Organizational Attributes, Market Growth, and Product Innovation*

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Extensive research has shown that organizational attributes affect product innovation. Extending this literature, this article delimits two general categories of organizational attributes and relates them to product innovation. Organizational attributes can be either control oriented or flexibility oriented. Control-oriented organizational attributes strive to realize organizational activities as intended, while flexibility-oriented attributes allow organizational activities to emerge in a directed way. The classical institutional theory suggests that organizational attributes, no matter whether they are control oriented or flexibility oriented, serve two major functions: a constraining function and an enabling function. Recognizing the dual functions of organizational attributes, this article argues that both types of organizational attributes are indispensable for the functioning of innovative organizations and that the impacts of control-oriented organizational attributes on product innovation decrease with market growth, while the impacts of flexibility-oriented organizational attributes on product innovation increase with market growth.

Empirical results largely support these hypotheses. Strategic planning, as a control-oriented organizational attribute, is positively associated with product innovativeness, regardless of the market growth rate. The effectiveness of other organizational attributes, including formalization and organizational redundancy, varies with market conditions. As the rate of market growth increases, formalization becomes less effective for, but never becomes detrimental to, product innovativeness. Conversely, as the rate of market growth increases, organizational redundancy becomes more effective for product innovativeness. Overall, the results show that both control-oriented and flexibility-oriented elements are indispensable for the design of innovative organizations.

Introduction

Product innovation is more than knowledge creation. Product innovation requires not only knowledge creation but also knowledge integration (Grant, 1996; Nonaka, 1994; Song, Berends, van der Bij, and Weggeman, 2007; Song, van der Bij, and Weggeman, 2005, 2006; van der Bij, Song, and Weggeman, 2003). On the one hand, experimentation and information redundancy are instrumental in bringing about novelty (March, 2010; Nonaka, 1994). On the other hand, strategic direction and formal rules are helpful in integrating novel ideas into an innovative product (Amabile, 1998; Wheelwright and Clark, 1992). For instance, Brad Bird of Pixar points out that the carrying out of innovation involves collaboration among many different functions and that an organization needs to establish a way to integrate creative ideas into a coherent whole. “Otherwise, it’s like you have an orchestra where everybody’s playing their own music. Each individual piece might be beautiful, but together they’re crazy” (Rao, Sutton, and Webb, 2008, p. 3). Similarly, Ed Catmull of Pixar mentions that, in carrying out innovation, successful leaders “must have a unifying vision—one that will give coherence to the thousands of ideas that go into a movie—and they must be able to turn that vision into clear directives that the staff can implement” (Catmull, 2008, p. 69).¹ Anecdotal evidence clearly shows that both knowledge creation and knowledge integration are critical to product innovation.

This study focuses on the roles of organizational attributes on product innovation through their impacts on knowledge creation and knowledge integration. What does the current organization design literature tell us about the relationship between organizational attributes and innovation? Organizational attributes affect organizational actions by functioning as constraints and

¹ Our mention of any particular company does not imply that the company is included in our data set.
enablers of organizational behaviors (cf. Adler and Borys, 1996; Hodgson, 2004). Innovation has been found to be related to many organizational attributes, such as organization size (Ahuja, Lampert, and Tandon, 2008; Cohen, 2010; Damanpour, 1992), organization age (Sorensen and Stuart, 2000), organizational memory (Moorman and Miner, 1997), formalization (Adler and Borys, 1996; Damanpour, 1991), reorganization (Karim, 2009), and so on (see Ahuja et al. [2008], Cohen [2010], and Damanpour [1991] for comprehensive reviews).

Organization design is concerned not only with individual organizational attribute, but also with the combination of organizational attributes (Simon, 1996). Accordingly, researchers not only investigate the effects of individual organizational attributes on product innovation, but also explore the impacts of different organization archetypes on product innovation. Some studies have proposed complex organization designs to support product innovation and enable organizational adaptation.

These organization designs include semi-structured design (Brown and Eisenhardt, 1997), modular design (Sanchez and Mahoney, 1996; Simon, 1962), contingent design (Christensen and Overdorf, 2000; Eisenhardt and Tabrizi, 1995; Westerman, McFarlan, and Iansiti, 2006), and ambidextrous organization design (Tushman and O’Reilly, 1996; Tushman, Smith, Wood, Westerman, and O’Reilly, 2010), among others.

Although previous studies have generally established that organizational attributes matter for product innovation, a few critical issues remain. First, it is still unclear how to conceptualize organizational structure in order to allow for the simultaneous pursuit of control and flexibility. Many previous proposals just shift the problems to a different level (e.g., individual level, subsystems level, or inter-organizational level) “without resolving them” (Schreyogg and Sydow, 2010, p. 1257). Second, it is still unclear whether control and flexibility should be distinguished by the amount of structure or by the types of structure. Distinguishing control from flexibility through the amount of structure, a recent theoretical study implicitly placed control and flexibility at the two ends of a continuum (Davis, Eisenhardt, and Bingham, 2009). If such a continuum exists, organizations may happily end up being flexibility oriented, semi-structured, or control oriented. However, if control and flexibility belong to different dimensions, a fourth and unfavorable possibility exists: an organization may have neither flexibility-oriented nor control-oriented attributes. In order to allow for this fourth possibility, this article conceptualizes control and flexibility as different types of structure (Adler and Borys, 1996; Adler, Goldoftas, and Levine, 1999; Zammuto and O’Connor, 1992). Control-oriented attributes strive to realize organizational activities as intended, while flexibility-oriented attributes allow for the emergence of organizational activities in a directed way (Mintzberg and Waters, 1985). Third, even though researchers agree that formal organizations can be enabling (Adler and Borys, 1996; Hodgson, 2004; Weber, 1978), it is still unclear whether such formalized organizations can innovate and adapt. If the behavior of a control-oriented organization is strongly shaped by organizational rules and procedures, where are the sources of novelty in such an organization (Becker, Knudsen, and March, 2006)? In order to understand this question, it is important to note that control-oriented organizational attributes function not only as constraints on actions, but also as repositories of organizational knowledge (Hodgson, 2004, pp. 105–7). Accordingly, control-oriented organizational attributes store learning from past experience and thus support the carrying out of new combinations.
This article focuses on two major aspects of organizations: how to allocate resources to organizational activities and how to achieve collective action in organizations (cf. Arrow, 1974). Drawing on the typology of organizational attributes (Mintzberg and Waters, 1985; Zammuto and O’Connor, 1992), this article categorizes organizational attributes into control-oriented and flexibility-oriented ones, according to the extent to which the attributes require organizational activities to be realized as intended (Mintzberg and Waters, 1985). Building on the concept of enabling bureaucracy (Adler and Borys, 1996) and on the nature of structure (Hodgson, 2004), this article stresses that organizational attributes function both as constraints and enablers of organizational activities. Drawing on these insights, this article develops a framework to help manage the seemingly conflicting demands of control and flexibility “within a single organizational unit,” without shifting the conflict to different levels of an organization (Schreyogg and Sydow, 2010, p. 1257).

Empirical results suggest that control-oriented and flexibility-oriented organizational attributes both contribute to product innovation. Strategic planning, as a control-oriented organizational attribute, is positively associated with product innovativeness, regardless of the market growth rate. The effectiveness of other organizational attributes—including formalization and organizational redundancy—varies with market conditions. As the rate of market growth increases, formalization becomes less effective for, but never becomes detrimental to, product innovativeness. Conversely, as the rate of market growth increases, organizational redundancy becomes more effective for product innovativeness. Results suggest that organizations that effectively combine control-oriented elements with flexibility-oriented ones are able to maintain a high level of innovativeness under different rates of market growth.

Theory Development and Hypotheses

Product Innovativeness

Among the many organizational performance criteria, product innovation is considered to be a crucial one, because new product introduction has become a vital competitive weapon (Brown and Eisenhardt, 1995; Katila and Chen, 2008) and because product innovation is a critical mechanism for organizational renewal and adaptation (Eisenhardt and Tabrizi, 1995; Tushman et al., 2010). “A product innovation is a new technology or combination of technologies introduced commercially to meet a user or a market need” (Utterback and Abernathy, 1975, p. 642). Product innovativeness, or product newness, refers to the extent to which a product is new to customers, the industry, and the focal firm (Olson, Walker, and Ruekert, 1995; Szymanski, Kroff, and Troy, 2007). “True innovations are those that are entirely new to both the firm and the marketplace and are described as new-to-the-world products” (Olson et al., 1995, p. 52).

A meta-analysis confirms the positive association between product innovativeness and product performance (Szymanski et al., 2007). Furthermore, product innovativeness may be indispensable for high-technology companies (Katila and Chen, 2008) because high-technology industries are characterized by market and technology dynamism. In such dynamic environments, organizations need to constantly renew themselves and adapt to environmental changes by introducing new products.

One of the key factors that facilitate product innovation is organization design. However, little is known about how to enable organizations to manage the seemingly contradictory demands of control and flexibility (Schreyogg and Sydow, 2010) and how to enable organizations to develop novel and innovative products (Teece, 1996; Williamson, 1985). The next session explores the two broad types of organizational attributes and their effects on product innovation.

Organization Design and Organizational Attributes

Organization design is concerned with combining organizational attributes to achieve organizational effectiveness (Dunbar and Starbuck, 2006; Simon, 1996). Organizational attributes not only enact organizational constraints, but also store organizational knowledge (cf. Hodgson, 2004, pp. 105–7). Organizational attributes are generally concerned with two aspects of organizations: resource allocation and collective action. According to Arrow (1974, p. 26), all organizations “share the common characteristics of the need for collective action and the allocation of resources through nonmarket methods.” Furthermore, organizational attributes can be broadly categorized into control-oriented ones and flexibility-oriented ones (Zammuto and O’Connor, 1992). Control-oriented organizational attributes apply deliberate approaches to resource allocation and collective action, whereas flexibility-oriented organizational attributes employ emergent approaches to resource allocation and collective action (cf. Mintzberg and Waters, 1985).

Using the analogy of equipment technology, Adler and Borys (1996) conceptualize organizational attributes as
technology and distinguish enabling organizational technologies from coercive ones. In the equipment technology literature, it has been shown that flexibility is a key characteristic that distinguishes enabling technologies from coercive technologies (Adler and Borys, 1996; Adler et al., 1999; Tian, Wang, Chen, and Johansson, 2010). Enabling technologies provide organizations and users with effective supporting tools; they are also responsive to changes in user needs and organizational environments (Tian et al., 2010). Although coercive technologies are able to support users and organizations in a preconfigured way, they may fail to respond to changes in user requirements and organizational environments (Tian et al., 2010). Accordingly, enabling technologies should effectively combine discipline with flexibility—they should not only align businesses with technologies but also maintain the flexibility to deal with changes (Tian et al., 2010).

By the same reasoning, both control-oriented and flexibility-oriented organizational attributes are necessary elements for the structuring of innovative organizations. Without flexibility, too much control may lead to coercion and rigidity; without control, too much flexibility may give rise to chaos and fluidity. Innovative organizations must have both control-oriented and flexibility-oriented organizational attributes in order to provide employees with strategic directions, best-practice templates, individual flexibility, and mutual understanding. Accordingly, this article argues that both control and flexibility are irreplaceable ingredients in the design of innovative organizations.

The four building blocks in the design of innovative organizations are strategic planning, formalization, risk taking, and organizational redundancy. These attributes can be categorized as being either control oriented (i.e., strategic planning and formalization) or flexibility oriented (i.e., risk taking and organizational redundancy). Each attribute is concerned with either decisions regarding the allocation of resources (i.e., strategic planning and risk taking) or mechanisms for collective action (i.e., formalization and organizational redundancy). Strategic planning is a control-oriented attribute concerned with the allocation of resources. Strategic planning relies on formal procedures to establish strategic directions and to commit necessary resources to selected projects. Formalization is a control-oriented attribute concerned with collective action in organizations. Formalization relies on rules and procedures to support collective actions by clarifying goals and responsibilities and providing best-practice templates. Risk taking is a flexibility-oriented attribute concerned with the allocation of resources. Risk taking allows organizations to carry out projects that have uncertain payoffs. It also allows organizations to allocate resources to the explorations of novel ideas. Organizational redundancy is a flexibility-oriented attribute concerned with collective action in organizations. Organizational redundancy supports collective action by enhancing the reliability of subsystems and enabling real-time collaboration among different subsystems (Landau, 1969; Nonaka, 1991).

The Impact of Strategic Planning on Product Innovativeness

Strategic planning is a creative activity that draws various participants together for the purposes of building consensus and designing actions to achieve organizational objectives (Simon, 1996). “One of the expected benefits of formal planning is that it will avoid sub-optimization” (Armstrong, 1982, p. 203). Strategic planning processes allow organizations to clarify their objectives, collect relevant information, analyze complex tasks, and facilitate communication among organizational members (Shane and Delmar, 2004). As a process, strategic planning selects organizational goals and deconstructs them into subtasks that can be separately carried out by different organizational members (Malone and Crowston, 1994). Strategic planning is helpful in achieving coherence, collaboration, and autonomy. Strategic planning clarifies the direction of the company, which in turn facilitates collaboration among peers and enables quick responses to achieve product innovation. Strategic planning also defines the boundary of decision-making (Fiol and Lyles, 1985) and thus delineates the limits within which an organization can create innovations (Van de Ven, 1986).

Strategic planning is instrumental in providing a sense of direction. Strategic planning provides guidelines within which a company can carry out its innovative activities (Miller, 1983). Without the directions from strategic planning, an organization may face so many possibilities that making a choice becomes too difficult (Volberda, 1996). Therefore, strategic planning allows an organization to link different organizational activities and integrate the efforts of different organizational members into a coherent direction. In order to be innovative, an organization needs to have coherent organizational goals that delineate what it can and cannot do. “In fact, clearly specified strategic goals often enhance people’s

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2 Adler (1999) eventually adds the social dimension to the initial technological conceptualization. We adhere to the initial technological conceptualization, arguing that flexibility is a key characteristic of enabling organizational technologies.
creativity. . . . It is far more important that whoever sets the goals also makes them clear to the organization and that these goals remain stable for a meaningful period of time” (Amabile, 1998, pp. 81–82). To encourage innovation, management needs to clarify and establish organizational goals and communicate organizational goals to organizational members.

Substantial resources are indispensable for the development of genuinely innovative products, and strategic planning is a process that allocates the necessary financial and human resources to selected projects (Kaplan and Norton, 1996). Organizations must carefully select innovation projects to carry out and commit substantial resources to the selected projects. All ongoing projects in a company are “competing for senior executives’ time, energy, and resources” (Kaplan and Norton, 1996, pp. 76–77). With effective strategic planning, senior executives “can undertake and coordinate only those initiatives that move them toward their long-term strategic objectives” (Kaplan and Norton, 1996, pp. 76–77). Organizations that concentrate resources on a few major projects tend to succeed, whereas organizations that spread their resources out over a large number of small projects tend to fail (Utterback and Abernathy, 1975; Wheelwright and Clark, 1992). Companies are inclined to engage in too many projects at the same time, putting a strain on resources and causing project failures (Wheelwright and Clark, 1992). Formally, these arguments can be summarized by the following hypothesis:

H1a: Strategic planning is positively associated with product innovativeness.

The Impact of Formalization on Product Innovativeness

Formalization is defined as the extent to which formal and explicit rules define roles, responsibilities, norms, procedures, and performance standards (Damanpour, 1991). Formalization clarifies roles and responsibilities, therefore empowering collective action within organizations. Formalization “provides needed guidance and clarifies responsibilities, thereby easing role stress and helping individuals be and feel more effective” (Adler and Borys, 1996, p. 61). Furthermore, because every organizational member can clearly understand and perform his or her roles and responsibilities, the whole organization can carry out its activities effectively. By setting guidelines and clarifying responsibilities, formal rules and procedures enable organizational members to focus their attention on critical issues and make fewer and better choices (Cyert and March, 1963; Scott, 1995).

Meanwhile, formal rules and procedures also enable innovators to know what they can and cannot do to achieve innovative objectives (Anthony, Johnson, and Sinfield, 2008).

Formal rules, standards, and operating procedures are means through which organizations memorize and transfer experience accumulated by previous organizational members (Cyert and March, 1963; Levinthal and March, 1993). Formal rules and procedures record organizational solutions to previous political and technical issues and thus serve as best-practice templates for current problem solutions (Adler and Borys, 1996; March, Schulz, and Zhou, 2000). “Rules record solutions to old problems and thus become the basis for organizational competence” (March et al., 2000, p. 161). Therefore, clearly defined and explicitly documented rules and routines store a firm’s past experience and thus serve as enablers of product innovation.

As constraints on actions, control-oriented organizational attributes can bring challenges and excitements to innovators. These constraints will help innovators overcome the inclination to be satisfied with their outputs too quickly, because only truly innovative solutions can overcome a demanding set of constraints (Boland, Collopy, Lyytinen, and Yoo, 2008).

Furthermore, formal rules and procedures not only bring order and stability to organizations but also support organizational flexibility and change (March and Olsen, 2006) because the practices of organizational routines are inherently flexible (Feldman and Pentland, 2003). Just as great writers need to master grammar, great organizations need to have well-defined rules, responsibilities, templates, and frameworks to achieve superior performance (Pentland and Rueter, 1994). Likewise, just as grammar rules do not necessarily constrain a writer’s creativity, formalization does not necessarily suppress, and may actually enhance, product innovation. Formally, these arguments can be summarized by the following hypothesis:

H1b: Formalization is positively associated with product innovativeness.

Admittedly, established direction, dedicated commitment, and previous learning may become less effective in highly dynamic environments. In such situations, organizations need to rely not only on control-oriented attributes to maintain direction but also on flexibility-oriented attributes to deal with change. Flexibility-oriented attributes allow organizations to react in a timely manner to changes in a directed way (Volberda, 1996). As organizational environments change, strategic planning and formal
The Impact of Risk Taking on Product Innovativeness

Risk taking allows organizations to allocate resources to projects with uncertain payoffs. The process and outcome of new product development tend to be uncertain, and risk taking enables organizations to allocate resources to projects with uncertain payoffs, thereby contributing to innovation and adaptation (Miller, 1983).

Encouraging risk-taking behaviors will remove the downside risks of innovative activities, which in turn will encourage experimentation and other explorative behaviors (Arrow, 1962) that may result in innovative products. If top managers encourage risk-taking behaviors, the inherent risks of innovative activities are shifted from the innovators to the organization (Arrow, 1962). “Management’s job is not to prevent risk but to build the capability to recover when failures occur” (Catmull, 2008, p. 66).

Risk taking enables organizational members to experiment with novel ideas. Exploring creative ideas, by definition, involves high variability in outcomes (March, 2010). Accordingly, taking risks and accepting failures are indispensable in creating innovative products (Jaworski and Kohli, 1993; Kohli and Jaworski, 1990). If a company wants to tap into the creativity of its employ- ees, it should establish a culture in which innovators know that it is safe to fail and that failing early and often is an essential part of innovation (Amabile and Khaire, 2008). In order to encourage employees to take risks, management must encourage new initiatives and tolerate mistakes.

However, risk shifting has its drawbacks. Risk shifting not only mitigates the problem of underinvestment in risky activities but also reduces innovators’ incentive to succeed (Arrow, 1962). “Lack of accountability may cause organization members to feel little responsibility and to make decisions without due diligence” (Danneels, 2008, p. 537). Fortunately, the moral hazard problem of risk shifting can be mitigated by other organizational attributes (Arrow, 1962; Williamson, 1985) such as strategic plans and formal rules. On balance, the benefits of risk shifting would outweigh its costs. Risk shifting encourages risk-taking behaviors, and it is a way to empower people to work on new ideas to generate innovative products. Formally, these arguments can be summarized by the following hypothesis:

H2a: Risk taking is positively associated with product innovativeness.

The Impact of Organizational Redundancy on Product Innovativeness

Organizational redundancy is defined as “the conscious overlapping of company information, business activities, and managerial responsibilities” (Nonaka, 1991, p. 102). Organizational redundancy creates a common ground among employees, thus facilitating the transfer and integration of organizational knowledge (Nonaka, 1991, p. 102).

Organizational redundancy enables collective action in an organization because it is conducive to functional reliability and cross-functional coordination in new product development. First, because each part of an organization is not perfect, adding sufficient redundancy is a way to “build an organization that is more reliable than any of its parts” (Landau, 1969, p. 350). Because of the uncertain and complex nature of new product development, an innovative product may take a long time to finish. During the process of new product development, many unforeseeable problems may emerge (Catmull, 2008). The duplication and overlap of information, knowledge, and responsibilities among employees allow them to appreciate and evaluate others’ work, offer comments and criticisms, resolve emerging and potential problems, and achieve collective innovation (Catmull, 2008). “Redundancy involves cross checks, doubts that precautions are sufficient, and wariness about claimed levels of competence” (Weick, Sutcliffe, and Obstfeld, 2008, p. 43). When individual components become reliable, creative new combinations of components become possible (Simon, 1962). Such creative recombination may result in genuinely innovative products.

Because of the interrelatedness of different organizational functions in product innovation, effective cross-functional coordination is critical to product innovation (Teece, 1996; Troy, Hirunyawipada, and Paswan, 2008). As indicators of organizational redundancy, “shared knowledge and expertise is essential for communication” (Cohen and Levinthal, 1990) because “some amount of redundancy in expertise may be desirable to create what can be called cross-function absorptive capacities” (Cohen and Levinthal, 1990, pp. 132–34). Organizational redundancy may also provide common ground for people from different functions to understand and appreciate...
each other’s work (Catmull, 2008) and create trust and respect among them (Nonaka, 1994). By creating a common ground among employees, organizational redundancy contributes to the transfer and integration of complex knowledge, which is critical to new product development (Nonaka, 1990). Innovative products are the result of collaboration among people with diverse expertise because of the complexity of innovation and the potential benefits of cross-pollination (Amabile and Khaire, 2008).

Organizational redundancy provides real-time information to effect coordination. When environments change, organizations may not be able to rely on established rules and procedures to manage the interdependence among different organization functions and different organizational members; rather, organizations need to capitalize on new information and new knowledge to adapt to new opportunities (Eisenhardt and Martin, 2000). Hence, information redundancy (as an indicator of organizational redundancy) among organizational members facilitates real-time communication and coordination and thus contributes to new product development in dynamic environments (Moorman and Miner, 1998).

Admittedly, organizational redundancy is not without cost. “Normally, redundancy in any system means that there is duplication and backups” (Weick et al., 2008, p. 43). The opportunity cost of the redundant resources is the value they can generate in their best alternative use. Fortunately, the cost of organizational redundancy is “quite manageable” because “it requires only arithmetic increases in redundancy to yield geometric increases in reliability” (Landau, 1969, p. 350). Formally, these arguments can be summarized by the following hypothesis:

\[ H2b: \text{Organizational redundancy is positively associated with product innovativeness.} \]

**Market Growth as a Moderator**

High-growth markets are characterized by high growth in customer demands and by rapid increase in business investments (Aaker and Day, 1986; Levitt, 1965; Spence, 1979). Customer demands are driven by the growing demands of existing customers and by the increasing product adoption of new customers. In addition, increased investments in new technologies facilitate technological advancement in the industry (Aaker and Day, 1986). Because new knowledge and new opportunities constantly emerge in high-growth markets (Eisenhardt and Martin, 2000), the effectiveness of control-oriented and flexibility-oriented organizational attributes differs according to the rate of market growth.

The higher the market growth rate is, the less effective control-oriented organizational attributes are. Control-oriented attributes rely on deliberate approaches to effect resource allocation and collective action within organizations. As sources of direction, control-oriented organizational attributes enable organizations to pursue opportunities that are consistent with preconceived strategic intents; however, they may also constrain organizations to adhere to intended strategic choices, thus preventing organizations from sensing and seizing emerging opportunities. Hence, control-oriented attributes may be less effective in providing employees with the flexibility to seize emerging opportunities in highly dynamic markets.

As templates of best practice and memory of prior learning, established rules and procedures may become less effective to support and enable organizational members to achieve innovation in fast-moving markets. In high-growth markets, the constraining effect of control-oriented attributes increases, while the enabling effect of them decreases. Even though the effectiveness of control-oriented attributes decreases as the rate of market growth increase, control-oriented organizational attributes are still indispensable in maintaining direction, order, and coherence in organizations. Therefore, the positive impacts of control-oriented organizational attributes on product innovativeness may become less positive; however, control-oriented organizational attributes may not become detrimental to product innovativeness even in high-growth markets.

On the contrary, as the rate of market growth increases, flexibility-oriented organizational attributes become more effective for product innovation. In a high-growth market, organizations face many new opportunities and new threats. In order to quickly seize emerging opportunities and to effectively adapt to environmental changes, organizations must allow their managers and employees to take risks to experiment and explore new possibilities (Davis et al., 2009). Because established strategic plans and organizational procedures may not be able to provide effective directions and templates, flexibility-oriented organizational attributes certify managers and employees to explore new possibilities and create new knowledge, thereby facilitating innovation. In addition, formalization may not be able to provide effective best-practice templates and fail to define clear roles and responsibilities. Accordingly, organizations must allow the duplication and overlap of information and duties in order to enable employees to achieve real-time, effective communication.
and coordination (Moorman and Miner, 1998; Nonaka, 1990, 1991, 1994). Formally, these arguments can be summarized by the following two hypotheses:

\[ H_{3a}: \text{Market growth will weaken the effects of control-oriented organizational attributes (i.e., strategic planning and formalization) on product innovativeness.} \]

\[ H_{3b}: \text{Market growth will strengthen the effects of flexibility-oriented organizational attributes (i.e., risk taking and organizational redundancy) on product innovativeness.} \]

**Method**

**Data and Sample**

The sampling frame included 686 firms from the High-Technology Industries Directory. The survey was administered according to the total design method for survey research (Dillman, 1978). The data were collected through two waves of surveys from different data sources. From the original sample of 686 firms, 227 completed questionnaires were collected, achieving a response rate of 33%. The detailed data collection procedures were described in Song, Im, van der Bij, and Song (2011).

This article focuses on different research questions from that of Song et al. (2011), although the two articles draw on the same data set. The two studies build on different theories to study different variables, thereby contributing different insights to the relationships between organizational attributes and product innovation. For example, Song et al. (2011) find that strategic planning reduces the number of new product development projects but enhances firm performance. This finding is not only interesting but also puzzling. This study contributes to our understanding of this puzzle by pointing out that strategic planning, by directing resource allocation, is positively associated with product innovativeness, which is positively correlated with firm performance.

**Measures**

Product innovativeness is defined as the degree to which the products that a company introduced in the past few years were new to the firm, the industry, and the market (Olson et al., 1995; Song and Parry, 1997). It is measured by a multi-item 7-point Likert scale adapted from Song and Parry (1997).

Strategic planning is defined as the extent to which a company has formal processes for determining specific long-term objectives, generating alternative strategies, implementing strategic plans, and monitoring results (Armstrong, 1982). It is measured by a five-item scale adapted from Armstrong (1982).

Formalization is conceptualized as the degree to which formal rules and procedures define roles, relations, communications, standards, norms, rewards, and sanctions in an organization (Damanpour, 1991; Hage and Aiken, 1967; Hall, Johnson, and Haas, 1967). It is measured by a four-item scale adapted from Hage and Aiken (1967).

Risk taking is conceptualized as the degree to which an organization allows managers and employees to engage in novel and uncertain initiatives (Jaworski and Kohli, 1993; Lumpkin and Dess, 1996). It is measured by a three-item scale adapted from Jaworski and Kohli (1993).

Organizational redundancy is defined as the conscious duplication and overlap of skills, resources, information, business activities, and management responsibilities (Nonaka, 1994). It is measured by a four-item scale adapted from Nonaka (1994).

Market growth is defined as the rate of demand growth in the industry within which the organization operates (Jaworski and Kohli, 1993). It is measured by a three-item scale measuring the rate of demand growth in the industry (Jaworski and Kohli, 1993).

**Control Variables**

Firm age is measured by the difference between the current year and the year the company was founded (Sorensen and Stuart, 2000). As firm age increases, an organization deepens and broadens its knowledge structure and its capability stock; however, its knowledge and capabilities may become misaligned with the current environments (Sorensen and Stuart, 2000). Accordingly, the effect of firm age on innovation is controversial. The direction of the relationship between firm age and product innovativeness is not specified.

This study also controls for the effect of organizational size. It is measured by (the natural log of) the number of employees (Damanpour, 1992). However, the effect of firm size on innovation is an issue of considerable debate (Ahuja et al., 2008; Cohen, 2010). Accordingly, the direction of the relationship is not specified.

Research and development (R&D) intensity refers to the percentage of total revenue that a company devotes to R&D (Cohen, 2010; Cohen and Levinthal, 1990). R&D intensity measures the R&D effort, while product innovation measures the R&D output (Ahuja et al., 2008;
Cohen, 2010). R&D intensity is expected to have a positive impact on product innovativeness.

**Data Analysis and Results**

**Measurement Validation**

All measures were subjected to a confirmatory factor analysis (CFA) to assess the convergent validity and discriminant validity of each construct (Bagozzi, Yi, and Phillips, 1991; O’Leary-Kelly and Vokurka, 1998). In order to achieve convergent validity, the fit indices of the CFA model should be reasonable, all factor loadings should be significant, and each standardized loading should be larger than .5. The results from the CFA model indicate that all three of these criteria are satisfied. First, the overall model fit indices suggest that the measurement model is acceptable (Hu and Bentler, 1999): minimum fit function chi-square = 328.15 with 174 degrees of freedom, root mean square error of approximation = .060, nonnormed fit index = .96, comparative fit index = .97, and standardized root mean square residual = .062. Second, all factor loadings have t-values that are larger than 2.0. Third, the lowest factor loading is .53, while most of the factor loadings are larger than .7. These results demonstrate that convergent validity is achieved.

For the discriminant validity test, the correlation of each possible pair of constructs is constrained to be 1. Each constrained model is compared with the unconstrained measurement model. If the chi-square difference between the constrained model and the unconstrained one is significant, discriminant validity is achieved (Bagozzi et al., 1991). All 15 pairs of chi-square differences between the constrained and unconstrained models are significant at the .01 significance level. The analysis thus shows that discriminant validity is achieved in this study.

The commonly used reliability indicator, Cronbach’s alpha, should be at least .70 when the number of measurement items is not very large (Cortina, 1993). All constructs in this study have a Cronbach’s alpha higher than .78, suggesting a reasonable reliability level.

**Common Method Variance**

Two different methods are used to test possible common method variance in this study. First, Harman’s single-factor test is employed. Following this procedure (Podsakoff and Organ, 1986), all measure items from all constructs are entered into an exploratory factor analysis. The initial (i.e., unrotated) factor solution shows that the six factors can be retained according to the criterion that the minimum eigenvalue should be 1.0. In this model, the first unrotated factor accounts for 33.16% of the total variance, indicating that common method variance is not a serious concern for this study.

Second, the correlation matrix is scrutinized for exceptionally high correlation because common method variance always results in extremely high correlations (e.g., .90) among constructs (Bagozzi et al., 1991; Spector, 2006). As Table 1 shows, the highest correlation among the principal constructs (excluding performance and return on investment) is .42, far less than the problematic level. Furthermore, some correlations are not significant. For example, the correlation between risk taking and product innovativeness is insignificant. Insignificant correlations indicate that common method variance is not a serious concern for this study (Spector, 2006).

In addition, Spector (2006) points out that the problem of common method variance is too often overstated: it is

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<td>Organizational redundancy</td>
</tr>
<tr>
<td>Market growth</td>
</tr>
<tr>
<td>Firm age</td>
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<tr>
<td>Firm size logged</td>
</tr>
<tr>
<td>R&amp;D intensity</td>
</tr>
</tbody>
</table>

* p < .05, ** p < .01.

R&D, research and development; STD, standard deviation.
more an urban legend than a reality. “The urban legend that there is universally shared variance inherent in our methods is both an exaggeration and oversimplification of the true state of affairs” (Spector, 2006, p. 230). Similarly, Lance, Dawson, Birkelbach, and Hoffman (2010, p. 435) argue that, “although common method variance does have an inflationary effect on observed relationships, this effect is almost completely offset by the attenuating effect of measurement error.” Therefore, Spector (2006, p. 231) suggests that “[t]he time has come to retire the term common method variance and its derivatives.”

**Correlation Matrix**

Table 1 shows the mean and standard deviation of each construct. For each multiple-item construct, the average value of all the corresponding measurement items is used to represent the value of the construct. In this high-technology company sample, the average age of the company is 18.78 years, and the average number of employees is 399 (the average of log transformation of firm size is 5.73). On average, companies invest 10.99% of their total sales revenue in R&D activities.

The correlation matrix shows that product innovativeness is positively correlated with both overall performance \( (r = .24, p < .01) \) and return on investment \( (r = .28, p < .01) \). As predicted, product innovativeness is correlated with strategic planning \( (r = .35, p < .01) \), formalization \( (r = .39, p < .01) \), and organizational redundancy \( (r = .37, p < .01) \). However, contrary to the prediction, the correlation between risk taking and product innovativeness is negative and insignificant \( (r = -.11, ns) \).

**Hypothesis Testing**

Table 2 shows the results of ordinary least squares (OLS) regressions. For ease of interpretation, all independent and control variables are mean centered before calculating the interaction terms and running the OLS regression. In carrying out the formal hypothesis test, one-tailed tests are used for all directional hypotheses and two-tailed tests for control variables. In model 1, only control variables are included. Among the three control variables, only R&D intensity is significant \( (\beta = .06, p < .01) \). Built upon model 1, model 2 further includes two control-oriented organizational attributes and an environmental variable. Similarly, two flexibility-oriented organizational attributes, one environmental variable, and three control variables are included in model 3. In model 4, all four organizational attributes are entered into the regression. In model 5, interaction terms are included. Model 6 is a parsimonious model that deletes all insignificant terms (except market growth) from model 5 (Brambor, Clark, and Golder, 2006).

Model 5 is used to test all hypotheses. Because all variables are mean centered in this model, H1 and H2 are tested under the condition when market growth rate is at the mean level (i.e., 3.68 out of 7). Relationships at other rates of market growth are further explored in subsequent analyses (see Table 3). In model 5, the variance inflation factors range from 1.05 to 1.66, suggesting that multicollinearity is not a serious concern in this model.

H1a, which predicts a positive association between strategic planning and product innovativeness, is supported \( (\beta = .20, p < .01) \). As predicted by H1b, formalization is positively associated with product innovativeness \( (\beta = .26, p < .01) \). Contrary to the prediction of H2a, the relationship between risk taking and product innovativeness is not significant \( (\beta = .02, ns) \). The effect of organizational redundancy (H2b) on product innovativeness is positive and significant \( (\beta = .28, p < .01) \).

As shown in model 5, the interaction between market growth and formalization is negative and significant \( (\beta = -.07, p < .05) \). The interaction between market growth and strategic planning is insignificant \( (\beta = -.00, ns) \). Therefore, H3a, which predicts that the market growth rate will negatively moderate the positive relationship between control-oriented organizational attributes and product innovativeness, is partially supported. This result means that the impact of formalization on product innovativeness will decrease as the market growth rate increases; it also means that the effectiveness of strategic planning for product innovation will not depend on the rate of market growth.

H3b predicts that the market growth rate positively moderates the positive relationship between flexibility-oriented organizational attributes and product innovativeness. The empirical results partially support this hypothesis. In model 5, the interaction between market growth and organizational redundancy is positive and significant \( (\beta = .12, p < .01) \). However, the interaction between market growth and risk taking is positive but insignificant \( (\beta = .03, ns) \). This result indicates that organizational redundancy will be more effective in a high-growth market than in a low-growth one; it also points

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3 Market growth is still included in model 6 because market growth is a constitutive term (i.e., the element of interaction terms) for the interaction terms and cannot be deleted.
out that risk taking is not associated with product innovativeness across different contexts with varying rates of market growth.

**Additional Analysis**

A significant interaction effect means that the marginal effect of an independent variable is conditioned on the moderator (Brambor et al., 2006). Because two interaction terms are significant in model 5, additional tests are carried out to investigate the marginal effects of formalization and organizational redundancy on product innovativeness, conditioning on each level (from 1 to 7) of market growth (Brambor et al., 2006). All covariates, except market growth, are mean centered. Separate regressions with different levels of market growth are run for additional analyses (Brambor et al., 2006).

As shown in Table 3 and Figures 1 and 2, when the rate of market growth is between 1 and 5 (out of 7), the effect of formalization on product innovativeness becomes insignificant. When the level of market growth is either 6 or 7, the relationship between formalization and product innovativeness becomes insignificant. When the level of market growth is either 1 or 2, the effect of...
organizational redundancy on product innovativeness is insignificant. When the level of market growth ranges from 3 to 7, the effect of organizational redundancy on product innovativeness is positive and significant.

**Discussion**

**Major Findings**

Organization design is concerned with the combination of organizational attributes to construct an organizational structure that is instrumental in the pursuit of certain organizational objectives (Simon, 1996). Organizational structure serves two basic functions: it places constraints on human interaction, and it acts as the knowledge repository of an organization (Hodgson, 2004). Relying on the typology of control-oriented and flexibility-oriented organizational attributes, this article theoretically justifies and empirically verifies the importance of both control-oriented and flexibility-oriented organizational attributes to product innovation. Control-oriented organizational attributes infuse order, establish direction, retain a best-practice framework, enable rule-following behaviors, and capitalize on organizational knowledge. Meanwhile, flexibility-oriented organizational attributes allow risk taking, certify experimentation, encourage flexibility, enable adaptation, and capitalize on local information and knowledge. The effects of control-oriented organizational attributes on product innovativeness tend to decrease with market growth, while the impact of flexibility-oriented organizational attributes on product innovativeness increases with market growth.

Specifically, our empirical findings indicate the following patterns. First, strategic planning has a significant positive impact on product innovativeness. Strategic planning affects the allocation of resources through a deliberate approach. The importance of strategic planning is invariant across different rates of market growth. That is, regardless of the market growth rate, strategic planning is always important in establishing strategic direction and securing resource commitments for product innovation. Undoubtedly, the innovation journey is full of uncertainty. However, it is because of the fundamental uncertainty and unavoidable turbulence that a navigating instrument, such as strategic planning, becomes particularly important. Without strategic planning, an organization cannot remain truly innovative, even if it can carry out some innovation activities in some time periods.

### Table 3. The Marginal Effects of Formalization and Organizational Redundancy on Product Innovativeness

<table>
<thead>
<tr>
<th>Rate of market growth</th>
<th>Formalization Estimate (SE)</th>
<th>Organizational Redundancy Estimate (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.45** (.12)</td>
<td>-.04 (.12)</td>
</tr>
<tr>
<td>2</td>
<td>.38** (.09)</td>
<td>.08 (.09)</td>
</tr>
<tr>
<td>3</td>
<td>.31** (.07)</td>
<td>.20** (.07)</td>
</tr>
<tr>
<td>4</td>
<td>.24** (.07)</td>
<td>.32** (.08)</td>
</tr>
<tr>
<td>5</td>
<td>.17* (.10)</td>
<td>.44** (.11)</td>
</tr>
<tr>
<td>6</td>
<td>.10 (.13)</td>
<td>.56** (.14)</td>
</tr>
<tr>
<td>7</td>
<td>.03 (.16)</td>
<td>.67** (.18)</td>
</tr>
</tbody>
</table>

*p < .05, **p < .01.

SE, standard error.
Second, formalization is another driver of product innovativeness. Formalization enables the coordination of collective action through a deliberate approach. As a constraint on human interactions, formalization is helpful in clarifying roles and responsibilities within an organization, facilitating the coordination of collective action. As a knowledge repository, formalization stores previous learning and thus enables the performance of current action. Without formalization, precious experience may not be codified, division of labor may be unclear, and coordination cannot be seamless. Without formal rules and procedures, organizations may luckily succeed in launching a single innovative product, but a constant stream of innovative products may never be possible. The importance of formalization for product innovativeness varies with market growth rate. In a low-growth market, formalization has a significant impact on product innovativeness because previous best-practice frameworks are still applicable under current market conditions. Within a high-growth market, the impact of formalization on product innovativeness becomes negligible (i.e., neither effective nor detrimental) probably because previous rules and procedures may become neither applicable nor detrimental to product innovation in dynamic market environments.

Third, risk taking does neither good nor harm. Risk taking enables organizations to allocate resources to innovation projects in an emergent way. Although risk taking allows organizations to undertake risky explorations of novel ideas, it may also reduce innovators’ incentive to succeed. This study finds that product innovativeness does not depend on taking excessive amount of risk. Instead of taking an excessive amount of risk, those that create truly innovative products must exercise judgments with strategic planning, enable deliberate coordination through formal rules and procedure, and facilitate emergent coordination and cross-pollination through organizational redundancy.\(^4\)

Fourth, organizational redundancy is instrumental in establishing functional reliability and facilitating cross-functional collaboration in the generation of innovative products. Organizational redundancy enables the coordination of collective action through an emergent approach. The impact of organizational redundancy varies with market growth. In high-growth markets, organizational redundancy has a significant impact on product innovativeness. However, this study also reveals that, in low-growth markets, its impact on product innovativeness becomes negligible (i.e., neither effective nor detrimental). Establishing organizational redundancy is not without costs; the opportunity cost of a redundant component is the value of its best alternative usage. In low-growth markets, the cost of organizational redundancy may be roughly equal to its benefit. However, in high-growth markets, the benefits of organizational redundancy outweigh its costs because organizational redundancy increases reliability and facilitates mutual adjustment in a dynamic environment.

Contributions

This article contributes to the literature on the design of innovative organizations. Previous studies tend to emphasize the constraining role of organizational structure in innovation. Viewing organizational structure as both constraint and enabler, this article finds that both control-oriented and flexibility-oriented organizational attributes have significant impacts on product innovativeness. This article also finds that the effectiveness of some attributes is contingent on market growth. Furthermore, as the effect of formalization decreases, the effect of organizational redundancy increases accordingly. The combined effect of formalization and organizational redundancy remains, to some degree, stable under varying levels of market growth. Therefore, organizations need to adopt both control-oriented and flexibility-oriented elements if they want to remain innovative in different market environments.

This article also contributes to the literature on the tension between control and flexibility in organization design (Adler et al., 1999; Davis et al., 2009; Schreyogg and Sydow, 2010). This article shows that control and flexibility can be conceptualized as different dimensions. Viewing control and flexibility as different dimensions is crucial because it allows for the possibility that some organizations may end up with neither control nor flexibility. According to the general typology of organizational attributes, organizations with both a low level of control and a low level of flexibility can be labeled as chaos organizations, organizations with both a medium level of control and a medium level of flexibility as semi-structured organizations, organizations with both a high level of control and a high level of flexibility as enabling bureaucracies, organizations with a high level of control and a low level of flexibility as coercive bureaucracies, and organizations with a low level of control and a high level of flexibility as fluid organizations.

\(^4\) However, it should be noted that there are many different dimensions and measurements of risk taking. The insignificant results may be a product of the measurement scale. We thank an anonymous reviewer for pointing out this possibility.
This article further contributes to the emerging literature on enabling bureaucracies. As an early advocate of the bureaucracy concept, Weber (1978) associates bureaucratic organizations with technical efficiency. However, recent theory and practice tend to view bureaucracy as evil and want to eliminate it from organizations (Adler, 1999). If theories and practices keep condemning control and advocating flexibility, organizations may throw out the baby with the bathwater (Schreyogg and Sydow, 2010). Currently, the theorizing of enabling bureaucracies is trying to discard the dregs (i.e., coercive bureaucracy) and keep the essence (i.e., enabling bureaucracy) of the original concept (Adler, 1999; Adler and Borys, 1996; Adler et al., 1999). However, the initial definition remains vague and tautological (Adler and Borys, 1996). In a nutshell, enabling bureaucracies are formal organizations that enable employees to perform their tasks effectively. Incorporating a social dimension, subsequent conceptualizations seem to be expansive (Adler, 1999). According to this article, enabling bureaucracies can be reconceptualized as organizations that effectively combine control-oriented attributes with flexibility-oriented attributes. Enabling bureaucracies have organizational attributes to support the realization of organizational actions as intended, but they also have other organizational attributes to enable the emergence of organizational action in a directed way. Undoubtedly, the level of analysis in this article is different from the initial conceptualization: this article treats enabling bureaucracy as an archetype of organization design (i.e., a combination of organizational attributes), while previous studies (e.g., Adler, 1999, Adler and Borys, 1996, Adler et al., 1999) focus on the analysis of individual organizational attributes, such as formalization (cf. Ahuja et al., 2008). Currently, it is impossible to know which level is more appropriate; however, carrying out research that studies enabling bureaucracy at different levels of analysis may allow fruitful avenues to emerge in future research (cf. Krugman, 1993).

Limitations

One limitation of this article is that the dependent variable, product innovativeness, is collected from surveying company executives. Common method bias is still a concern because survey respondents could try to guess the nature of the interaction effect between organizational attributes and product innovativeness. However, this issue would not cause serious biases in the empirical results. First, strict anonymity and confidentiality were ensured in this study. Hence, executives had no incentive to inflate the level of product innovativeness. Second, respondents have a good understanding of their own companies, their customers, and their industries. Practically, it may be difficult to find industry experts who can understand a company better than the executives of the focal company. Third, tests show that common method variance is not a serious concern. Fourth, respondents may be unable to guess the complex interaction effects between organizational attributes and market growth. Admittedly, a better way for data collection would be to collect data from customers and experts. It would require the precise identification of customers for each innovation and then collection of data directly from a group of actual customers for each product. However, such data collection would be difficult to implement for a large-sample survey.

Another limitation of this study is that in order to achieve parsimoniousness, a certain level of accuracy may be lost in categorizing organizational attributes as being either control oriented or flexibility oriented. Future studies may overcome this limitation by developing scales for control-oriented organization design and flexibility-oriented organization design.

Future Research Directions

This article has investigated the roles of formal rules in product innovation. A promising future research direction is to study what kinds of rules and how many of them are conducive to product innovation. For example, rules can be either simple or complex. This simple–complex dimension can be conceptualized as a qualitative dimension of rules, and future studies can investigate whether simple rules or complex rules are more conducive to innovation (Cyert and March, 1963). In addition, future studies can investigate the quantitative dimension of organizational rules. For example, an empirical study shows that the number of rules has a positive impact on new venture performance (Bingham, Eisenhardt, and Furr, 2007). Built upon these pioneering studies, more studies are needed to further explore the roles of rules and routines in product innovation.

More subtle relationships between organizational attributes and product innovation deserve further research. It is argued that flexibility is more effective in the initiation stage of product innovation and that control is more effective in the commercialization phase than of product innovation (Amabile and Khaire, 2008). Accordingly, potential moderators, such as the stage of a project, may affect the relationship between organizational attributes and product innovativeness. Future studies can further explore this research direction.
Conclusion

Organizational attributes affect product innovation. Control-oriented organizational attributes demand organizational activities to be realized as intended, whereas flexibility-oriented organizational attributes allow for the emergence of organizational actions in an unintended way. Both control-oriented and flexibility-oriented organizational attributes affect product innovation by functioning as organizational constraints and knowledge repositories. Organizational constraints establish directions and clarify roles and responsibilities, whereas organizational knowledge repositories store past experience and function as best-practice templates. However, organizational constraints and organizational knowledge repositories reflect past experience and future expectations. As environments change, organizations need to rely on flexibility-oriented attributes to relax constraints and update organizational knowledge. By effectively combining control-oriented organizational attributes with flexibility-oriented ones, organizations are able to maintain innovativeness under varying market conditions. Organizational structure matters for product innovation, and this relationship deserves our attention and future research.

References


Appendix. Measures

Product Innovativeness (Song and Parry, 1997)

PI1. Most of our new products introduced in the past three years relied on technology which has never been used in the industry before.

PI2. Our products are perceived as highly innovative in the—totally new to the market.

PI3. Most of our new products introduced in the past three years were totally new to our company.

Strategic Planning (Armstrong, 1982)

In our strategic business unit,

Plan1. Our strategic planning process is (1 = a very informal process; 7 = a very formal process).

Plan2. We are expected to strictly implement our strategic plan (1 = we have flexibility in the implementation; 7 = we are supposed to strictly implement our strategic plan).

Plan3. Our strategic planning process includes (1 = a very vague process; 7 = a very explicit process) for determining specific long-range objectives.

Plan4. Our strategic planning process contains (1 = a very vague procedure; 7 = a very explicit procedure) for generating alternative strategies.

Plan5. As part of our strategic planning process, we (1 = do not have an explicit system; 7 = have an explicit system) for monitoring the results of our strategic plan.

Formalization (Hage and Aiken, 1967)

Form1. Duties, authority, and accountability are documented in policies, procedures, or job descriptions.

Form2. Rules and regulations have a very important place here.

Form3. People ask permission before deviating from common policies or practices.

Form4. Standards of performance and control systems have been established in writing.

Risk Taking (Jaworski and Kohli, 1993)

RT1. Top managers provide enough incentives to work on new ideas despite the uncertainty of their outcomes.

RT2. Top managers around here like to implement plans only if they are very certain that they will work. (R)

RT4. Top managers in this business unit like to take big financial risks.

Organizational Redundancy (Nonaka, 1994)

OR1. Organizational redundancy is a characteristic of our firm (1 = strongly disagree; 7 = very strongly agree).

OR2. The degree of overlapping of skills and resources in this organization is (1 = none; 7 = very high).

OR4. The degree of overlapping of business activities across different divisions/ departments in our company is (1 = none; 7 = very high).

Market Growth (Jaworski and Kohli, 1993)

MG1. Sales growth in this industry is high.

MG2. The market is growing at a very high rate.

MG3. The demand for products in this industry increases rapidly.

Firm Age (Sorensen and Stuart, 2000)

Calculated from the date when the firm was established to the date of the data collection.
**Firm Size (Damanpour, 1992)**
The natural log of the total number of employees.

**R&D Intensity (Cohen and Levinthal, 1990)**
R&D expenditures as percentage of the total revenue (in percentage).

**Notes**
1. (R) denotes the item was reversed coded.
2. A 7-point Likert scale is used for items of multi-item constructs.