of a manager to other organization members. Connectedness of a manager relates to the extent to which the manager is networked to other organization members across hierarchical levels and organizational units in terms of direct personal contacts (Jaworski & Kohli, 1993; Sheremata, 2000). It refers to the size of the manager's network of direct contacts across hierarchical levels and organizational units, and to the pattern of the manager's network in terms of density (Jansen et al., 2006; Jaworski & Kohli, 1993; Sheremata, 2000). An increasing size of a manager's network of direct contacts across hierarchical levels and organizational units is associated with increasing possibilities for that manager to identify and acquire knowledge for both exploration and exploitation purposes (Hansen et al., 2001: 26; Nahapiet & Ghoshal, 1998: 248; Subramaniam & Youndt, 2005). A manager may benefit from using network contacts by acquiring new and diverse knowledge to, for instance, develop new competences (Floyd & Lane, 2000), pursue radical innovations (Subramaniam & Youndt, 2005), or to find innovative solutions to problems (Sheremata,

2000). A manager may also benefit from using network contacts by obtaining related and complementary knowledge to, for instance, improve and refine existing competences (Floyd & Lane, 2000), to pursue incremental innovations (Subramaniam & Youndt, 2005), or to reinforce existing beliefs and decisions (Rivkin & Siggelkow, 2003).

Increasing levels of density of direct personal contacts within a manager's network is associated with an increased ability by that manager to acquire and understand complex and ambiguous knowledge from the network contacts (Hansen et al., 2001), and to engage in reciprocal, non-routine information processing (Daft & Lengel, 1986; Egelhoff, 1991). These characteristics enable that manager to reduce equivocality surrounding exploratory tasks (Daft & Lengel, 1986; Lubatkin et al., 2006: 648). At the same time, increasing levels of density within a network increases trust and cooperation and decreases the likelihood of goal conflict within the network (Adler & Kwon, 2002; Rowley et al., 2000), which benefits the exploitation of new knowledge and the implementation of innovations (Jansen et al., 2005; Sheremata, 2000).

These arguments suggest that connectedness is positively related to a manager's ambidextrous behavior. However, beyond a moderate level, increasing levels of a manager's connectedness may have dampening effects on that manager's ambidexterity. Increasingly dense networks diffuse strong norms, establish shared behavioral expectations, and create a dominant logic (Bettis & Wong, 2003; Miller, 1993; Rowley et al., 2000). This reduces, first, managers' openness to different opportunities, needs, and perspectives (Nahapiet & Ghoshal, 1998), which reduces their motivation and ability to host contradictions (Smith & Tushman, 2005). And second, it constrains managers to perform broad searches for acquiring knowledge and information (Jansen et al., 2005), which reduces their ability to both refine and renew their knowledge base (Hansen et al., 2001; Sheremata, 2000). Furthermore, a large and densely connected network may decrease managers' ability to engage in high levels of both exploration and exploitation related activities as maintaining such a network requires time and effort to stay in touch and interact with others (Hansen et al., 2001; Uzzi, 1997). Hansen et al. (2001), for instance, show that maintaining a densely connected network is associated with reduced speed and efficiency in completing both explorative and exploitative projects. These arguments suggest the following hypothesis:

Hypothesis 4 There will be an inverted U-shaped relationship between connectedness of a manager to other organization members and this manager's ambidexterity

Interaction Effects between Formal Structural and Personal Coordination Mechanisms

A manager's decision making authority and participation in cross-functional interfaces. As argued above, increasing decision making authority of managers positively relates to their ambidexterity by increasing their freedom and ability to actively pursue a range of diverse goals (Gibson & Birkinshaw 2004; O'Reilly & Tushman, 2004). However, increasing freedom to actively pursue a range of diverse goals confronts managers with the challenge to reduce uncertainty and equivocality about which goals to pursue, about how to pursue a range of diverse goals, and about the possible outcomes of the goals being pursued (Floyd & Lane, 2000; Smith & Tushman, 2005). Participation in cross-functional interfaces increases managers' opportunities and ability to reduce such uncertainty and equivocality (Daft & Lengel, 1986; Miller, 1978), for instance, by promoting thorough and multifaceted assessments of problems, proposals, and projects, by exchanging information, opinions, and judgments with experts, by eliciting factual arguments from managers who have to defend their proposals before peers, and by offering opportunities for consultation (Daft & Lengel, 1986; Egelhoff 1991; Miller, 1978).

Furthermore, as increasing decision making authority of managers enables them to pursue a range of diverse goals (Gibson & Birkinshaw 2004; O'Reilly & Tushman, 2004), authors indicate the importance for ambidextrous managers to deal with conflict. Pursuing multiple and different goals is associated with getting confronted with other managers who hold different expectations, who have different perspectives, and who pursue contrasting goals (Duncan, 1976: 180; Floyd & Lane, 2000: 162; Smith & Tushman, 2005: 525). Participation in cross-functional interfaces increases managers' ability to effectively confront and resolve conflicts with other managers in several ways. For example, by stimulating discussion and cooperation among them (Duncan, 1976: 181), by stimulating trust among them (Adler et al., 1999: 52), and by motivating systematic attempts to scrutinize and reconcile divergent perspectives (Miller, 1987: 11).

Finally, increasing decision making authority of managers positively relates to their ambidexterity by increasing their motivation to use and refine their existing skills and expertise as well as to develop new skills and expertise (Crossan & Berdrow, 2003; McGrath, 2001; Floyd & Lane, 2000). Participation in cross-functional interfaces increases managers' opportunities to do so, by creating a context for managers with different backgrounds to learn from each other (Gibson & Birkinshaw, 2004), and by offering opportunities to exchange knowledge which enables participants to acquire both new and diverse knowledge and related and complementary knowledge (Egelhoff, 1991; Jansen et al., 2005). These arguments suggest the following hypothesis:

Hypotheses 5 There will be positive interaction effects between a manager's decision making authority and participation in cross-functional interfaces by the manager, on this manager's ambidexterity

A manager's decision making authority and connectedness. Increasing managers' decision making authority positively relates to these managers' ambidexterity by stimulating their willingness to become aware and recognize a large diversity of organizational, market, and technological opportunities and needs (Pierce & Delbecq, 1977; Sheremata, 2000; Tushman & O'Reilly, 1996). An increasing size of managers' networks helps them to become more aware and recognize a larger diversity of such opportunities and needs, by creating more possibilities to search for and identify different ideas, information, and inputs from organization members across hierarchical levels and organizational units (Birkinshaw & Gibson, 2004; Burt, 1992; Jaworski & Kohli, 1993).

Furthermore, increasing decision making authority of managers positively relates to their ambidexterity as it makes them more sensitive to thoroughly understand the identified diverse needs and opportunities for being able to act upon them (Adler et al., 1999; Sheremata, 2000). However, understanding ideas, information, and inputs from different units and levels in an organization may be difficult as they tend to develop different languages, world views, and thought worlds (Burns & Stalker, 1961; Duncan, 1976). Increasing connectedness of a manager to other organization members enhances this manager's ability to better understand and act upon the identified diverse needs and opportunities. This understanding can be improved through the ability of densely connected networks

to reduce ambiguity surrounding different needs and opportunities by engaging into frequent, reciprocal, and non-routine information processing (Daft & Lengel, 1986; Egelhoff, 1991).

Finally, as indicated by Hypothesis 4, increasingly dense networks may have dampening effects on managers' ambidexterity by diffusing strong norms and creating a dominant logic (Bettis & Wong, 2003; Miller, 1993; Rowley et al., 2000). This constrains managers to perform broad searches for knowledge and information (Jansen et al., 2005), and it reduces their openness to different opportunities, needs, and perspectives (Nahapiet & Ghoshal, 1998). Increasing levels of managers' decision making authority may, however, countervail these negative effects of densely connected networks (Sheremata, 2000: 401). For instance, increasing decision making authority stimulates managers to broaden their search for knowledge and information outside their current network of contacts (Jansen et al., 2005: 1001), leading to a richer network of diverse knowledge (Hage & Aiken, 1967: 510). Related to this, others have indicated that increasing decision making authority enlarges the diversity of managers' perspectives (Zmud, 1982), increases variety in their experience (McGrath, 2001), and enlarges the range of diverse solutions they find to problems (Atuahene-Gima, 2003). These arguments suggest the following hypothesis:

Hypotheses 6 There will be positive interaction effects between a manager's decision making authority and connectedness of the manager to other organization members, on this manager's ambidexterity

Formalization of a manager's tasks and participation in cross-functional interfaces.

Increasing formalization of managers' tasks negatively relates to their ambidexterity by fostering singleness of purpose and, hence, decreasing the range of different goals these managers are likely to pursue (Hage, 1965; Pierce & Delbecq, 1977). Participation in cross-functional interfaces may reduce these effects of formalization; it forces managers to increase the range of different goals to take into consideration (Miller, 1987; Whetten, 1978), as it demands them to cooperate with other managers who are likely to differ in terms of interests, perspectives, beliefs, and values (Duncan, 1976).

Furthermore, increasing formalization of managers' tasks negatively relates to managers' ambidexterity as it increases their sense of isolation resulting in a reduced motivation of these

managers to combine efforts with others (Hage & Aiken, 1969; Organ & Greene, 1981). The literature indicates, however, that participation in cross-functional interfaces pulls managers out of their isolation and increases their motivation to combine efforts with others. For instance, it positively influences motivation to work together to solve problems (Sheremata, 2000), to implement innovations (Duncan, 1976), and to generate mutual commitment to take and realize decisions (Bahrami & Evans, 1987).

Finally, increasing formalization of managers' tasks negatively relates to these managers' ambidexterity by stimulating them to increasingly develop expertise within the specialized area of their formalized tasks (Hage, 1965; Zander & Kogut, 1995), and by making it more difficult for them to broaden their knowledge and skill base (Daft & Lengel, 1986). Effective participation in cross-functional interfaces, however, requires managers to understand, enter into discussion, and interact, with managers from different fields of expertise and with different knowledge related backgrounds (Egelhoff, 1991; Ghoshal & Bartlett, 1988). Consequently, participation in cross-functional interfaces stimulates managers to learn from each other (Nonaka & Konno, 1998), to broaden their expertise beyond the narrow confines of their own job (Bahrami & Evans, 1987; Miller, 1987), and to broaden their knowledge base by acquiring, assimilating, and using new knowledge (Jansen et al., 2005).

These arguments suggest the following hypothesis:

Hypotheses 7 There will be positive interaction effects between formalization of a manager's tasks and participation in cross-functional interfaces by the manager, on this manager's ambidexterity

Formalization of a manager's tasks and connectedness. Increasing formalization of managers' tasks negatively relates to these managers' ambidexterity as formalization increases the possibility that a manager becomes less receptive to decision making stimuli which are not monitored by formal systems (Cyert & March, 1963). An increasing size of managers' networks across organization units and hierarchical levels may more than compensate these effects of formalization by extending the number of information channels by which a manager can access valuable ideas, insights, and information (Burt, 1992; Ghoshal et al., 1994). Furthermore, an increasingly dense

network of personal contacts positively influences the speed by which these ideas, insights and information become available to the network members (Burt, 1992; Nahapiet & Ghoshal, 1998).

Furthermore, increasing formalization of managers' tasks negatively relates to their ambidexterity by reducing the extent to which these managers establish and maintain interpersonal relations (Hage & Aiken, 1969; Pugh et al., 1963). Moreover, it may increase a sense of isolation resulting in a reduced motivation to cooperate and combine efforts with others (Organ & Greene, 1981; Pierce & Delbecq, 1977). Increasing levels of connectedness with other organization members may compensate these effects as it is directly associated with establishing and maintaining an increasing number of interpersonal relations (Jaworksi & Kohi, 1993). Furthermore, increasing levels of densely connected relations decrease the network members' sense of isolation, and increase their motivation to cooperate and combine efforts by developing trust and mutual identification (Adler & Kwon, 2002; Coleman, 1990), by providing a common frame of reference (Coleman, 1990; Uzzi, 1997), and by reducing the probability of opportunistic behavior (Rindfleisch & Moorman, 2001).

Finally, increasingly dense networks may have dampening effects on a manager's ambidexterity as maintaining a large and densely connected network requires time and effort which is associated with increased costs and reduced efficiency in performing tasks and with reduced speed in completing both explorative and exploitative projects (Hansen et al., 2001; Uzzi 1997). Increasing levels of formalization of managers' tasks may undo these negative effects of increasing levels of connectedness as increasing formalization of tasks is associated with higher production, greater efficiency in performance, and increased speed of decision making (Baum & Wally, 2003; Hage, 1965; Hall et al., 1967). These arguments suggest the following hypothesis:

Hypotheses 8 There will be positive interaction effects between formalization of a manager's tasks and connectedness of the manager to other organization members, on this manager's ambidexterity

METHODS

Sample and Data Collection

We followed existing quantitative studies on managers' activities which typically draw upon a sample comprised of a large number of managers of a small number of firms (e.g. Ghoshal et al., 1994; Ireland et al., 1987; Walsh, 1988). To test the hypotheses, we obtained data through a survey of managers in five large firms. Each of these firms ranks among the top 25 on the Fortune Global 500 (2007) in terms of total revenues in their industry. The choice of these five companies was a result of several considerations. To minimize compromising the external validity of the findings due to industry specific effects, we selected firms that operate in different manufacturing and service industries (Gibson & Birkinshaw, 2004); electronics (Firm A), financial services (Firm B), accountancy and professional services (Firm C), telecommunications (Firm D), and chemicals (Firm E). Furthermore, investigating managers' ambidexterity compelled us to examine managers whose firms are confronted with pressures to explore and with pressures to exploit. Several studies indicate (e.g. Banker et al., 2005; Flier et al., 2001; Gibson & Birkinshaw, 2004; Henisz & Macher, 2004) that firms in the selected industries are forced to explore due to changes regarding technologies, customer demands, competition, and regulation. These studies also indicate that, at the same time, these firms are forced to exploit due to short term competitive pressures in terms of an increased pressure to focus on efficiency and cutting costs, and increasing importance of economies of scale. Moreover, focusing on large firms increased the possibility to observe variance, not only in this study's dependent variable, but also in the explanatory variables (Ghoshal et al., 1994; McDonough & Leifer, 1983).

In each of the firms, the survey was sent, in consultation with corporate top management, to a number of selected managers. These are business unit level and operational level managers with various functional backgrounds such as R&D, Marketing and Sales, and Operations. Furthermore, the managers represent a wide variety in terms of demographic characteristics like age, job-tenure, functional-tenure, and education. The survey was sent to 1,797 managers. For each firm, chi-square tests ($p < .05$; $\alpha = .05$) indicate that the distribution of the managers over the hierarchical levels and functional areas corresponds to the distribution of all managers. This indicates that bias due to the sampling procedure may not be a problem. To ensure confidentiality, we agreed not to reveal the names of the respondents and to return the completed surveys to us without interference of corporate

management. We received 755 completed surveys, corresponding to a response rate of 42%. List-wise deletion of cases with missing values reduced the final sample size to 716¹; i.e. 110, 161, 186, 148, and 111 managers of firm A, B, C, D, and E respectively. This sample included 215 business unit level managers and 501 operational level managers. The average age of the managers is 39 years, the average job-tenure within the firm is 10 years, and the average span of control is 41 employees.

We examined differences between respondents and non-respondents to test for non-response bias. Chi-square tests ($p < .05$; $\alpha = .05$) indicate that the distribution of the respondents over the firms, hierarchical levels, and functions corresponds to the population's distribution. We also compared early and late respondents (t -test; $p < .05$) in terms of demographic characteristics and model variables as late respondents can be expected to be similar to non-respondents (Armstrong & Overton, 1977). No significant differences appeared, indicating that non-response bias may not be a problem.

Measures and Validation

Dependent variable. We constructed a scale to measure a manager's ambidexterity, as an appropriate scale at the individual level was not available in the literature. Scales of firm or business unit ambidexterity are constructed by combining measures of exploration and exploitation (Gibson & Birkinshaw, 2004; He & Wong, 2004; Lubatkin et al., 2006). Following this practice, we started by developing measures for exploration and exploitation at the manager level of analysis.

To develop these measures, the following steps were taken. *First*, following the definition of ambidexterity at the manager level, we developed seven manager's exploration activity items and seven manager's exploitation activity items. To enhance content validity, we developed these items based on the features by which March (1991: 71) characterized the constructs of exploration and exploitation, and based on studies which illustrate managers' ambidextrous behavior in terms of exploration and exploitation related activities (e.g. Adler et al. 1999; Floyd & Lane, 2000; Ghemawat & Ricart I Costa, 1993; Tushman & O'Reilly 1996). *Second*, to further increase content validity and to enhance the wording of the items, six in-depth interviews were held by the authors with managers

¹ We identified two cases with residual values larger than three standard deviations (Aiken & West, 1991). Excluding these two outliers did not change any of the results.

of various hierarchical and functional positions of firms A, B, and C. During the interviews, managers were asked to complete the questionnaire, to indicate the relevance of the items, and to indicate any ambiguity regarding the phrasing of the items. Based on these interviews, the content and phrasing of the items was further enhanced by the authors, a process which resulted in a test-version of the survey. *Third*, to allow enhancement of the reliability, unidimensionality, and convergent and discriminant validity of the exploration and exploitation scales, we quantitatively tested the scales based on data we obtained through a test-version of the survey of 33 managers of various hierarchical and functional positions of firms A, B, and C. Following reliability and validity analyses, five ambiguous items of the exploration and exploitation scales were identified. *Fourth*, during 12 in-depth interviews with managers of various hierarchical and functional positions of firms A, B, and C, managers were asked to suggest improvements to the ambiguous items as identified at the previous step. Based on these interviews, we further enhanced the phrasing of these items, a process which resulted in the final version of the scales. The exploration scale determines the extent to which a manager engaged in exploration activities last year, while the exploitation scale determines the extent to which the manager engaged in exploitation activities last year.

To check for convergent and discriminant validity, we performed exploratory and confirmatory factor analyses. Exploratory factor analysis (see Table 1) with Varimax rotation with all 14 items, based on the survey data, revealed that two summated scales could be constructed; one exploration scale with the seven exploration items and one exploitation scale with the seven exploitation items. Eigenvalues for each factor were greater than 3.6, all items loaded on their appropriate factors at greater than .69, and no item cross-loading was greater than .18. Both scales are reliable; exploration $\alpha = .90$; exploitation $\alpha = .87$. We conducted confirmatory factor analysis (CFA) of the 14 items to check for discriminant validity of the constructs. Results indicate that the two-factor model fits the data well (NFI = .93, CFI = .95, RMSEA < .07). Moreover, a comparison of a one-factor model with a two-factor model shows a significant improvement in fit ($\Delta\chi^2$ significant at $p < .001$) providing evidence of discriminant validity (Bagozzi & Phillips, 1982).

INSERT TABLE 1 ABOUT HERE

Prior studies combine exploration and exploitation measures to assess ambidexterity (Gibson & Birkinshaw, 2004; He & Wong, 2004; Lubatkin et al., 2006). Gibson & Birkinshaw's (2004: 211) conceptualization of ambidexterity explicitly takes the ambidextrous behavior of individuals into consideration. In our study on individual level ambidexterity, we followed their approach by assessing managers' ambidexterity by computing the multiplicative interaction between managers' exploration activities and managers' exploitation activities.

Independent variables. This study's measures of the formal structural and personal coordination mechanisms are based on existing scales. To measure the extent of *a manager's decision making authority*, we used a four item scale of Dewar et al., 1980, which assesses the extent to which a manager has decision making authority referring to the performance of his or her tasks, and to set goals ($\alpha = .91$). To assess the extent of *formalization of a manager's tasks*, this study used a four item scale from Desphande and Zaltman (1982), which measures the extent to which a manager's tasks are being defined by rules, procedures, or regulations ($\alpha = .89$). To measure participation in *cross-functional interfaces by a manager*, this study used a scale on the basis of Nadler and Tushman (1987) and Gupta and Govindarajan (2000), which assesses the extent to which a manager participates in cross-unit and cross-hierarchical integrative mechanisms, asking each manager to what extent he or she (1) coordinates work across internal organizational boundaries, (2) works in temporary task forces, and (3) works in permanent teams. Following Gupta & Govindarajan (2000: 495) and Jansen et al. (2005: 1005), we constructed the final measure as a weighted average of the three items, where the first item is given a weight of 1, the second item a weight of 2, and the last item a weight of 3. To measure *connectedness of a manager to other organization members*, a four-item scale, based on Jaworski and Kohli (1993) and Jansen et al. (2006) was used, assessing the extent to which a manager is networked or connected to other organization members across hierarchical levels and organizational units in terms of direct personal contacts ($\alpha = .87$). Prior to the creation of the *interaction terms* in the regression models, we mean centered the independent variables to reduce multi-collinearity (Aiken & West, 1991). Appendix 1 shows the items of the independent variables.

Control Variables. Managers' experience may influence their ambidexterity; increased levels of experience are associated with an increased ability to interpret and deal with a larger diversity of

ambiguous cues (Daft & Lengel, 1986: 555). The broadness of experience also matters, as an ambidextrous manager's skill base is 'more generalists' rather than 'more specialists' (Birkinshaw & Gibson, 2004: 49). To control for experience, we included a manager's *age* and *tenure within the firm*, which are expected to positively relate to managers' ambidexterity (Tushman & O'Reilly, 1996: 27). We also included a manager's *tenure in his or her current function*, which is associated with increasing levels of specialization, and, hence, is expected to negatively relate to their ambidexterity (cf. Birkinshaw & Gibson, 2004: 49). Increasing levels of education are associated with increasing cognitive abilities to process information and learning (Papakandis et al., 1998), which may positively relate to managers' ambidexterity (Adler et al., 1999: 51). We controlled for *educational effects* by including two dummy variables; one reflecting managers with Master degrees or higher, and another reflecting managers with Bachelor degrees, making managers with degrees below Bachelor level the reference group. Exploration and exploitation compete for scarce resources (March, 1991). Managers of larger units may have more resources at their disposal, which can be allocated to both exploration and exploitation activities (Lewin et al., 1999). To control for *size effects*, we included the natural log of the number of subordinates of a manager. The *hierarchical level* of a manager may impact upon the manager's level of ambidexterity. Higher level managers are typically expected to be more ambidextrous than lower level managers (Floyd & Lane, 2000: 158; O'Reilly & Tushman, 2004). We distinguished business unit level managers and operational level managers, and controlled for hierarchical level effects by including one dummy variable (business unit level = 1, operational level = 0). Business unit level managers had at least two levels of supervisors under their responsibility and no more than two reporting levels below top executives. Operational level managers report to business unit managers or to levels below these managers (cf. Ireland et al., 1987: 474). Levels of managers' exploration and exploitation activities may differ across *functional areas* (Duncan, 1976). We created three dummy variables, one for Research & Development (R&D), one for Marketing and Sales (M&S), and one for Operations, to control for functional effects. Dummies for R&D and M&S are included in the regression models. *Environmental dynamism* may influence the extent to which a manager engages in exploration and/ or exploitation activities (Jansen et al., 2006; Lewin et al., 1999). We therefore included a four-item scale ($\alpha = .89$) that captured the degree of environmental dynamism

that a manager faces (Dill, 1958; Jansen et al., 2006). Sample items are, “My (internal or external) clients regularly ask for complete new products and services” and “In my business, changes are intense.” Finally, to control for organizational contextual factors (Gibson & Birkinshaw, 2004), we created dummy variables reflecting the five *firms*. No dummy has been included for firm E, making this firm the reference firm.

Validation. We conducted exploratory and confirmatory factor analyses including all items of this study’s constructs, i.e. those measuring exploration, exploitation, and the four coordination mechanisms, to assess construct validity of the measures. Results of the exploratory factor analysis (extraction method: principal component analysis; rotation method: varimax with Kaiser normalization) indicate that the measures were appropriately constructed; eigenvalues for each factor were greater than 1, all items loaded on their appropriate factors at greater than .67, and no item cross-loading was greater than 30, supporting the six factor solution. We conducted an integrated confirmatory factor analysis on all items. We allowed each item to load only on the factor for which it was a proposed indicator. Results indicate that the six factor model fits the data well (NFI = .92, CFI = .95, RMSEA < .05). Moreover, a comparison of a one-factor model with a two-factor model for every pair among the factors shows a significant improvement in fit for each of the 15 pairs ($\Delta\chi^2$ significant at $p < .001$) providing evidence of discriminant validity (Bagozzi & Phillips, 1982).

ANALYSIS AND RESULTS

INSERT TABLES 2 AND 3 ABOUT HERE

Table 2 shows descriptive statistics and correlations for all variables. Table 3 presents the results of the hierarchical regression analyses for managers’ ambidexterity. To examine multicollinearity, we calculated variance inflation factors (VIF) for each of the regression equations. VIF factors are between 3.48 and 1.08, which is below the rule-of-thumb cut-off of 10 (Neter et al., 1990); issues of multicollinearity seem not to be a problem. Among the control variables, the full model – Model 3 of Table 3 – shows that age and tenure in the current function negatively relate to

managers' ambidexterity, that tenure in the firm and environmental dynamism positively relate to managers' ambidexterity, that business unit level managers are more ambidextrous than operational level managers, and that managers of Firm A are more ambidextrous than those of the reference Firm, whereas managers of Firm D are less ambidextrous.

Tests of main effects. Model 2 of Table 3 shows the main effects referring to hypotheses 1, 2, 3, and 4. This model shows that a manager's decision making authority positively relates to this manager's ambidexterity ($\beta = .14, p < .001$), supporting Hypothesis 1. The coefficient for formalization of a manager's tasks is positive and not significant ($\beta = .03, ns$); hence, Hypothesis 2 is not supported. Participation of a manager in cross-functional interfaces positively relates to the manager's ambidexterity ($\beta = .19, p < .001$), supporting Hypothesis 3. Regarding connectedness of a manager to other organization members, we predicted an inverted U-shaped relationship with this manager's ambidexterity. As Model 2 shows, the coefficient for connectedness is positive and significant ($\beta = .17, p < .001$). However, the coefficient for the squared term is positive and not significant ($\beta = .03, ns$). Accordingly, the relationship between a manager's connectedness to other organization members and the manager's ambidexterity is positive rather than curvilinear, thereby not supporting Hypothesis 4. Regarding the size of the three significant main effects, two significant differences appear. That is, the coefficient of participation in cross-functional interfaces is larger than the coefficient of decision making authority (t -value of difference = 2.47; $p < .05$; 2-tailed testing), and the coefficient of connectedness is larger than the coefficient of decision making authority (t -value of difference = 1.94; $p < .05$; 2-tailed testing). Hence, the direct effect of the two personal coordination mechanisms on manager's ambidexterity is larger than the direct effect of the formal structural coordination mechanisms.

Tests of interaction effects. Model 3 of Table 3 shows the interaction effects referring to Hypotheses 5, 6, 7, and 8. As the inclusion of connectedness squared did not significantly improve model fit (Model 2 of Table 3), we dropped the squared term in Model 3 (e.g. Katila & Ahuja, 2002). The interaction term between a manager's decision making authority and participation in cross-functional interfaces by the manager is positive and significant ($\beta = .12, p < .001$), supporting Hypothesis 5. Hypothesis 6 is also supported as the interaction term between a manager's decision

making authority and the manager's connectedness to other organization members is positive and significant ($\beta = .09, p < .01$). The interaction term between formalization of a manager's tasks and the manager's participation in cross-functional interfaces is positive and significant ($\beta = .09, p < .01$), supporting Hypothesis 7. Hypothesis 8 is also supported as the interaction term between formalization of a manager's tasks and the manager's connectedness to other organization members is positive and significant ($\beta = .11, p < .01$). These results indicate that positive interaction effects exist between the formal structural and the personal coordination mechanisms on managers' ambidexterity. There are no significant differences between the four interaction effects in terms of their size.

Post hoc analyses. The sample's managers can be grouped into different functional areas, firms, and hierarchical levels. We conducted several post hoc analyses, which indicate that (1) possible functional area, firm, or hierarchical level specific characteristics are not driving the results of the paper as presented in Table 3, and (2) the results as reported in Table 3 do not significantly differ across functional area, firm, or hierarchical level subgroups of managers. With respect to the second result there are two exceptions; the effect of decision making authority on ambidexterity is larger for operational level manager than for business unit level managers, whereas the effect of participation in cross-functional interfaces on ambidexterity is larger for business unit level managers than for operational level managers. For the detailed procedures and results of the post hoc analyses we refer to Appendix 2.

DISCUSSION AND CONCLUSION

The current body of research on ambidexterity focuses on firm and business unit level ambidexterity. Although some scholars explicitly argue that 'ambidextrous organizations need ambidextrous senior teams and managers' (O'Reilly and Tushman, 2004: 81), conceptual and empirically validated understanding about what is ambidexterity at the manager level of analysis, and about variation in managers' ambidexterity, is still underdeveloped (Gupta et al., 2006; Raisch & Birkinshaw, 2008). This paper contributed to further understanding on both issues in three ways: (1) by proposing and clarifying three related characteristics of ambidextrous managers by integrating insights from prior

research; (2) by developing a model and associated hypotheses on both the direct and interaction effects of formal structural and personal coordination mechanisms on managers' ambidexterity; and (3) by testing the hypotheses based on a sample of 716 business unit level and operational level managers. The paper's contributions raise several important issues for both theory and practice.

First, whether ambidextrous managers may exist; i.e. whether exploration and exploitation exclude each other at the individual level of analysis is still debated (cf. Gupta et al., 2006). Although it may be argued to be 'very difficult for an individual to (...) excel at both exploration and exploitation' (Gupta et al., 2006: 696), this paper demonstrates that these difficulties are not insurmountable. By integrating insights from previous studies, we theorized and illustrated three related characteristics of ambidextrous managers. Empirically, the paper also demonstrates that managers can indeed be ambidextrous; i.e. that they may engage in high levels of both exploration and exploitation related activities. This is, for instance, illustrated by the results of the exploratory and confirmatory factor analyses which show that exploration and exploitation are two distinct latent factors of a second order construct; managers' ambidexterity. This indicates that managers' exploration and exploitation activities are not mutually exclusive ends of a continuum. Furthermore, as the data indicates, managers differ in the extent to which they are ambidextrous. Whereas some are not ambidextrous by focusing on either exploration or exploitation, others are ambidextrous by engaging in high levels of both exploration and exploitation related activities.

Second, the paper furthers theoretical and empirically validated understanding about variation in managers' ambidexterity by developing and testing hypotheses on the *direct effects* of formal structural and personal coordination mechanisms on managers' ambidexterity. Existing studies on firm or business unit level ambidexterity mostly put forward structural mechanisms for advancing ambidexterity (e.g. Benner & Tushman, 2003; Duncan, 1976), whereas others have illustrated the importance of more personal relationships (e.g. Birkinshaw & Gibson, 2004; Subramaniam & Youndt, 2005). Regarding individual level ambidexterity, the hypotheses of this paper indicate that both kinds of mechanisms matter for managers' ambidexterity. However, the empirical findings on the direct effects indicate that both types might not be equally effective. Instead, the findings emphasize the relatively large effect of the personal types of coordination mechanisms as compared to

the formal structural types of mechanisms on managers' ambidexterity. This is in line with recent studies on learning and coordination, which indicate the importance of more informal and personal types of coordination for shaping knowledge and learning related processes and activities of organization members (e.g. Argote et al., 2003; Faraj & Xiao, 2006).

Interestingly, two hypotheses on the direct effects were not confirmed. With regard to formalization of a manager's tasks (Hypothesis 2), our findings did not provide support for the predicted negative relation with a manager's ambidexterity. This may concur with recent insights that formalized routines may increase information flows to managers which may improve their overall quality and speed of decision making (Baum & Wally, 2003). Formalized rules and procedures may also include processes for effecting change (Adler & Borys, 1996), which corresponds to Adler's et al. (1999: 45) concept of 'metaroutines' that may enable organizations to become more ambidextrous by transforming non-routine into more-routine tasks. As the effect of formalization on individuals' behavior may be contingent on its design, future studies could differentiate between types of formalization, such as enabling and coercive types (Adler & Borys, 1996). Regarding connectedness of a manager to other organization members across hierarchical levels and organization units, Hypothesis 4 predicted an inverted U-shaped relationship with this manager's ambidexterity. Instead, we found the relationship to be positive rather than curvilinear. Apparently, the expected dampening effects of increasing levels of connectedness on managers' ambidexterity are not present in the data sample. A possible explanation may be the study's research context, i.e. large firms in which members of organization units may differ considerably from each other in terms of values, norms, and their knowledge base, due to different products or services they provide, different technologies or processes they apply, and different markets they serve. Hence, future research may examine the impact of other characteristics of managers' personal networks such as the level of heterogeneity, which may make the diffusion of strong norms and the creation of a dominant logic more difficult, even if the network is densely connected (Reagans & Zuckerman, 2001; Rodan & Galunic, 2004; Smith et al., 2005).

Third, the paper develops theoretical and empirically validated understanding about variation in managers' ambidexterity by developing and testing hypotheses on the *interaction effects* of formal structural and personal coordination mechanisms on managers' ambidexterity. Not only empirically

validated insight, but also theoretical insight on the combined effect of different organizational elements on ambidexterity is scarce in the literature on ambidexterity (see e.g. Jansen et al., 2006; Rivkin & Siggelkow, 2003). This gap is highlighted by Raisch & Birkinshaw (2008: 399) who argue that ‘the interrelations between different antecedents’ have thus far ‘been neglected or not been fully conceptualized in the literature on ambidexterity’. Consequently, they argue to ‘develop and test propositions on how different antecedents interact and complement one another in a firm’s pursuit of organizational ambidexterity’ (Raisch & Birkinshaw, 2008: 399). This paper’s interaction hypotheses and the associated results indicate positive interaction effects between the formal structural and the personal coordination mechanisms. Hence, an interesting finding, also for managerial practice, is that the combined effect of the two types of coordination mechanisms on managers’ ambidexterity is larger than simply the sum of their independent effects. In other words, complementing formal structural coordination mechanisms with personal mechanisms increases the mechanisms’ contribution to managers’ ambidexterity.

The paper’s hypotheses and empirical findings on the interaction effects seem also to provide new avenues for research on new organizational forms. A well-established stream in contingency theory has examined mechanistic versus organic forms, stressing internal fit and consistency between coordination mechanisms (Burns & Stalker, 1961; Duncan, 1976; Lawrence & Lorsch, 1967). However, our results seem to support hybrid or simultaneous forms that combine the formal structure with strong cross-functional integration and internal networks. In these illogical designs, according to contingency theory, there is a coexistence of formal organization structure and horizontal ties. Managers responsible for ambidextrous forms can choose to compensate their formal mechanistic structure by encouraging decision making authority, cross-functional interfaces and connectedness among their managers. On the other hand, they can also seize upon the formalization devices to solidify and extend a more homogeneous orientation of their managers. This simultaneous expression of formal hierarchical structure and horizontal relationships fosters their managers’ ambidexterity.

Fourth, results of the post hoc analysis indicate that the effect of decision making authority on ambidexterity is larger for operational level manager than for business unit level managers, whereas the effect of participation in cross-functional interfaces on ambidexterity is larger for business unit

level managers than for operational level managers. These findings highlight the particular importance, also for managerial practice, of personal coordination mechanisms for business unit level managers' ambidexterity. This is in line with studies on strategy process research which indicate that business unit level managers focus on establishing interactions and building relationships between different hierarchical levels, organization units, and functions, for conducting exploration and exploitation related activities (Burgelman, 1983; Floyd & Lane, 2000). One of the main characteristics of cross-functional interfaces is that they allow for establishing interactions and building relationships across internal organizational boundaries; vertical, horizontal, and lateral (Martinez & Jarillo, 1989; Galbraith, 1973). Therefore, cross-functional interfaces may have greater capacity for enabling business unit level managers' ambidexterity as compared to operational level managers' ambidexterity. An interesting finding, also for managerial practice, is the importance of formal structural coordination mechanisms for operational level managers' ambidexterity. This is in line with, among others, Floyd & Lane (2000), who stress the importance of formal structural mechanisms for shaping lower level managers' exploration and exploitation activities.

Finally, investigating ambidexterity at the manager level of analysis raises the question about the locus of action; i.e. about who exerts control on the coordination mechanisms to enable managers' ambidexterity. Several studies on ambidexterity at the firm and business unit level of analysis indicate the importance of corporate or most senior management for controlling formal structural elements (e.g. Duncan, 1976; Tushman & O'Reilly, 1996) and for developing the organization context (Gibson & Birkinshaw, 2004: 223). Investigating ambidexterity at the manager level of analysis highlights an important insight for managerial practice: the importance of both these managers' supervisors, which may reside at lower levels in the organization than corporate management, and the managers themselves, for shaping these managers' surroundings, and, consequently, their ambidexterity. We argue that regarding a manager's decision making authority and formalization of tasks, and to a large extent participation in cross-functional interfaces, the locus of action is most likely with that manager's direct supervisor and that manager's supervisors at higher levels. While, regarding connectedness of a manager to other organization members, the locus of action may be more with the manager self, as connectedness comprises a more 'voluntary and personal mode of coordination'

(Tsai, 2002: 181). These arguments are in line with, for instance, McDonough and Leifer (1983), who argue and empirically demonstrate that a ‘supervisor may employ different structures at the same time for use by different individuals or groups within the work unit’ (1983: 728).

Limitations and Future Research

Our study has limitations, suggesting several issues for future research. The study involves cross-sectional, single informant data and uses perceptual scales highlighting issues of common method bias and causal reciprocity. Regarding the issue of common method bias, we performed Harman’s one-factor test on items included in the regression models. If common method bias were a serious problem in the study, we would expect a single factor to emerge to account for most of the covariance in the dependent and independent variables (Podsakoff & Organ, 1986). We did not find such a single factor. The issue of common method bias could be addressed in future studies by measuring ambidexterity at the managerial level of analysis using objective measures. Furthermore, as indicated, our methods are suited to establish relationships between the constructs, but not causality. To create more insight in the direction of causality, future studies may adopt a longitudinal approach to increase insight into how changes in coordination mechanisms and changes in managers’ ambidexterity causally relate to each other. Related to the question of causality, is the discussion above on the locus of action. Future research could create more insight into this issue by adopting a multiple level approach examining interactions between actions and decisions of managers of different hierarchical levels. Furthermore, we limited the focus of this paper by investigating how different coordination mechanisms relate to the ambidextrous behavior of managers. Although this leads to valuable and actionable knowledge, future research could investigate other potential factors which relate to managers’ ambidexterity. For instance, the results on the control variables indicate that demographic factors such as age and tenure in the firm and in the current function significantly relate to managers’ ambidexterity. Future research could delve into the role of moderators, such as the hierarchical level of managers. Another limitation of this paper in this respect is that we did not explicitly address external drivers of managers’ ambidexterity; except that the paper controlled for the impact of

environmental dynamism. Hence, future research could explore and compare, for instance, the impact on managers' ambidexterity of formal inter-organizational personal relationships, like task forces with suppliers or clients, and more informal direct contacts with these external constituencies. Finally, in the introduction section of the paper we illustrated that previous research indicates the relevance of investigating managers' ambidexterity for increasing understanding about how to build ambidexterity in a firm. Related to this, it is also interesting to explicitly examine the relationships between managers' ambidextrous behavior and the firm's or business unit's level of ambidexterity and performance.

Despite these limitations, in response to the call for research into variations in managers' ambidexterity, this paper contributed to the literature by investigating both conceptually and empirically ambidexterity at the manager level of analysis, and how different types of coordination mechanisms relate to variations in managers' ambidexterity. By doing so, we contributed to both theoretical and empirical foundations of the concept of ambidextrous organizations and their managers.

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Table 1. Factor Analysis for Managers' Ambidexterity

Items ^a	Factors ^b	
	1	2
To what extent did you, last year, engage in work related activities that can be characterized as follows:		
A Manager's Exploration Activities ($\alpha = .90$)		
Searching for new possibilities with respect to products/ services, processes or markets	.82	-0.05
Evaluating diverse options with respect to products/ services, processes or markets	.84	-0.05
Focusing on strong renewal of products/ services or processes	.79	-0.02
Activities of which the associated yields or costs are currently unclear	.74	-0.05
Activities requiring quite some adaptability of you	.83	.01
Activities requiring you to learn new skills or knowledge	.76	-0.06
Activities that are not (yet) clearly existing company policy	.72	-0.13
A Manager's Exploitation Activities ($\alpha = .87$)		
Activities of which a lot of experience has been accumulated by yourself	.08	.75
Activities which you carry out as if it were routine	-0.18	.71
Activities which serve existing (internal) customers with existing services/ products	-0.08	.75
Activities of which it is clear to you how to conduct them	-0.11	.80
Activities primarily focused on achieving short-term goals	-0.03	.69
Activities which you can properly conduct by using your present knowledge	-0.03	.81
Activities which clearly fit into existing company policy	.00	.75

^a Items are quoted from our survey. All items were measured on a seven-point scale (1 = to a very small extent to 7 = to a very large extent).

^b Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Explained variance: 60%

Table 2. Means, Standard Deviations, Minimum and Maximum Values, and Correlations^a

	Mean	St. dev.	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1 Managers' Ambidexterity	20.87	6.85	3.12	45.0																			
2 Decision making authority	3.72	1.67	1.00	7.00	.37																		
3 Formalization of tasks	3.88	1.39	1.00	7.00	.00	-.01																	
4 Cross-functional interfaces	4.41	1.31	1.00	7.00	.34	.23	.01																
5 Connectedness	4.59	1.39	1.00	7.00	.33	.31	-.04	.29															
6 Age	39.04	8.44	26.0	61.0	.07	.18	.10	.04	.07														
7 Education: Master or higher	.47	.50	.00	1.00	.10	.09	-.07	.02	.01	-.01													
8 Education: Bachelor	.35	.48	.00	1.00	-.02	.02	-.01	-.06	.01	.03	-.69												
9 Tenure in firm	10.13	8.22	.00	39.0	.08	.10	.19	.04	.09	.65	-.11	.01											
10 Tenure in current function	4.26	4.06	.00	34.0	-.18	-.09	.08	-.08	-.07	.21	-.09	.05	.26										
11 Size ^b	1.14	.51	.30	3.18	.19	.17	-.10	.00	.02	.20	.10	-.01	.09	-.02									
12 Hierarchical level	.30	.46	.00	1.00	.22	.20	-.15	.06	.04	.24	.12	.01	.09	-.02	.82								
13 Function: R&D	.32	.47	.00	1.00	.11	.13	.01	.05	.04	.14	.01	.02	.12	-.07	.23	.26							
14 Function: M&S	.37	.48	.00	1.00	-.08	-.12	-.03	.01	.00	-.13	-.08	.02	-.05	.09	-.19	-.23	-.53						
15 Environmental Dynamism	4.48	1.31	1.00	7.00	.30	.28	-.15	.33	.28	.11	.04	-.06	.09	-.06	-.06	.00	.05	.02					
16 Firm A	.15	.36	.00	1.00	.28	.35	.19	.09	.13	.20	.25	-.13	.09	-.19	.05	-.01	.13	-.22	.19				
17 Firm B	.22	.42	.00	1.00	-.03	-.10	.02	.04	.02	.08	-.24	.10	.16	.09	-.11	-.10	-.06	.15	.07	-.23			
18 Firm C	.26	.44	.00	1.00	-.10	-.07	-.17	-.15	-.14	-.20	.12	.00	-.24	.00	.13	.20	-.01	-.10	-.16	-.25	-.32		
19 Firm D	.21	.41	.00	1.00	-.13	-.12	.09	.00	.00	-.13	-.18	.00	.03	.07	-.14	-.21	-.03	.11	-.04	-.22	-.27	-.30	

^a N = 716; All correlations above |.09| are significant at $p < .01$, All correlations above |.07| are significant at $p < .05$ (2-tailed)

^b Logarithm of number of manager's subordinates

Table 3^a. Results of Hierarchical Regression Analyses for a Manager's Ambidexterity

	Model 1		Model 2		Model 3	
	b (s.e.)	β	b (s.e.)	β	b (s.e.)	β
Intercept	16.94 (1.91)		19.57 (1.84)		19.31 (1.77)	
Main Effects						
A manager's decision making authority			0.57 (0.15)	.14***	0.52 (0.15)	.13***
Formalization of a manager's tasks			0.13 (0.17)	.03	0.16 (0.16)	.03
Part. in cross-functional interfaces by a manager			1.01 (0.18)	.19***	0.94 (0.17)	.18***
Connectedness of a manager to other org. members			0.85 (0.18)	.17***	0.83 (0.16)	.17***
Connectedness-Squared			0.09 (0.10)	.03		
Interaction Effects						
Dec. making authority*cross-fun. interfaces					0.36 (0.10)	.12***
Dec. making authority*connectedness					0.27 (0.09)	.09**
Formalization*cross-fun. interfaces					0.31 (0.11)	.09**
Formalization*connectedness					0.35 (0.10)	.11**
Control Variables						
Age	-0.11 (0.04)	-.14**	-0.10 (0.04)	-.13**	-0.11 (0.03)	-.13**
Education: Master or higher	0.89 (0.69)	.07	0.84 (0.65)	.06	0.83 (0.63)	.06
Education: Bachelor	0.98 (0.68)	.07	0.81 (0.64)	.06	0.85 (0.62)	.06
Tenure in firm	0.11 (0.04)	.13**	0.09 (0.04)	.11*	0.08 (0.04)	.09*
Tenure in current function	-0.21 (0.06)	-.13***	-0.17 (0.06)	-.10**	-0.16 (0.05)	-.09**
Size (log)	0.28 (0.78)	.02	0.53 (0.73)	.04	0.49 (0.71)	.04
Hierarchical level	3.24 (0.92)	.22***	2.29 (0.87)	.15**	2.30 (0.83)	.15**
Function: R&D	0.29 (0.59)	.02	0.18 (0.55)	.01	0.21 (0.53)	.01
Function: M&S	0.41 (0.58)	.03	0.29 (0.54)	.02	0.49 (0.52)	.03
Environmental Dynamism	1.31 (0.18)	.25***	0.63 (0.19)	.12**	0.70 (0.18)	.13***
Firm A	3.53 (0.87)	.19***	2.63 (0.86)	.14**	2.36 (0.83)	.12**
Firm B	-0.28 (0.79)	-.02	-0.04 (0.74)	.00	-0.21 (0.71)	-.01
Firm C	-1.25 (0.75)	-.08 [†]	-0.57 (0.71)	-.04	-0.55 (0.68)	-.04
Firm D	-1.13 (0.82)	-.07	-1.00 (0.77)	-.06	-1.29 (0.74)	-.08 [†]
R-squared		.23		.33		.38
Adjusted R-squared		.21		.31		.36
F improvement of fit		14.64***		20.51***		14.97***

^a Centered data; Unstandardized coefficients are reported, with standard errors in parentheses, as well as standardized coefficients; N = 716; [†] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

Appendix 1. Measures and Items of Explanatory Variables at the Manager Level*

A manager's decision making authority (based on Dewar et al., 1980)

I can undertake little action, until my supervisor approves a decision

If I want to make my own decisions, I will be quickly discouraged

I have to ask my supervisor before I do almost everything

Any decision I make has to have my supervisor's approval

Formalization of a manager's tasks (based on Desphande & Zaltman, 1982)

Whatever situation arises, I have procedures to follow in dealing with it

I have to follow strict operational procedures at all times

Rules occupy a central place in my work related activities

There is a written job description for going about my tasks

Participation in cross-functional interfaces by a manager (based on Gupta & Govindarajan, 2000; Nadler & Tushman, 1987)

I coordinate work across internal organizational boundaries

I work in temporary task forces

I work in permanent teams

Connectedness of a manager to other organization members (based on Jaworski & Kohli, 1993)

There are many opportunities for me to talk to individuals from all kinds of different organizational units

I very frequently have contact with people, regardless of rank or position

The personal network I have throughout the organization, can be called 'extensive'

I feel very comfortable calling others, regardless of rank, position, or organizational unit, when the need arises

*All items were measured on a seven-point scale (1 = 'to a very small extent' or 'strongly disagree' to 7 = 'to a very large extent' or 'strongly agree').

Appendix 2. Post Hoc Analyses

The sample's managers can be grouped into different functional areas, firms, and hierarchical levels. We investigated whether possible functional area, firm, and hierarchical level specific characteristics are driving the results, and whether the results differ across functional area, firm, and hierarchical level subgroups of managers. To do so, we first examined whether significant interaction effects exist between the four independent variables and functional area, firm, and hierarchical level, on managers' ambidexterity. Second, we examined whether the main effects that were found to be significant in Model 3 of Table 3, remain significant *after including* the functional area-, firm-, and hierarchical level- interaction terms. Finally, we split the total sample into functional area, firm, and hierarchical level subgroups of managers to examine the main effects within each separate subgroup (Aiken & West, 1991; Hardy, 1993; Jaccard & Turrisi, 2003).

After having created interaction terms of the dummy variables pertaining to the *functional areas* with the four independent variables, we included these interaction terms in regression Model 3 of Table 3. Results are as follows: First, the interaction terms are not significant and including the interaction terms does not result in a significant improvement of model fit. Second, the three main effects which are found to be significant in Model 3 of Table 3 remain significant, whereas the main effect of formalization of tasks remains insignificant. Finally, the four main effects in each of the three functional area subsamples are the same as those in the total sample; i.e. within each of the three functional area subsamples there is no significant relation between formalization of tasks and managers' ambidexterity, but positive and significant relations between decision making authority, participation in cross-functional interfaces, and connectedness, and managers' ambidexterity. These results indicate that functional area does not moderate the relation between the independent variables and managers' ambidexterity, that possible functional area specific characteristics are not driving the results as presented in Model 3 of Table 3, and that the results as presented in Model 3 of Table 3 do not differ across functional area subgroups.

After having created interaction terms of the dummy variables pertaining to the *firms* with the four independent variables, we included these interaction terms in regression Model 3 of Table 3. Results are the same as those for functional area: first, the interaction terms are not significant and there is no significant improvement of model fit. Second, the three main effects which are found to be significant in Model 3 of Table 3 remain significant, whereas the main effect of formalization of tasks remains insignificant. Finally, the four main effects in each of the five firm subsamples are the same as those in the total sample. These results indicate that firm specific characteristics do not moderate the relation between the independent variables and managers' ambidexterity, that possible firm specific characteristics are not driving the results as presented in Model 3 of Table 3, and that the results as presented in Model 3 of Table 3 do not differ across firms.

After having created interaction terms of the dummy variables pertaining to the *hierarchical levels* with the four independent variables, we included these interaction terms in regression Model 3 of Table 3. Including these interaction terms, first, results in a significant improvement of model fit. More specifically, results indicate that the effect of decision making authority on ambidexterity is larger for operational level manager than for business unit level managers, whereas the effect of participation in cross-functional interfaces on ambidexterity is larger for business unit level managers than for operational level managers. Second, notwithstanding these significant interaction effects, the three main effects which are found to be significant in Model 3 of Table 3 remain significant after inclusion of the interaction terms, whereas the main effect of formalization of tasks remains insignificant. Finally, the four main effects in both hierarchical level subsamples are the same as those in the total sample, except the effect of managers' decision making authority which is positive but not significant in the business unit level subsample. These results indicate that hierarchical level does moderate the relation between two of the independent variables and managers' ambidexterity, but that possible hierarchical level specific characteristics are not driving the results as presented in Model 3 of Table 3.