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The role of operations executives in strategy making

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ABSTRACT

Creating competitive advantage based on operations capabilities is likely to require much analysis and communication within the operations function. At the same time, much communication and joint strategizing with the top and other functional executives is likely to be needed as well. Hence, given that operations executives have limited time and also have to perform many other routine tasks, they need to manage two tradeoffs. The first one is between the time spent on strategy making and the time spent on everything else. The other is within strategy making, between the time spent on "functional deliberation" within the operations function and "top-level communication" with other executives. Using a survey of 134 operations executives, we find that an increase in the time the operations executive spends on strategy making is positively associated with performance in complex and hostile environments and when the relative strength of the operations function within the firm is low. Within the operations executive's strategy making, an increased emphasis on top-level communication is positively associated with performance in environments that are complex, stable (less uncertain), or hostile.

1. Introduction

It is well established that operations executives (OEs) contribute to competitive advantage when they play an active role in strategy making (Brown et al., 2007; Papke-Shields and Malhotra, 2001; Swamidass and Newell, 1987; Wheelwright and Hayes, 1985). The types of decisions made in this role are also well known from descriptions of the process of operations strategy (Skinner, 1969; Fine and Hax, 1985; Hill, 1989; Menda and Dilts, 1997). What is not well understood, though, is how and to what extent various internal and external contingencies affect the optimal involvement of the OE in strategy making. For example, Clancy and Kieff (2004) found that increased communication with other functional executives was necessary to formulate successful strategies in an industry facing a threat of commoditization. A different need was suggested by reports on the retail industry's response to the emergence of the Internet. Here, a number of OEs fell short in developing newly needed logistics capabilities (e.g. Wall Street Journal, 1999), implying that these OEs may have failed to devote sufficient time to the analysis, planning, and execution *within* their function. How OEs can best adjust their involvement in strategy making as the context changes is the question we address in this paper.

We define the OE as the person in charge of the operations function and responsible for the resources and processes used in the production and delivery of a firm's goods and services. The OE's job entails a number of monitoring, coordination, and other tasks (e.g. Fayol, 1949) beside what we refer to as strategy making, that is, the involvement in the analysis and formulation of business level and operations strategies as well as in the analysis and planning of how to best implement them. Importantly, like everyone else, OEs have limited time, attention, and ability to process and communicate information at their disposal (Simon, 1947), and these limitations, in turn, imply that OEs have to prioritize and balance their numerous tasks. Moreover, these priorities and balances probably need periodic reevaluation and adjustment.

In this paper, we focus on two broad tradeoffs, or balances, in the OE's job. The first is between strategy making and all other tasks. The second occurs within strategy making, between what we call *functional deliberation* and *top-level communication.* We define functional deliberation (FD) as the analysis and communication with subordinates in the operations function and external parties. In contrast to the functional focus of FD, top-level communication (TLC) is inherently cross-functional and consists of various engagements with the CEO and senior executives of other functions such as marketing, research and development, finance, etc. In essence, the second tradeoff corresponds to a tradeoff between strengthening

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operations resources and tightening the strategic linkages between operations and the rest of the firm.

To understand these tradeoffs and their impact on competitive advantage, we synthesize insights from operations strategy (e.g. Skinner, 1969, 1974, 1985; Hayes and Wheelwright, 1979, 1984; Ferdows and De Meyer, 1990; Miller and Roth, 1994), competitive strategy including the influential resource-based view (RBV) of the firm (e.g. Barney, 1986, 1989; Dierickx and Cool, 1989; Porter, 1980, 1996), and more recent studies that seek to integrate these two literatures (Paiva et al., 2008; Schroeder et al., 2002). We then hypothesize about how these tradeoffs are likely to be affected by the complexity, uncertainty, and hostility of the firm's environment, three external variables which are most commonly used in the literature on strategic planning (e.g., Dess and Beard, 1984; Tushman and Nadler, 1978; Miller and Friesen, 1983). In addition, we hypothesize about the impact of the relative strength of the operations function within the firm as an internal context variable (Wheelwright and Hayes, 1985).

We test our hypotheses using responses from multiple surveys with respondents from a range of different industries. We find support for 6 out of the 8 hypotheses. Specifically, an increase in the time the OE spends on strategy making is positively associated with performance in complex and hostile environments and when the relative strength of the operations function within the firm is perceived as low. We also find that within the OE's strategy making, an increased emphasis on TLC is positively associated with performance in environments that are complex, stable (less uncertain), or hostile.

These results resonate with the evidence from the literature, business press, and our contacts with executives. Regarding the above examples, commoditization of an industry is likely to increase the hostility and complexity of the environment, resulting in the need for an increase in strategy making and especially TLC. On the other hand, the rise of the Internet caused a great deal of uncertainty for the retail industry, suggesting the need for more FD. More recently, in China, many shopping mall operators started to underperform as their industry moved from the munificent and relatively simple (in terms of the recipe for success) environment of rapid growth to the one characterized by overcapacity and new competition from online retailers such as Alibaba. OE's who were once busy managing the construction of new and routine operations of the existing shopping malls had to rethink the more complex model of mixed online and physical retail in a more saturated market. An OE of a major international developer told us: "While we were building shopping malls, Alibaba and other online retailers were developing a new business model. We need to spend much more time on redesigning and running the malls differently in order to create more of a special experience. We also need to interact more with our colleagues and partners to understand the nature of online sales, and how we can align the way we run the malls with it." In other words, complexity and hostility seem linked to a need for more strategy making by the OE and especially more TLC.

While contingency theories for the process of operations strategy have been proposed before (e.g. Wheelwright and Hayes, 1985; Mills et al., 1995), we provide a different approach by distinguishing between FD and TLC, and we test our hypotheses empirically. Our results also help interpret insights from the literature on strategic planning in the context of the process of operations strategy.

Finally, our analysis could also be relevant to other functional executives because they tend to face similar tradeoffs. Essentially, we unpack strategy making and the role of a specific functional executive in it to derive and test specific contingency-based hypotheses. By doing so, we further explore strategy making as a dynamic capability (e.g. Eisenhardt and Martin, 2000), that is, a process that can be purposefully designed to help a firm select and accumulate resources that create and sustain competitive advantage (Teece et al., 1997). Specifically, our analysis raises the question whether this process could benefit from mechanisms to adjust itself and become more decentralized and functionally focused in some contexts and more collaborative and cross-functional in others. Perhaps it is not surprising that this exploration of the strategy making process should come from an investigation of the role of executives in operations, as the investments in equipment, people, and technology are typically so big and important that the fields of competitive and operations strategy are natural candidates for co-evolution and cross-pollination.

The rest of the paper is structured as follows: Section 2 reviews the relevant literatures and Section 3 synthesizes these literatures to develop eight hypotheses regarding the impact of external and internal context on the balance between different components of the OE's role. Section 4 describes the data and the measures, and Section 5 presents the results. Section 6 concludes the paper with a discussion of the results and their implications.

2. The role of operations executives in strategy making: insights from the literature

The notion that businesses face tradeoffs in what they can do and hence need to choose how to compete has been a cornerstone of competitive and operations strategy since the early days (e.g. Skinner, 1969, 1974; Porter, 1980; Hayes and Wheelwright, 1979, 1984). At the level of operations, typical tradeoffs involve cost, quality, variety, responsiveness, etc. and result in the need to select specific priorities or a "manufacturing task" that should subsequently guide facilities, capacity, technology, quality management, and other important choices (Hayes and Wheelwright, 1979, 1984; Skinner, 1969, 1974, 1985). The conception of operations strategy as a pursuit of coherent and mutually reinforcing operational choices in support of the overall firm strategy has entered the mainstream of managerial thinking and practice (e.g., Fine and Hax, 1985; Hill, 1989; Miller and Roth, 1994). Importantly, this conception also implies a top-down approach in which competitive priorities for the operations function stem from the overarching business level strategy (Porter, 1980; Hayes and Wheelwright, 1984).

This classical view of strategy as positioning on tradeoffs – implicitly assumed to be static – was supplemented over time with more dynamic views. Barney (1986, 1989) proposed that firms pursuing an attractive position may compete away their profits as they try to acquire necessary resources in the so-called "strategic factor markets." Firms can hence earn rents only if they are lucky, act faster or based on superior information, or if they pursue opportunities for which they already have some resources that other firms do not have. A closely related view proposes that only resources and capabilities that are assembled over time and cannot be bought in strategic factor markets can be a source of sustained rents (Dierickx and Cool, 1989; Teece et al., 1997). The two views are referred to as the resource-picking and capability-building perspectives within the resource-based view (RBV) in strategy (Makadok, 2001).

Mirroring the capability-building perspective, Ferdows and De Meyer (1990) have documented the cumulative nature of some operations capabilities. Motivated by the success of Japanese manufacturers which seemed to defy operational tradeoffs in the last decades of the 20th century, some researchers have proposed that the general excellence-based approach to operations strategy may be an alternative or even superior to the one based on positioning (Hayes and Wheelwright, 1984; Nakane and Hall, 1991; Womack et al., 1990; Corbett and Van Wassenhove, 1993). These so-called "world-class" operations capabilities have also been found to contribute to firm performance in empirical studies (e.g., Rosenzweig et al., 2003; Rosenzweig and Easton, 2010).

In response to the tension between the classical and capabilities-based perspective, Porter (1996) has proposed that the ever-changing technologies and best practices effectively shift various tradeoffs that firms face. Hence maintaining general operational effectiveness is a necessary condition for staying in the game but not sufficient for sustained profits, which still require firms to anticipate and occupy unique profitable positions in this changing world.

These arguments and the RBV in general imply a more nuanced role of the OE in the strategy process than the classical top-down view. The first task of the OE is the accumulation of operations resources and capabilities, whether those related to general best practices needed to keep up with the moving efficiency frontiers (Ferdows and De Meyer, 1990; Hayes and Pisano, 1996), or those in support of the firm's unique positioning (Porter, 1996). We posit that this task requires a substantial amount of functional deliberation (FD). Accumulating resources and capabilities requires a great deal of careful deliberation within the operations function as well as information exchange with external parties (Schroeder et al., 2002). Moreover, some capabilities such as those in total quality management (TQM) make it easier to acquire others such as those related to responsiveness and flexibility (Ferdows and De Meyer, 1990), implying the need for careful sequencing of learning efforts. Finally, the development of higher order combinative capabilities benefits from both exploration and exploitation (Kristal et al., 2010), further increasing the difficulty of the OE's first task.

The second task of the OE is to make sure that operations resources and those in other functions work well together and we posit that top-level communication (TLC) is the main way in which the OE can contribute to such coherence across functions. For example, if marketing executives are not aware of advances in the flexibility of operations, they will likely fail to increase the variety of product offerings believing that the production costs would be prohibitive (de Groote, 1994). Similarly, if the firm's internal resources are to inform the selection of future strategies (Barney, 1986, 1989), then the OE needs to communicate to the top management team what resources the operations function has and to help evaluate the viability of different strategic choices through the lens of these resources. For example, if a company has a high-performing offshore plant in Vietnam, the growing local economy may offer an opportunity to enter the Vietnamese market by building on the network relationships, knowledge of the market for local talent, and the proximity to customers provided by the existing plant management. An appropriate amount of TLC will likely allow the company to become aware of this opportunity and take advantage of it. Importantly, empirical studies have found that, while challenging (Menda and Dilts, 1997), cross-functional communication contributes to competitive advantage and performance (Paiva et al., 2008; Papke-Shields and Malhotra, 2001; Swink et al., 2007).

The need to perform two distinct and demanding tasks poses important challenges to the OE from the standpoint of bounded rationality (Simon, 1947). To address questions of this type, research in organization theory and strategic decision making often conceptualizes organizations as hierarchies of boundedly rational information processors in which the structure and intensity of information flows need to respond optimally to the environment (e.g. Galbraith, 1973, 1977). The implication for our analysis is that the limited ability to communicate and process information forces the OE to trade the time spent on FD against that spent on TLC. Hence, we arrive at the key questions in this paper: What is the right balance between the two tasks and how might this balance change depending on the context that the firm faces? In addition, how are these two strategy-related tasks in aggregate balanced against the basic coordination, control, and other management tasks (e.g., Fayol, 1949) that an OE has to perform?

For practice, answers to such questions can provide guidance on how operations executives and top management teams can adjust the frequency and structure of various planning processes when internal or external context changes. For example, one of the ways we have seen an operations executive at a large ingredient producer in Asia raise TLC is through the implementation of a sales-and-operations-planning routine in which sales, operations and new product development executives met bi-monthly to discuss operational and strategic issues.

So far, only a few studies have examined how internal and external factors influence the role of OEs in the process of strategy. Wheelwright and Hayes (1985) have posited that the manufacturing function passes through four stages of development in which the role of the OE within the firm steadily increases, with increasing emphasis on top-level communication. Other studied have focused on external factors. Swamidass and Newell (1987) and Ho (1996) empirically examined the effect of environmental uncertainty on the role of manufacturing managers in the process of strategy. Both studies found a diminished role in uncertain environments but also generally positive association between a larger role of the OE and firm performance. However, these studies did not consider a contingency framework in which environmental conditions and the role of manufacturing managers interacted to explain performance. Finally, Mills et al. (1995) proposed a contingency approach to the process of operations strategy and stressed the need to link it with the contingency theories for the general process of strategy. Our study is different in two ways. First, we do not treat the firm's strategy-making mode as a context variable. Rather, we treat one part of it – the role of the OE – as a managerial variable that can be influenced. Second, the parsimonious characterization of context and strategy process outcomes allows us to test several hypotheses regarding the interaction between the context, the strategy-making process, and firm performance.

3. Information processing, resources, and the job of the operations executive

In this section, we synthesize the supporting literature to develop a model that links the OE's strategy-making activities, their strategically important outcomes, and firm performance (Fig. 1). We then use this model to derive hypotheses regarding the impact of context on the optimal allocation of the OE's time spent on these activities.

To streamline the analysis, we abstract additional layers of complexity that arise in large corporations and we consider a functionally organized firm with a single business unit. The OE is in charge of the operations function and has direct access to the chief executive officer (CEO) and the heads of other functions such as marketing, R&D, finance, etc. The OE also has direct lines of communication with the subordinates in the operations function as well as with external parties such as suppliers, vendors, service providers, etc.

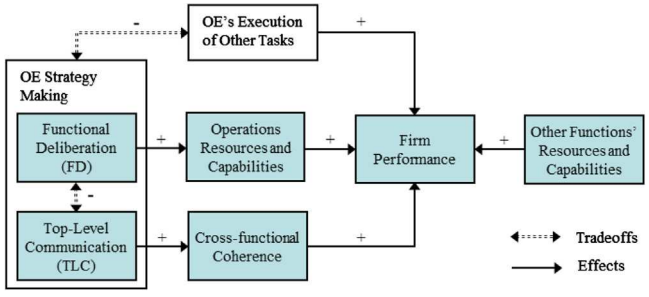

Fig. 1. The job of the operations executive.

We focus on two bounded-rationality-induced tradeoffs faced by the OE, shown in Fig. 1 using dashed lines. The first tradeoff is between the time spent on strategy making and the time spent on what we label "execution", which includes organizing, commanding, coordinating, and controlling (Fayol, 1949). While it stands to reason that both strategy making and execution should contribute to firm performance, the tradeoff between the two raises the questions of their optimal balance and how this balance is affected by context. Studies by Wheelwright and Hayes (1985), Swamidass and Newell (1987), and Ho (1996) have implied that context has an impact but, as mentioned above, no specific hypotheses have been tested.

The other tradeoff is between TLC and FD as two distinct strategy-making activities. TLC consists of the OE's communication with the CEO and/or other functional heads. As argued in Section 2, this activity increases the cross-functional coherence of firm resources residing in different functions (Brown et al., 2007; de Groote, 1994; Menda and Dilts, 1997; Papke-Shields and Malhotra, 2001) and helps the firm select better strategies. FD consists of the remaining strategy-making activities including individual analysis and deliberation, communication with subordinates, and communication with external parties such as vendors, suppliers, consultants, and distributors. FD thus represents the strategy making activities within the function performed independently from the rest of the firm. As described in Section 2, this activity increases the stock of resources and capabilities residing in the operations function (Ferdows and De Meyer, 1990; Kristal et al., 2010; Schroeder et al., 2002).

The distinct strategically important outcomes of TLC and FD that ultimately contribute to firm performance are shown in Fig. 1. FD helps accumulate operations resources and capabilities that help the firm produce and deliver goods or services. Similarly, FD in other functions can be expected to help accumulate the respective resources and capabilities that facilitate marketing, new product development, recruitment, etc. TLC, on the other hand, steers the accumulation of functional resources and capabilities toward cross-functional coherence and synergies. TLC also helps the firm select strategies that leverage these resources and capabilities residing in different functions because the respective functional heads are most familiar with them. A central question in this study is how the optimal mix of TLC and FD changes as the firm faces different contingencies.

3.1. Impact of external context: complexity, uncertainty, and hostility

Environmental complexity, uncertainty, and hostility have been widely used in the literature (e.g. Brews and Hunt, 1999; Dess et al., 1997; Goll and Rasheed, 1997; Miller and Friesen, 1983) to describe external context. Dess and Beard (1984) demonstrated that it is along these dimensions that context tends to vary the most. Environmental complexity refers to the number of factors and their interactions that affect firms. Environmental uncertainty relates to the unpredictability of these factors and is high in dynamic, fast-changing environments. Environmental hostility is a measure of the difficulty of survival and growth in an environment.

Complex environments require more information processing in general (Tushman and Nadler, 1978) and in the strategy process in particular (Miller and Friesen, 1983). Dess et al. (1997), Hart (1992), and Mintzberg and Waters (1985) have argued that complex environments require a balance between the initiative of the organizational members and central guidance. This proposition was echoed by Nickerson and Zenger (2004), Siggelkow and Rivkin (2005), and Loch et al. (2006) who found extensive information sharing and participative or consensus-based decision making to be optimal organizational responses to complexity.

In essence, problems with many moving parts and strong interactions among them require harnessing the expertise of multiple experts and their extensive communication. Consequences for the OE's strategy making activities (Fig. 1) are rather straightforward. The accumulation of functional resources and capabilities is likely to be more challenging as the OE needs to solve difficult problems in collaboration with functional experts, workers, and external parties. As a result, we expect the optimal time spent on FD to increase. At the same time, the OE is likely to spend significantly more time communicating with the CEO and other functional heads on the formulation of appropriate strategies as this problem is now more difficult as well. In complex environments, customers are more segmented, competitors more closely watched, and the nature of competition oligopolistic (Dess and Beard, 1984; Miller and Friesen, 1983), all requiring careful positioning and high coherence across functions. In addition, TLC is likely to be required on an ongoing basis to ensure that dense and unanticipated interactions are resolved and cross-functional coherence maintained. Finally, the accumulation of functional resources and capabilities that in a simple environment may entail only FD is likely to require some TLC to prevent imposing unanticipated negative externalities on other functions (Siggelkow and Rivkin, 2005). As a result, with the requirements for TLC exceeding those for FD, we formulate the following two hypotheses:

Hypothesis 1a. Higher environmental complexity is associated with a more positive relationship between the time the OE spends on strategy making and firm performance.

Hypothesis 1b. Higher environmental complexity is associated with a more positive relationship between the share of top-level communication in the OE's strategy making and firm performance.

Numerous studies including those by Goll and Rasheed (1997), Miller and Cardinal (1994), Miller and Friesen (1983), and Priem et al. (1995) have suggested that more strategic planning is associated with higher performance in dynamic environments. Researchers have also suggested that uncertain environments call for loose coupling or incrementalism (Fredrickson, 1984; Fredrickson and Mitchell, 1984; Mintzberg, 1973), decentralization (Siggelkow and Rivkin (2005), and simple forms of control with less communication between the constituent parts (Eisenhardt and Bhatia, 2002; Eisenhardt and Martin, 2000). Importantly, environmental dynamism, characterized by unpredictable markets, rapid technological development, and competitive ambiguity (Davis et al., 2009; Hough and White, 2003), makes it relatively more likely that a significant portion of strategic decision making occurs during implementation, given the risks of premature commitment to any particular course of action.

The implication for TLC is that whereas formulating strategies is likely to entail some additional effort in considering more risks and scenarios, the considered strategies are likely to be simpler and emphasize flexibility and postponement of commitments. Moreover, we can expect significantly less TLC in assuring cross-functional coherence because of the likely implementation of simple rules and an emphasis on flexibility across functions. The consequence is that we expect little or no increase in the need for TLC in dynamic environments.

In contrast, dynamism is likely to increase the need for FD. Basic operations capabilities are more at risk of losing their value and new ones may need to be built quickly in uncertain, dynamic environments (Loch et al., 2006; Klingebiel and De Meyer, 2013). Moreover, the likely focus on flexibility tends to entail non-trivial learning and resource accumulation processes that require a great deal of expertise, time, and effort (Ferdows and De Meyer, 1990). Hence uncertain environments can be expected to call for *decentralization of the strategy process* in that the OE's contribution to strategy

making is likely to take place mainly within the operations function and away from the center. Hence the following pair of hypotheses:

Hypothesis 2a. Higher environmental uncertainty is associated with a more positive relationship between the time the OE spends on strategy making and firm performance.

Hypothesis 2b. Higher environmental uncertainty is associated with a less positive relationship between the share of top-level communication in the OE's strategy making and firm performance.

Interestingly, there are fewer studies and less agreement in the literature on strategy making in hostile environments than with respect to other contextual variables. The inconsistent results could be due to different research designs. Defining hostility as "the degree of threat to the firm posed by the multifacetedness, vigor, and intensity of the competition and the downswings and upswings of the firm's principal industry," Miller and Friesen (1983) found that relative to samples of poor performers, samples of successful firms showed a more positive correlation between increases in environmental hostility and increases in analysis. Slevin and Covin's (1997) results were similar but Goll and Rasheed (1997) found that organizational rationality was more strongly associated with performance in highly munificent environments characterized by high sales growth.

Like Miller and Friesen (1983), we expect that firms in hostile environments typically have to carefully assess their strengths, resources, and opportunities in order to formulate good strategic responses to the difficulties that they face. Hence we expect a significant increase in the need for TLC. In addition, turnarounds in hostile environments are likely to entail realignment and search for new synergies, with the implication that additional TLC is likely to be needed in the search for cross-functional coherence (e.g. Clancy and Kieff, 2004). In contrast, munificent or non-hostile environments are typically those in which firms have to manage rapid growth, with the implication that speedy and efficient execution of the existing strategy is likely the best course of action.

The impact of environmental hostility on the need for FD is less straightforward. On the one hand, hostility can be a sign of a mature or even declining industry with low or negative sales growth (Dess and Beard, 1984) in which the development of operations capabilities through FD has reached diminishing returns. On the other hand, the environment can be hostile immediately after the emergence of a dominant design in a growing industry, and the competition to upgrade production techniques and reduce costs can become fierce (Jovanovic and MacDonald, 1994; Klepper, 1996). Similarly ambiguous predictions can be derived by considering high-growth, munificent environments. Such environments can be seen as calling for rapid accumulation of operations resources and capabilities in order to facilitate growth. Alternatively, it can also be that most technological and production problems have been solved and the main priority is simple replication of well-established recipes in additional locations or production facilities. Given the positive effect on the need for TLC and the ambiguous effect on the need for FD, we formulate the following pair of hypotheses:

Hypothesis 3a. Higher environmental hostility is associated with a more positive relationship between the time the OE spends on strategy making and firm performance.

Hypothesis 3b. Higher environmental hostility is associated with a more positive relationship between the share of top-level communication in the OE's strategy making and firm performance.

3.2. Impact of internal context: relative strength of operations

An important internal contingency that is likely to affect the OE's allocation of time and effort is the relative strength of the operations function within the firm. We draw on applications of the RBV to operations strategy (e.g. Paiva et al., 2008; Rosenzweig et al., 2003; Schroeder et al., 2002) to define this contingency as the contribution of operations resources and capabilities to the competitive advantage of the firm relative to that of the other functional resources. The four-stage development path of the manufacturing function proposed by Wheelwright and Hayes (1985) predicts that the primary focus on operational improvements is gradually replaced by a focus on the alignment with the rest of the firm and the pursuit of competitive advantage as the relative strength of the manufacturing function within the firm increases. Somewhat puzzlingly, this important managerial question has received little further attention in the literature.

When the operations function is relatively underdeveloped, fixing this problem is likely to be high on the OE's agenda. Dearth of operations resources is likely to result in high production costs and possibly quality problems, directly hurting the firm's performance. The implication is that gathering and careful analysis of information about the resources that need to be developed are relatively more important than the OE's other activities in this situation. Similarly, when operations resources and capabilities are highly developed and have an important and supportive role in the value chain, the OE is likely to be facing technological limits to and diminishing returns from further resource and capability accumulation, implying that the OE's time and effort are likely to be more useful elsewhere. In summary, we expect the OE to spend less time on FD as the relative strength of the operations function increases.

Resources and capabilities that are housed in the operations function are likely to create strategic opportunities for the firm (Barney, 1989; Dierickx and Cool, 1989). Hence one can expect the OE to assume a more prominent role in the formulation of strategies and engage in more TLC as the relative strength of the operations function increases (Wheelwright and Hayes, 1985). However, if operations resources and capabilities are highly developed and serve as an anchor for firm strategies, cross-functional coherence with resources in operations might be achieved through the TLC of executives in other functions with a CEO who is already aware of operations resources, and less through TLC with the OE. In summary, the effect of the relative strength of the operations function on TLC is ambiguous, as the OE will have more influence on strategy but perhaps with less need for communication. Combined with the negative effect on FD, these arguments lead to the following pair of hypotheses:

Hypothesis 4a. Higher relative strength of operations resources and capabilities within the firm is associated with a **less** positive relationship between the time the OE spends on strategy making and firm performance.

Hypothesis 4b. Higher relative strength of operations resources and capabilities within the firm is associated with a more positive relationship between the share of top-level communication in the OE's strategy making and firm performance.

4. Sample and measures

We tested the hypotheses using an approach similar to that of Miller and Friesen (1983): We investigated whether interactions between changes in firm context and changes in the OE's strategy-making activities are associated with firm performance. This measurement approach is not based on longitudinal data but relies on retrospection by managers, which has been shown to be a valid technique for management research (Miller et al., 1997).

By adapting existing instruments to measure external context and by constructing new ones for internal context and the OE's role in strategy making, we developed a questionnaire and pilot-tested it with five OE's from different industries. To obtain a sample

with large context diversity we generated a web-based version and an identical hard-copy version of the questionnaire, and we used two different databases. In an INSEAD database of past participants in executive programs, we identified approximately 700 OEs (as apparent from job titles) with valid e-mail addresses and collected 125 web-based responses, obtaining a response rate of 17%. We also mailed the survey to an additional 900 past participants for whom we did not have a valid e-mail address and 1300 OEs drawn from an external South-East Asian marketing database. Each of these mailings generated an additional 35 responses. Despite the low response rate of the mailings we included the responses in the sample as no bias between sub-samples was found, non-response biases are known to rarely impact correlations or regressions (Dey, 1997), and the removal of the responses from the sample did not substantially change the hypothesis test results (reported in an annex available upon request).

To increase the likelihood that strategy-making involved multiple top-level and functional managers, we restricted our sample to firms with 50 or more employees. We thus retained one large data set of 167 observations to extract and score the external context factors of complexity, uncertainty and hostility and a smaller data set of 134 observations for the testing of hypotheses. The data set reduction was a result of missing data for relevant variables (21 observations) and from eliminating respondents who stated to have no responsibilities in operations (9 observations) and respondents from business units that had been in business for less than four years (3 observations), with four years being the period over which changes were to be observed. Of those 134 OEs, 51% reported directly to the head of a business unit, 25% reported to the head of a region and the remaining 24% reported to the head of operations. The reported number of employees in the business units of respondents ranged from 50 to 45,000 with a median of 575. The sample contained respondents from companies in a range of industries (process industry: 29%, assembly/production: 26%, finance and insurance: 10%, transportation and warehousing: 5%, and other services: 30%) operating in a range of geographies (worldwide: 53%, Asia-Pacific: 21%, Europe and Africa: 17%, Americas: 4.5%, Middle East: 4.5%).

4.1. Context variables

To measure the firm's external context along the dimensions of complexity, uncertainty, and hostility, we adapted instruments from previous studies in the strategy-making literature (Miller and Friesen, 1983; Slevin and Covin, 1997). These instruments rely on managerial perceptions, a measurement method that has been found to be accurate with respect to objective measures of external context (Bourgeois, 1985). We posed 13 questions, each using a seven-point Likert scale to assess the change in external context compared to four years earlier. Four items were used to measure the change in the uncertainty of the environment: uncertainty about customer preferences, competitors, regulators, and suppliers. Five items were used to measure the change in complexity: change in the numbers of competitors, technological designs, customer segments, suppliers, and regulatory bodies. The final set of four items was designed to measure the change in hostility of the company's environment: change in survival chances, competitive rivalry, customer loyalty, and profit margins.

To extract and score factors previously identified in the literature as meaningful and significant, we applied principal factor analysis on the 13 items. After a standard power-of-three promax rotation, which allows for correlation between factors, this analysis generated factor loadings that were generally consistent with the previously validated constructs of (1) complexity, (2) uncertainty (or dynamism) and (3) hostility.

Table 1 shows that the first factor, which we will refer to as *complexity*, loads strongly on the number of competitors, number of technological designs and number of customer segments. It also loads strongly on competitor rivalry and negatively on customer loyalty. The complexity factor seems to correspond to the notion of an increasingly complex, increasingly competitive business environment. The factor with the second highest eigenvalue loads strongly on all measures of increased environmental uncertainty and is simply referred to as *uncertainty*. The factor loadings for the third factor provide for a straightforward interpretation as environmental *hostility*. It loads negatively on increased survival chances of a typical company, increased customer loyalty and increased profit margins. It also loads positively on increased rivalry and negatively on increased numbers of suppliers and regulators, consistent with unfavorable market situations. The eigenvalue of this third factor is below the usual cut-off value of 1 but above 0.7, which has been suggested as a cut-off value by other authors (Joliffe, 1972). Because of its straightforward interpretation as a commonly used factor in comparable studies, we retain the factor for our main analysis but we also report on tests without it.

To test hypotheses regarding the impact of a change in the relative strength of operations resources and capabilities, the questionnaire also contained three items aimed at measuring this construct, each one employing a seven-point Likert scale. Respondents were asked to indicate their level of agreement (or disagreement) with statements of increased relative contribution of the operations function to (1) competitive advantage, (2) firm strategic assets, and (3) firm value, compared to four years earlier. The Cronbach alpha coefficient for the three items was 0.87, above the usual cut-off value of 0.7 for construct reliability. The scale is constructed by averaging the three items and is referred to as *strength of operations*.

Table 1
Factor loadings for external context variables ($N = 167$).

Variable (increase in [. . .] during last four years)	Complexity factor 1 (e.v. = 1.90)	Uncertainty factor 2 (e.v. = 1.06)	Hostility factor 3 (e.v. = 0.79)
Number of competitors	**0.57**[a]	0.12	−0.04
Number of technological designs	**0.57**	−0.01	−0.10
Number of customer segments	**0.50**	0.00	−0.05
Number of regulators	**0.36**	−0.08	−0.25
Number of suppliers	0.16	0.02	−0.27
Competitor rivalry	**0.53**	0.05	0.29
Customer loyalty	**−0.33**	0.21	**−0.34**
Survival chances of typical company	0.15	0.01	**−0.52**
Profit margins	−0.11	−0.16	**−0.42**
Uncertainty about customer preferences	0.07	**0.41**	−0.01
Uncertainty about competitors	0.10	**0.68**	0.06
Uncertainty about regulators	0.03	**0.55**	−0.04
Uncertainty about suppliers	−0.06	**0.63**	−0.01

[a] Variables with loadings > 0.30 are in bold face.

Table 2
Measuring increases in the share of top-level communication.

Questionnaire items	Top-level communication (range: −3 to 3) (sum of 3 components below)
Percentage of top-level communication, now and 4 years earlier Percentage of functional deliberation, now and 4 years earlier	1, if percentage of functional deliberation decreased and percentage of top-level communication increased −1, if the opposite is indicated 0, otherwise
"For strategy making, I now spend relatively more time researching options by myself or with my staff, while four years ago the focus was more on discussions with the upper management team" (7 point Likert scale: strongly disagree – neutral – strongly agree)	−1, if agreement is indicated 0, if neutrality is indicated 1, if disagreement is indicated
"Compared to four years ago, I now spend proportionally less time on strategic discussions with my colleagues and upper management, and more on strategic decision making within my own team" (7 point Likert scale: strongly disagree – neutral – strongly agree)	−1, if agreement is indicated 0, if neutrality is indicated 1, if disagreement is indicated

4.2. Role of operations executives in strategy making

To obtain a measure for the change in time spent on strategy making, we provided the following definition of strategy making: "The process by which a company makes decisions about long term commitments (investments, large or long-term contracts, public commitments, etc.)". Next, we asked the respondents to estimate the percentage of time they spent on strategy making, now and four years earlier. To avoid measuring the change in the respondent's position instead of the position's role, we asked the respondents who did not hold the same position four years earlier to compare their situation with that of their predecessor at that time. This question is comparable to what Miller and Friesen (1983) asked CEOs when inquiring about change in the strategy making approach of "top managers", "senior management", and "managers". In other words, the respondents were asked to recall the strategy-making approaches of other members in their organization in the past. *t*-tests for means also revealed that these respondents ($n = 81$) did not differ significantly from others ($n = 53$) with respect to independent variables (four context variables and two strategy making variables), except for perceiving a slightly higher increase in hostility, which can be expected to correlate with shorter tenures.

To obtain a scale for the increase (or decrease) in the percentage of time spent on strategy making, we calculated the natural logarithm of the ratio of the current percentage over the percentage from four years earlier, a scale we refer to as *strategy making*. With the use of the ratio of the percentages instead of their difference, an OE who changed from 5% four years earlier to 25% now registers a higher score than an OE who changed from 20% to 40%. We take the logarithm of the ratio to obtain a symmetrical scale that does not assign excess weight to very high or very low ratios. This scale has a mean value of 0.62 and a standard deviation of 0.66. Hence the average increase in the amount of time spent on strategy making by the respondents over the four years is 86%.

To obtain estimates of changes in the share of top-level communication (TLC) in the OE's strategy-making activities, we asked respondents what percentage of their time spent on strategy making was devoted to TLC and what percentage to functional deliberation (FD), now and four years earlier. The definition for TLC was: "exchanging information with the person you report to and with peers or colleagues in other functions". The definition provided for FD was: "personal research, analysis and decision-making as well as information exchange with staff, subordinates and external sources". To assure sufficient reliability for this new construct, we also included two additional questions to measure increases in the ratio of FD to TLC directly. These last two measures were obtained directly from items in which the respondents were asked to state their level of agreement (or disagreement) with statements aimed at reflecting an increase in the ratio of FD to TLC (the bottom two left cells in Table 2 contain the exact wording of the two statements). In total, these measurements provided three independent ways of measuring an increased, steady, or decreased share of TLC in strategy-making activities (see Table 2).

The three measurements allowed the construction of Guttman scales with coefficients of reproducibility larger than the suggested cut-off value of 0.9 (Anderson et al., 1983, p. 259). For example, if respondents' answers for the three measurements are classified as agreement or disagreement with an increased share of FD (by treating neutral answers as disagreement), only 5% of "agreements" had to switch to "disagreements" or vice versa to create a perfectly reproducible Guttman scale (in which all observations are consistent with a ranking among the three measurements by which an "agreement" on a higher ranked measure implies "agreement" in all lower-ranked measures but not the other way around). If the same procedure is applied to construct a Guttman scale indicating an increased share of TLC only 9% of answers needed to be switched (the differences in the number of switches required is simply related to the different treatment of the neutral answers for the two scales). The coefficients of reproducibility of 0.95 and 0.91 for these two Guttman scales indicate that our measures are reliably measuring a one-dimensional construct and we performed tests of our hypotheses that use these two scales. To leverage the more fine-grained information available in the measurements for our main tests, we constructed a combined scale by allowing each of the three measurements in Table 2 to take on one of three instead of two values, −1, 0, or 1, and by adding these values for each respondent as done in a regular Guttman scale. This scale, which we refer to as *top-level communication* is thus limited to discrete values ranging from −3 to +3, with −3 indicating a clear increase in the share of FD and +3 indicating a clear increase in the share of TLC.

4.3. Performance

To measure performance, we obtained subjective assessments, a method that is commonly used in comparable studies (e.g. Brews and Hunt, 1999; Dess et al., 1997). We asked respondents to compare their business unit's performance during the last two fiscal years with the performance of their industry along three dimensions: sales growth, return on sales and return on assets. All three dimensions were measured on a seven-point Likert scale in which the fourth point corresponded to the industry average. We averaged out the three measures to generate an aggregate performance measure. As this measure relates to the respondent's industry, there was no need to obtain industry controls for performance effects. However, as performance may be related to organizational size, data on the number of employees and sales-range (four ranges: $0–$10 M, $10–$100 M, $100–500 M, above $500 M) were also collected. The sales range variable correlated most with performance so that variable was used as a control for size.

With performance assessed in the two most current years, and changes in context and role of the OE assessed in a four-year retrospection, the measurements were specified to allow for a

Table 3
Descriptive statistics and correlations[d].

Variables[a]	Mean	Standard Deviation	Complexity	Uncertainty	Hostility	Strength of operations	Strategy making	Top-level communication	Sales range	Performance
Complexity[b]	0.01	0.84	1							
Uncertainty[b]	0.02	0.83	**0.33**	1						
Hostility[b]	0.00	0.71	−0.11	−0.04	1					
Strength of operations[b]	1.28	1.16	**0.16**	**0.20**	0.00	1				
Strategy making[b]	0.61	0.66	0.09	−0.01	−0.05	−0.01	1			
Top-level communication[b]	−0.10	1.70	**−0.26**	−0.12	−0.00	**−0.24**	−0.11	1		
Sales range	3.03	0.92	−0.08	−0.05	−0.07	−0.13	0.05	0.03	1	
Performance[c]	0.76	1.02	−0.02	−0.12	**−0.18**	0.04	0.14	0.01	0.15	1

[a] Responses from OEs in business units 4 years old or older.
[b] Change in the last 4 years.
[c] During last two fiscal years.
[d] Correlations that are significant at $p \leq 0.05$ are bold faced.

time-lagged performance effect of adjustments to the OE's role in strategy making.

5. Analysis and results

5.1. Correlations

Table 3 contains the descriptive statistics and correlations of the different variables. We comment on the significant correlations, indicated in bold face in the table.

The promax rotation of factors resulted in a correlation between environmental complexity and uncertainty, which is consistent with the view that these two conditions frequently occur together. There are also positive correlations between the strength of operations and uncertainty, and between the strength of operations and complexity. One potential explanation is that the capabilities of an operations function become more critical in complex and uncertain environments, a notion that may be of interest for further research.

There is no significant correlation between top-level communication and strategy making, supporting the notion that these are independent constructs. Top-level communication correlates negatively with complexity ($p \leq 0.01$), indicating that OEs increase the share of FD in more complex environments. This result indicates that OEs tend to look for solutions to complexity within the operations function. We will see later that, even though common, this reflexive response to complexity is associated with *low* performance. Top-level communication also correlates negatively with the strength of operations. There could be a tendency for OEs to spend more time on FD as the operations function is perceived to grow in strength and importance, thereby spending more time on what is considered of value to the firm. An alternative hypothesis may be that an operations function growing in value may simply draw more attention from the OE, because of the number of issues that have to be resolved. Regardless of the causal explanation, our findings will indicate that this co-movement of context and process is *not* significantly associated with high performance.

Finally, performance is negatively correlated with hostility. This result is not surprising given that executives at poorly performing companies may attribute part of their problems to the hostility of the environment even when the performance is defined relative to the competitors in the same industry.

5.2. Regression analysis

To test the hypotheses regarding the role of OEs in strategy making, we use moderated regression analysis in which we compare regression models with and without the interaction terms of interest. Performance is the dependent variable and the independent variables include four context variables (complexity, uncertainty, hostility, strength of operations) and two variables for the OE's role in strategy making (strategy making and top-level communication). The interaction terms include the product of each of the four context variables with each of the two variables for the OE's role in strategy making. To control for company size, the sales range was included in all regressions.

To check normality conditions, we performed an information matrix test for the levels of heteroskedasticity, skewness, and kurtosis and had to reject the normality conditions required for OLS at the $p \leq 0.1$ levels for two of our three regression models (Models 1 and 2 in Table 4). Hence we used the Huber/White method (Huber, 1967; White, 1980) instead of OLS to obtain robust standard errors for the regression coefficients. To generate coefficients that are easy to interpret and to avoid hard-to-interpret coefficients for non-interaction terms when interaction terms are significant, all variables were standardized.

Table 4 contains the results for three models. The first one does not contain interaction terms and is the base model. The second contains the interactions between context and strategy making, which are highly significant as a set and thus included in a third model. The third model tests for interactions between context and the share of TLC in strategy making. The table shows the coefficients and their *t*-statistics for each of the independent variables. Variance inflation factors did not reveal any multi-collinearity concerns.

The changes in *R*-squared values indicate that the interaction between changes in context and changes in the role of the OE in strategy making can explain significant amounts of variation in perceived performance. *R*-squared increases from 0.076 in Model 1 to 0.252 in Model 3, with all interaction terms included. An *F*-test on the *R*-squared values of Models 1 and 2 indicates that the strategy making interaction terms are jointly significant at the $p \leq 0.01$ level. Using the *R*-squared values of Models 2 and 3, a similar *F*-test finds the top-level communication interaction terms significant at the $p \leq 0.05$ level. The explanatory power of the interaction effects is comparable to those reported in other studies that gauged the interaction between the strategy process, environment and performance (Goll and Rasheed, 1997; Priem et al., 1995).

In Model 3, six of the eight hypotheses are supported at a level of $p \leq 0.05$ or higher and the coefficients of the interaction terms have the correct sign for the two remaining hypotheses. Fig. 2 summarizes the hypotheses and the level of empirical support in Model 3 (see Table 4).

5.3. Robustness tests

To check the robustness of our findings, we tested Model 3 without the hostility factor, with alternative scales for the time spent on strategy making (1 alternative) and the share of TLC (2 alternatives), with the outliers removed, and without the responses from low response-rate populations. We report these tests in an annex which is available upon request. As could be expected, significance levels

Table 4
Moderated regressions.

Dependent variable: performance linear regressions (with robust standard errors) independent variables	Model 1		Model 2		Model 3	
	β	t-stat	β	t-stat	β	t-stat
Constant	−0.43	−1.56	−0.42	−1.50	−0.43	−1.44
Sales range	0.15	1.64	0.14	1.57	0.15	1.65
Complexity	0.01	0.13	−0.02	−0.19	0.01	0.14
Uncertainty	−0.07	−0.75	−0.09	−1.06	−0.07	−0.84
Hostility	−0.19*	−2.27	−0.20*	−2.48	−0.16*	−2.14
Strength of operations	0.07	0.63	0.01	0.10	0.01	0.08
Strategy making	0.09	0.90	0.03	0.32	0.02	0.18
OE top-level communication	0.01	0.13	−0.03	−0.41	−0.04	−0.47
Strategy making × complexity			0.17*	2.22	0.22**	2.66
Strategy making × uncertainty			0.06	0.71	0.02	0.33
Strategy making × hostility			0.12	1.53	0.17*	2.10
Strategy making × strength of operations			−0.27***	−4.18	−0.26***	−3.96
Top-level communication × complexity					0.25***	3.41
Top-level communication × uncertainty					−0.16*	−2.46
Top-level communication × hostility					0.11*	1.98
Top-level communication × strength of operations					0.02	0.25
Observations	134		134		134	
R-squared	0.076		0.184		0.252	
F-value	2.08		3.30***		4.49***	

* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.

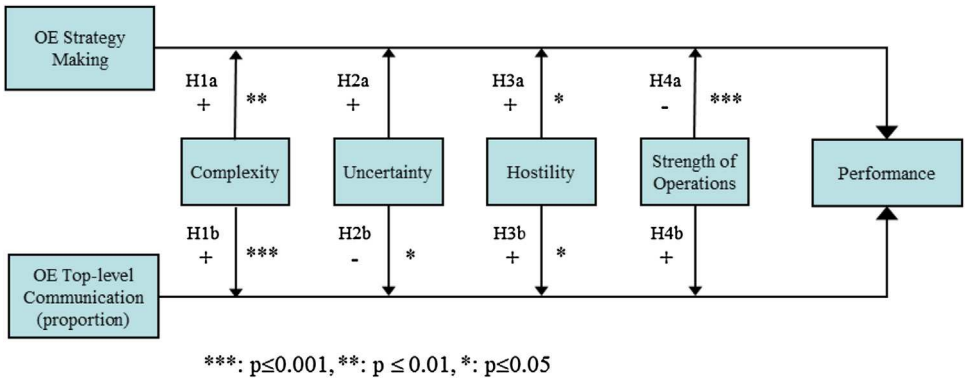

Fig. 2. Hypotheses with level of empirical support.

slightly change, but in all of the six robustness checks hypotheses H1a, H1b, H2b and H4a maintain support at $p \leq 0.1$ level or above. Both H3a and H3b maintain the level of support in 5 out the 6 tests. We conclude that the empirical support for six of the eight hypotheses appears robust.

6. Discussion

Our results provide empirical support for a contingency view of the OE's role in strategy making that can ultimately help in achieving and sustaining competitive advantage. The results also appear to be the first to empirically validate the important tradeoff between top-level communication (TLC) and functional deliberation (FD) in strategy making. In addition, the findings have important implications for some widely accepted concepts in operations strategy and can help us interpret contingency theories and findings from the strategic planning literature in the particular context of the OE's job.

The first set of implications relates to the relationship between complexity and the share of TLC in the OE's strategy-making activities. Inspecting pair-wise correlations only (Table 3), we find that OEs have a tendency to reduce TLC in complex environments. This is perhaps not surprising because a larger number of technological designs and customer segments may lead to unfocused factories (Skinner, 1974), and OEs may then be inclined to increase their FD to strategize about problems stemming from such complexity. However, we find that in complex environments, it is an increase in TLC that leads to better performance (see Table 4). Hence, it appears that an effective way to avoid the trap of unfocused factories in complex environments is to infuse the processes for firm-level and operations-function strategizing with sufficient TLC by the OE, an approach that was not the norm among the firms in our sample.

The second important insight is related to the negative impact of the relative strength of the operations function on the relationship between the OE's strategy making and firm performance. This finding indicates that it is useful to increase the time spent on strategy making when the operations function is struggling to build capabilities and, vice versa, to focus on coordination, control and other non-strategic tasks, when the operations function is contributing strongly. Even if intuitive to some top executives, this finding comes as a useful reminder that when a function is not contributing to competitive advantage, more often than not, the solution lies in

revisiting the functional strategy and not in more emphasis on execution.

This result also alerts executives not to presume that a progression along Wheelwright and Hayes' (1985)four stages implies a gradual increase in the OE's time spent on strategy making. While the OE's influence over business unit strategy is likely to increase, we find that in high-performing companies the OE tends to spend less time on strategy making and more on other tasks as the operations function becomes a source of competitive advantage.

Our findings regarding complexity and uncertainty add insight to the literature on strategic planning. These two dimensions are often treated similarly as they both require an increased amount of planning (Dess et al., 1997; Hart, 1992; Miller and Friesen, 1983). We indeed find a correlation between perceived environmental complexity and uncertainty and we find a positive relationship between strategy making and firm performance under both conditions (significant for complexity, correct sign for uncertainty). However, we also theorized that the importance of TLC would increase in complex (H1b) and decrease in uncertain environments (H2b), marking a clear difference between the two kinds of external conditions. Complexity confronts the firm with difficult problems that have many moving parts and dense interactions, which can only be uncovered and mapped through collaboration between different functional experts. Therefore picking a good strategy requires intense communication across the top management team. Moreover, as functional heads go back to their functions to build resources and capabilities, they need to keep communicating in order to mitigate the risk of unanticipated interactions. In contrast, uncertainty is likely to call for the pursuit of flexibility of resources and implementation of simple rules and strategies at the firm level. Hence the focus shifts toward maintaining general functional excellence through FD. The support we found for these hypotheses draws attention to the difference between complex and uncertain environments.

Our result that more involvement in strategy making by the OE is associated with high performance in hostile environments seems broadly consistent with the studies by Miller and Friesen (1983) and Slevin and Covin (1997). The finding that the same is valid for larger shares of TLC within this strategy-making activity adds another layer of detail to the optimal response of top management teams to environmental hostility. It appears that challenges in these environments require strategic solutions and attention to TLC, while the opportunities in non-hostile or munificent environments seem best leveraged through an emphasis on the development of functional resources and capabilities as well as attention to other tasks such as coordination and control.

To the extent that other functional executives face similar tradeoffs, our analysis seems generalizable to their roles in strategy making as well and may stimulate similar research in other functional counterparts to operations strategy. If generalizable, the analysis may be seen as describing aspects of the strategy making process by the entire top management team rather than the OE exclusively. Eisenhardt and Martin (2000) have argued that dynamic capabilities, which help firms achieve and sustain competitive advantage (Teece et al., 1997), are sets of *specific and identifiable processes*. Our results resonate with this view as they as they raise the question whether the strategy making process by the top management team may include more decentralized work with functional focus in uncertain environments and more collaborative and cross-functional efforts in those that are complex and hostile. An additional somewhat intriguing question is whether to involve the executives from relatively weaker functions more intensely in strategy making. We leave these questions for further research, noting that researchers seem to have only begun to unpack this and other strategically important processes.

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