Specialization, Slack Orientation, and Adaptive Capacity in Uncertain Environments

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This investigation applies a structural contingency perspective toward the problem of operations specialization under conditions of uncertainty. Generally, more environmental uncertainty is proposed to reduce the degree of specialization associated with effective adaptation. The study also considers how specialized operations, which are costly to modify due to their high asset specificities, cope with changing environments. The concept of organizational slack is employed to develop various orientations that offer adaptive capacity for specialized operations. Appropriate slack orientation is proposed to depend on whether volume or technological uncertainty is prevalent in the environment.

INTRODUCTION

In the context of production, specialization is the degree to which an individual, group, or organization performs a narrow range of activities (Schilling et al., 2003). The benefits of specialization on productivity, including learning effects from repetitive practice and efficiency gains from low switching costs, have been recognized for some time (e.g., Fayol 1916; Smith, 1776; Taylor 1911). At the operating unit level, a sizeable body of research has associated specialization with higher performance (e.g., Fisher & Ittner, 1999; Hayes & Wheelwright, 1979; Huckman & Zinner, 2008; Tsikriktsis, 2007). On the other hand, many studies have found no significant performance benefits of specialization compared to more diversified operations (e.g., Panzar & Willig, 1981; Rumelt, 1974; Teece, 1980).

Indeed, there is reason to believe that productivity gains from specialization should be limited in some circumstances. Monotony from repetition may lead to reduced worker motivation and engagement, causing productivity to level off or perhaps even decline over time (Melamed et al., 1995). Market taste preferences could change, leaving specialized operations with specific assets that are difficult to modify or trade (Ghemawat, 1991; Williamson, 1975). The narrow scope of specialized work may limit learning capacity that accrues from some degree of task variation (Cellier & Evrolle, 1992; Narayanan et al., 2009; Schultz et al., 2003; Staats & Gino, 2012), making it difficult for operations to adapt to changing situations.

This paper develops a contingency-based framework to help explain and unify various conceptualizations and empirical outcomes related to specialized workflow. The framework is grounded in the intuition that high degrees of specialization are better suited for stable, rather than turbulent, operating contexts. Stable environments reduce task uncertainty (Galbraith, 1973) and foster conditions conducive to high volume repetition and associated learning effects that bolster productivity. As environments become more turbulent, performing a narrow range of activities becomes riskier due to the rising number of exceptions that must be dealt with in order to meet changing market demands. Productivities are likely to falter and specialized producers may face obsolescence if they do not increase

task variety. In uncertain environments, performing a broader range of tasks should improve productivity and raise capacity for coping with change.

Proposing that scope of work should depend on the level of uncertainty present in operating environments is not altogether revolutionary. After all, evolutionary theories have long held that variation is central to adaptation in changing environments (e.g., Darwin, 1859). When specialization is viewed as the degree of concentration in a "portfolio" of work tasks, then concepts from modern portfolio theory (Markowitz, 1952) suggest that task scope should vary depending on the uncertainty of estimated returns from those tasks performed in various production environments. Yet, the notion that degree of specialization should depend on the amount of uncertainty present in the external environment has not been well addressed in the operations literature. For example, with some notable exceptions (e.g., Ketokivi & Jokinen, 2006), studies of Skinner's (1974) focused factory idea, a concept clearly associated with specialization, have rarely considered environmental uncertainty as an important contingency.

This paper extends the literature by applying a structural contingency perspective (e.g., Lawrence & Lorsch, 1967; Thompson, 1967) to the problem of determining the extent to which an operation should specialize. The central proposition is that the degree of operations specialization depends on the nature of uncertainty present in the environment. Generally, more environmental uncertainty should reduce the degree of specialization associated with effective adaptation. The study also considers how specialized operations, which can be costly to modify due to their high asset specificities (Williamson, 1975), cope with changing environments. The concept of organizational slack (Bourgeois, 1981; Cyert & March, 1963; Thompson, 1967) is employed to propose various slack orientations that offer adaptive capacity for specialized operations.

This study contributes to research and practice in several ways. It extends calls for more contingency perspectives in operations management (Sousa & Voss, 2008) to the strategic context. It uniquely associates degree of work specialization necessary for effective performance with the nature of uncertainty present in operating environments. This study also develops the concept of slack orientation to help explain how specialized operations effectively respond to changing conditions by configuring slack in various ways. Testable propositions are developed throughout for future investigation, and research to test the framework developed here is discussed. Practically, this paper sensitizes managers to external influences on their decisions to specialize, and offers a framework for aligning scope of productive tasks with the operating environment.

SPECIALIZATION AND UNCERTAINTY

Specialization is the degree to which an individual, group, or organization performs a narrow range of activities (Schilling et al., 2003). Generally, a narrow range of work activities results in the production of a narrow range of outputs. Various terms have been employed to reflect meanings similar to specialization such as division of labor (Smith, 1776), homogeneity (Carter & Keon, 1989), and focus (Skinner, 1974). The literature has sometimes distinguished between task and person specialization (e.g., Carter & Keon, 1989). Task specialization involves production using a limited set of work activities, with little consideration given to the nature of knowledge or skill necessary to perform the task. For example, an assembly line worker who tightens screws on passing work in progress may require little specialized training to perform the job well. Person specialization involves mastering focused but deep pools of knowledge that require long periods of training (Hage, 1965). Person specialization may enable the performance of some variety of tasks to achieve relatively narrow ends. A neurosurgeon, for instance, may be capable of performing several sophisticated operating table procedures that, depending on the medical situation at hand, could be applied in various combinations to accomplish successful surgery. For purposes of this study, task and person specialization are viewed as sufficiently similar. Although person specialists may employ somewhat broad task portfolios, these tasks remain directed toward narrow outcome scopes (Spaeth, 1979). Moreover, the task portfolios of person specialists are likely to be less varied than generalist workers who possess less professional training. On the market, both task and person specialization result in a reduction in the set of outputs that workers can produce (Camera et al., 2003).

Because few operations possess the resources necessary for complete self-sufficiency, organizations must interact with their environments to some degree in order to obtain resources vital for survival and growth (Lawrence & Lorsch, 1967; Pfeffer & Salancik, 1978; Thompson, 1967). A central objective of these interactions, which often manifest as patterns of trade or exchange, is to maintain orderly and reliable patterns of resource flows (Katz & Kahn, 1978; Oliver, 1993). However, operating environments are subject to uncertainties that can upset the course of resources and threaten survival (Emery & Trist, 1963; Pfeffer & Salancik, 1978). Uncertainties arise from combinations of external disturbances and internal cognitive limitations that prevent organizational actors from accurately interpreting fluctuations in their environments and predicting all relevant contingencies in resource exchange with trading partners (Weber & Mayer, 2014; Williamson, 1991).

Specialized operations are well suited for stable environments. Stable environments reduce task uncertainty (Galbraith, 1973) and provide consistent conditions that enable specialized producers to realize large learning gains from repetitive work while reducing costs associated with switching tasks (Levinthal & March, 1993). Repetitive patterns of production are favorable for high fixed cost investments that enhance productivity in predictable markets. Stable environments also facilitate consistent patterns of trade with customers and suppliers, leading to further specialized investments as relationships strengthen. For example, a supplier might locate a plant adjacent to a large customer's facility, or staff workers might acquire specialized skill and experience from working with a particular supply chain partner. In environments perceived as stable and predictable, operations will be prone to narrow their task portfolios to exploit the productivity enhancing effects of specialization. Outsourcing "non-core" tasks to external suppliers constitutes one approach for narrowing activity sets to focus on high productivity work.

As environments become more uncertain, specialized assets can hinder rather than enhance productivity. Uncertainty reduces clarity about what must be accomplished to satisfy market needs, and generates exceptions to the status quo (Galbraith, 1973; March & Simon, 1958). As uncertainty increases, exceptions mount to the point where standardized work loses effectiveness in meeting changing customer requirements (Ford et al., 2014). Consequently, scope of work may require expansion to provide more capacity for processing information about the task environment and for producing to meet new market demands (Flynn & Flynn, 1999; Tushman & Nadler, 1978). Such task expansion can difficult for specialized operations, however, because of the cost and time required to revise stocks of specific assets (Williamson, 1975). On the other hand, operations that are more diversified should be more capable of navigating uncertain environments. Diversified operations employ a broader range of tasks that can generate varied outputs to enable more resource acquisition from external sources in turbulent times. Moreover, diversified operations often employ greater amounts of general purpose assets that are capable of being reconfigured quicker and with less cost compared to the specific asset stocks of specialized producers. It is also possible that, as task portfolios broaden, economies may accrue that further enhance the productivities of diversified operations in uncertain settings (Panzar & Willig, 1981). Less specialization should foster higher performance in settings where markets are unpredictable and time horizons are short (Ketokivi & Jokinen, 2006).

Proposition 1: The higher the environmental uncertainty, the lower the degree of specialization associated with effective performance.

TYPE OF UNCERTAINTY AS A MODERATOR

By itself, a contingency model that specifies a negative relationship between uncertainty and specialization is insufficient. It does not explain how, as suggested by empirical observation, many specialized operations are capable of persisting in turbulent settings. For example, despite their generally uncertain contexts, many "high tech" sectors are populated by firms with narrow task portfolios. Of course, it may be precisely their specialized nature that drives many such firms to failure. They simply do not possess the degree of diversification necessary to weather uncertainty over time. Nonetheless, some

specialized firms do persist in such settings, suggesting the presence of factors that serve to moderate the negative influence of uncertainty on specialization and enable operations with narrow task portfolios to cope with turbulent settings in a sufficient manner.

The nature of uncertainty emanating from the environment should attenuate the negative relationship with specialization to some degree. Walker and Weber (1984) distinguished between two types of environmental uncertainty: volume and technological. Volume uncertainty is the inability to accurately forecast volume requirements in a relationship. When volume uncertainty is high, capacities are poorly utilized, production costs are high, and inventories fluctuate significantly (Geyskens et al., 2006). Specialized operations should be capable of weathering some measure of volume uncertainty. For example, inventories can be adjusted to hedge against possible changes in upstream supply or downstream demand, thereby cushioning specialized operations against volume-related resource disruptions (Azadegan et al., 2012; Hendricks et al., 2009). Inventory and other buffers permit hierarchies to better handle exceptions to the status quo and to maintain smooth operations and resource flows (Galbraith, 1969). To some extent, specialized operations can cope with volume uncertainties with minimal alteration to their task portfolios.

Technological uncertainty is the inability to forecast the technical requirements in a relationship (Walker & Weber, 1984). Technological uncertainty may stem from unpredictable variation in standards and specifications (Geyskens et al., 2006) as well as from general conditions of rapid innovation and technological ferment (Benner & Tushman, 2003). Technological uncertainty presents a more difficult adaptation problem for specialized operations. Specialized investments in production processes and exchange relationships become risky propositions because they are susceptible to changes in technological regimes. Because of high costs and time periods associated with modifying operations with high asset specificities (Ghemawat, 1991; Williamson, 1975), entire facilities, supplier resources, and customer bases of specialized operations may be rendered obsolete in periods of rapid innovation before workflows can be revised. Buffers that cushion specialized operations against volume uncertainty provide little protection against technological upheaval. For example, warehouses of inventory offer little benefit if the items in stock are no longer deemed valuable by the market. In fact, inventory may act as a drag on specialized operations that need to adjust in uncertain times as stocks are liquidated and replaced with more useful resources. Because specialized workflows face greater exposure to forces of technological change, the performance of specialized operations is likely to fluctuate more in eras of technological ferment than in environments dominated by volume turbulence.

Proposition 2: Performance of specialized operations is more sensitive to changes in technological uncertainty than to changes in volume uncertainty.

SLACK ORIENTATION AS A COPING MECHANISM

Specialized operations can cope with volume and technological uncertainties by utilizing organizational slack. Organizational slack is a cushion of excess resources that can be deployed in a discretionary manner to enable adaptation to environmental change (Bourgeois, 1981). Slack may assume various orientations in organizational adaptation processes (Bourgeois, 1981; Cheng & Kesner, 1997). Slack may be oriented toward cushioning or protecting the internal organization from changes in external environmental demands (Thompson, 1967). Aforementioned inventory buffers, for example, enable operations to cope with unforeseen volume-related changes without having to make radical work process adjustments. Slack may also be oriented toward providing resources for innovation and experimentation (Cyert & March, 1963). For instance, research and development structure fosters growth of new products and production processes. Slack that advances innovation enables task portfolios to be reconfigured when status quo operations are unable to weather changing environmental demands.

It is reasonable to assume that specialized operations will prefer to employ slack orientations that shield task portfolios external from costly modification. However, the degree and nature of environmental uncertainty faced by specialized operations may render those orientations ineffective in some cases. Slack

that enables adjustment to, rather than preservation of, narrow task portfolios may be required. Table 1 summarizes various slack orientations available to specialized operations seeking to cope with changing environments and the relationship of those slack orientations to the degree and type of uncertainty prevalent in the operating environment. Propositions reflected by Table 1 are elaborated below.

TABLE 1: ENVIRONMENTAL UNCERTAINTY AND ORGANIZATIONAL SLACK FOR SPECIALIZED OPERATIONS

Degree of Uncertainty	Type of Uncertainty	Slack Orientation	Task Portfolio Objective
Low, moderate	Volume	Operating buffers	Preserve level of specialization
Moderate, high	Volume	Formal transaction governance mechanisms	Preserve level of specialization
Low, moderate	Technological	Relational governance mechanisms	Preserve level of specialization
Moderate, high	Technological	Innovation	Adjust level or nature of specialization

Operating Buffers

Because costs associated with reconfiguring specialized assets are high (Williamson, 1991), managers will prefer slack orientations that permit operations to function in changing environments while preserving degree of specialization. As such, the building of operating buffers is likely to be considered. Operating buffers are forms of organizational slack that serve to protect or insulate the organization from external contingencies (Cyert & March, 1963; Thompson, 1967). Operating buffers can be seen as shock absorbers that cushion the organization from external blows that would otherwise cause workflow disruption or breakdown (Bourgeois, 1981; Galbraith, 1973). Because they reduce disturbance from external sources, operating buffers permit production process to function with little or no task alteration. While inventory is a commonly employed operating buffer, other potential sources include excess capacity, order backlogs, peripheral staff personnel that support technical cores, lengthening promised delivery times, and lowering performance objectives (Azadegan, 2012; Bourgeois, 1981; Galbraith, 1969; Hendricks et al, 2009).

Although they help operations cope with external uncertainties, operating buffers can be costly (Modi & Mishra, 2011). For example, slack resources employed as buffers may take the form of inventory that is purchased and held, capacity that has been built but underutilized, or additional time that customers must wait. Of course, the cost of those buffers could be considerably less than the cost of modifying specialized task portfolios in the face of environmental uncertainty. Indeed, Galbraith (1973) noted that managers often find the benefit of operating buffers so compelling that they are unaware that they are employing high amounts of slack, and that use of buffers can be so pervasive that associated costs go unnoticed until managers are compelled to look for them. Given the cost-benefit tradeoff, it is likely that operations with highly specialized task portfolios will find investments in buffering capacity more attractive than would operations with less specialized task portfolios. Because of the high cost of modifying their task portfolios, specialized operations will perceive benefit from developing operating buffers to cope with uncertain times.

The applicability of operating buffers is limited, however, in that buffer-oriented slack primarily serves to cushion specialized operations against low to moderate volume uncertainty. Inventories can be

produced or consumed to shield workflows from, for instance, unanticipated changes in upstream supply and downstream demand. Operating buffers are less effective as safeguards against technological uncertainty. Stockpiles of finished goods are of little use when customers are drawn to innovative substitutes, thereby exposing workflows to the full force of changing marketplace demands. When technological uncertainty is present, buffers provide less assistance for specialized operations seeking to maintain existing task portfolios.

Proposition 3: Slack orientations that build buffering capacity will improve the performance of specialized operations primarily when low to moderate levels of volume uncertainty are present.

Formal Transaction Governance

If buffering capacity is added beyond a particular point, then it is possible that operations might adopt suboptimal structural arrangements aligned more with personal preferences rather than with economic efficiency (Child, 1972; Yasai-Ardekani, 1986). Building large amounts of buffer-oriented slack might slow managerial response to market conditions demanding aggressive action (Cheng & Kesner, 1997). Because of the limitations associated with operating buffers, specialized operations are likely to pursue other slack orientations as environmental uncertainty builds. As rising uncertainty threatens the flow of resources between interdependent organizations (Pfeffer & Salancik, 1978), managers will seek to create negotiated environments that govern exchanges in manners that secure those resources (Cyert & March, 1963; Dyer, 1997; Eisenhardt, 1989; Poppo & Zenger, 2002; Williamson, 1991). As such, slack oriented toward enabling effective governance of interorganizational transactions is likely to be pursued as environments become more uncertain.

Transactions are often governed formally through the use of contracts (Williamson, 1975). Contracts fortify exchanges to help preserve specialized investments from adverse effects of change, particularly opportunism (Williamson, 1991). Risk of opportunistic behavior is significant because switching costs associated with reversing relationship-specific asset commitments can hold exchange partners hostage to undesirable arrangements (Handley & Benton, 2012). For example, a supplier might fail to honor a previously agreed-to testing and inspection schedule if it anticipates no sanctions from customers captive to the supplier's inputs. Formal mechanisms such as supplier certifications or facility audits can be written into contracts to prevent such opportunism (Gray & Handley, 2011). To develop formal governance mechanisms with trading partners, operations require resources for contracting and enforcement. Slack that builds capacity for formal transaction governance is similar to buffer-oriented slack in that both preserve core workflow processes. However, while buffer-oriented slack develops adaptive capacity as a product of internal workflow decisions and outcomes, slack oriented toward formal transaction governance builds capacity for managing exchanges at the organization's boundaries.

Slack oriented toward formal transaction governance is most useful in environments with moderate to high volume uncertainty. As volume uncertainty increases, capacity utilizations decline and inventory fluctuations increase (Geyskens et al., 2006), thereby lowering the utility of operating buffers. To cope with higher volume uncertainties, interdependent organizations are likely to develop capacity for contractually managed exchanges. Practices that enable the establishment of formal agreements and managing across organizational boundaries enhance uniformity and reduce quality upsets in resource flows. For example, supply chain quality management (SCQM) practices such as quality incentive contracting and quality monitoring offer capacity for aligning responsibilities, objectives, and consequences to reduce risk of poor quality in outsourcing arrangements (Flynn & Flynn, 2005; Gray & Handley, 2011). Quality assurance system registration facilitates performance measurement that leads to better understanding of processes between supply chain partners (Sroufe & Curkovic, 2008). The formal, measurable nature of many SCQM practices makes them contractually enforceable, and associated penalty and reward provisions motivate behavior aimed at reducing opportunism and interorganizational quality problems (Zhu et al., 2007). An important thrust of these activities is that they make the quality of resource flows more predictable which reduces volume uncertainty (Ford, 2015). Slack that enables the

deployment of these practices constitutes an effective countermeasure for specialized operations experiencing volume-related turbulence in their environments that operating buffers are unable to address.

Proposition 4: Slack orientations that build formal transaction governance capacity will improve the performance of specialized operations primarily when moderate to high levels of volume uncertainty are present.

Relational Governance

Formal transaction governance mechanisms, such as those facilitated by the SCQM practices discussed above, lose effectiveness in technologically uncertain environments. As technologies change, measures and standards that form the basis for process control and improvement in previous technological regimes are rendered obsolete, making it difficult to enforce formal agreements over significant periods of time and driving up re-contracting costs (Handley & Benton, 2012; Heide & John, 1990). Information asymmetries between exchange partners increase risk of strategic behavior and opportunism (Eisenhardt, 1989; Nilikant & Rao, 1994), leading to less willingness to enter into formal commitments.

Lacking capacity for formal control while still seeking stability of resource flows, specialized operations are likely to build slack oriented toward relational transaction governance in technologically uncertain environments. Relational governance mechanisms are sustained by trust, parallel expectations, joint action, and procedural fairness that build open-ended relationships capable of developing strong alliances over time (Benton & Maloni, 2005; Dyer & Singh, 1998; Geyskens et al., 2006; Heide, 1994; Kanter, 1994). Because they do not depend on particular standards or specifications, relational governance mechanisms such as joint planning and steering committees, inter-organizational problem solving teams, and customer/supplier training programs are capable of enduring technological shifts while encouraging mutually beneficial collaboration on matters affecting resource stability. Slack that builds relational governance capacity, such as proficiencies for boundary spanning and interorganizational teamwork, helps stabilize resources flows and strengthen competitive positions in technologically uncertain contexts.

Proposition 5: Slack orientations that build relational governance capacity will improve the performance of specialized operations primarily when low to moderate levels of technological uncertainty are present.

Dynamic Capabilities for Innovation

The organizational slack alternatives discussed above permit specialized operations to function in turbulent settings while preserving their task portfolios. This is desirable because of the costs associated with redeploying specialized assets. When coping with uncertainty, specialized operations are likely to exploit the prospects of slack oriented toward building operational buffers, formal transaction governance, and relational governance capacity before altering core work processes. Several factors may motivate operations managers to consider the possibility of altering core workflows, however. As uncertainty increases, slack orientations that preserve task portfolios may not provide enough buffering or transaction governance capacity to adequately stabilize resource flows. Some measures of slack might also blind managers to the need for more drastic measures (Cheng & Kesner, 1997; Modi & Mishra, 2011), thereby widening the gap between actual and required level of specialization needed to properly address environmental turbulence. It is also possible that the nature of environmental change may be so dramatic that it provides obvious signals that current workflows will not enable adaptation and consequently must be modified (Rindova & Kotha, 2001).

Elevated environmental uncertainty creates discrepancies and challenges to the capabilities upon which operating tasks are based (Fredrickson & Mitchell, 1984). Capabilities are collections of learned, repetitious behaviors that often include tacit knowledge components (Winter, 2003). As organizations increasingly perform activities in reliable and satisfactory manners, capabilities associated with activities strengthen (Helfat & Winter, 2011). Capabilities can be categorized as either operational or dynamic. Operational capabilities enable present day production and are expressed by the actions that convert

inputs into outputs. Dynamic capabilities enable changes in production (Teece et al., 1997; Winter, 2003). They involve sensing and reconfiguring ordinary or operating capabilities (Cohen & Leventhal, 1990; Collis, 1994; Pavlou & El Sawy, 2011; Teece, 2007; Winter, 2003). Generally, greater dynamic capabilities increase organizational capacity for innovation and adaptation (Rindova & Kotha, 2001; Teece, 2014).

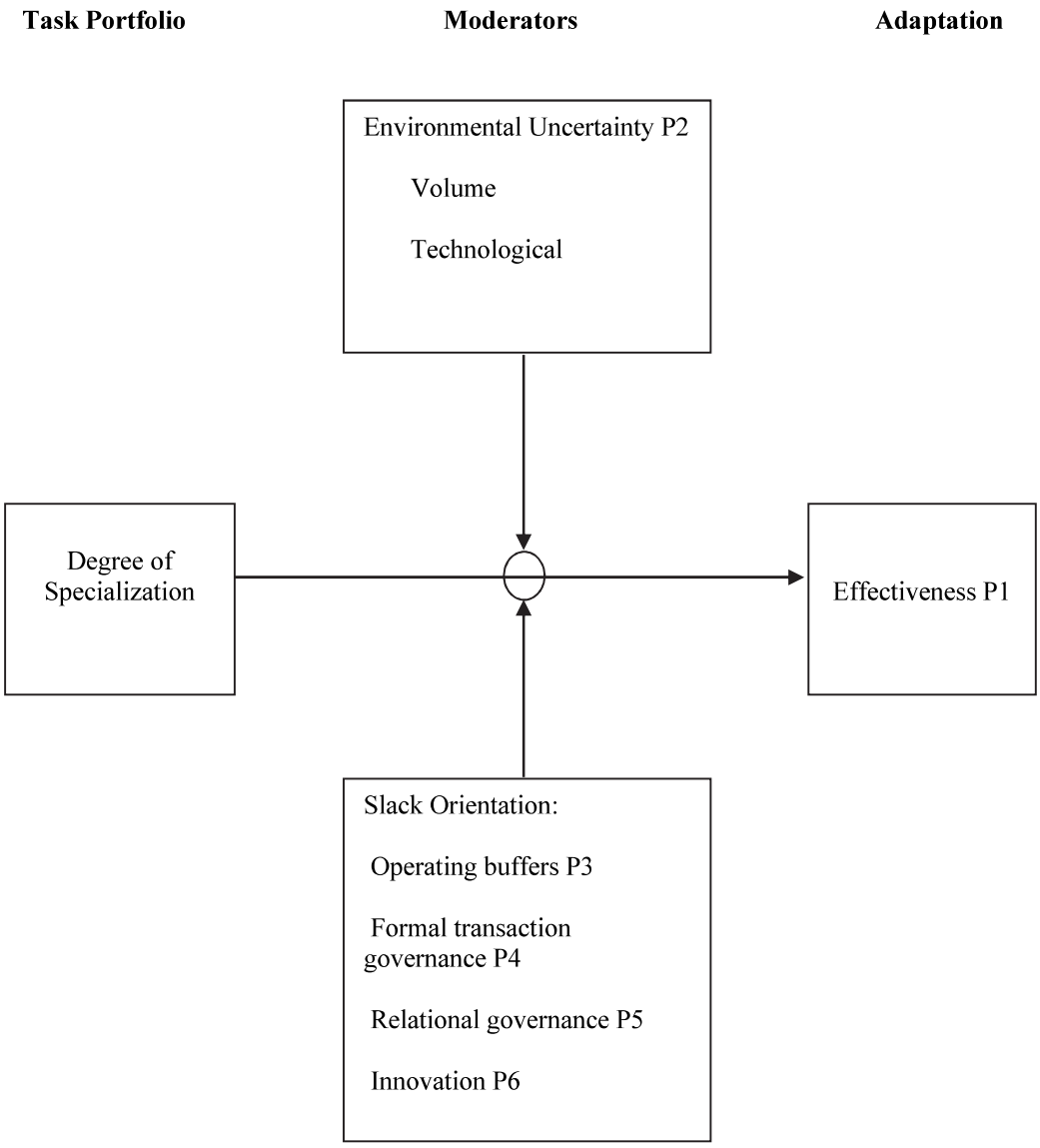
Because providing resources for creative behavior is a strategic function of organizational slack (Bourgeois, 1981), dynamic capabilities for sensing and reconfiguring operational capabilities associated with production can be seen as funded by slack. Sensing capacity must be developed for scanning environments to detect opportunities, threats, and changes. Reconfiguring capacity must be built for experimentation and for implementing new work processes that better meet environmental demands and secure vital resources from external providers. Although sensing and reconfiguring resources may help somewhat in eras of volume uncertainty, they are more useful in moderate to high technologically uncertain environments. Changing technologies render products and processes obsolete. Slack oriented toward innovation enables product and process developments necessary for specialized operations to reconfigure workflows to better meet changing market needs in turbulent settings. Absent slack that builds dynamic capabilities for innovation and change, specialized task portfolios become rigid and maladaptive in eras of high technological ferment.

Proposition 6: Slack orientations that build innovation capacity will improve the performance of specialized operations primarily when moderate to high levels of technological uncertainty are present.

CONCLUSIONS AND IMPLICATIONS

The general framework proposed by this study appears in Figure 1. Specialized operations face adaptation challenges in turbulent environments. As uncertainty increases, vital resource flows from external providers become at risk. Because of their habit forming, specialized nature, narrow task portfolios are difficult and costly to adjust. As such, less specialization is desirable as uncertainty increases (Proposition 1). The nature of environmental uncertainty moderates this relationship, however, as specialized operations and their performance are more sensitive to changes in technological uncertainty than to changes in volume uncertainty (Proposition 2). To cope with uncertainty and stabilize resource flows, specialized operations build adaptive capacity in the form of organizational slack. This slack can assume various orientations. Slack oriented toward operating buffers such as inventory permits specialized operations to cope with low to moderate levels of volume uncertainty (Proposition 3). As volume uncertainty grows, slack oriented toward formal governance mechanisms such as contracting expertise provides additional adaptive capacity (Proposition 4). Because buffers and formal transaction governance mechanisms are relatively ineffective in coping with technological uncertainty, specialized operations build slack oriented toward developing relational governance mechanisms such as boundary spanning skills to stabilize resource exchange in low to moderately turbulent technological regimes (Proposition 5). Each of these slack orientations enables specialized operations to preserve core workflows with minimal adjustment, which is desirable due to the costs associated with redeploying specialized assets. In highly uncertain contexts, however, specialized task portfolios may require significant adjustment in order to meet changing technological demands. Building slack orientations that foster innovation provides capacity for specialized operations to sense and reconfigure workflows in a manner that permits adaptation in highly turbulent environments, particularly in eras of technological ferment (Proposition 6).

FIGURE 1: SUMMARY OF STUDY FRAMEWORK



By applying a structural contingency perspective (e.g., Lawrence & Lorsch, 1967; Thompson, 1967) toward the problem of determining the extent to which operations should specialize, this paper addresses calls for more contingency theory building in operations management (Sousa & Voss, 2008). It provides a conceptual framework for recent empirical work suggesting that specialized operations perform more effectively in relatively stable contexts (e.g., Ketokivi & Jokinen, 2006; Mukherjee et al., 2000). This study also applies concepts of organizational slack (Bourgeois, 1981; Cyert & March, 1963; Thompson, 1967) and differing types of environmental uncertainty (Walker & Weber, 1984) in an innovative manner to explain the strategic response of specialized operations to different types of environmental uncertainty. Slack orientations as a source of adaptive capacity helps explain why some operations might maintain, or perhaps in some situations even increase (e.g., Toh & Kim, 2013), their level of specialization despite turbulent environments that challenge the relevance of mature workflow designs.

A paradoxical implication of the framework offered here is that some diversification is likely to be necessary for specialized operations to cope with turbulent environments. Except for the case of lower level volume uncertainties that favor doing "more of the same" in the form of creating operating buffers,

specialized operations will consider broadening their task portfolios to include activities that may not directly affect present day production but prove vital for coordinating or modifying processes over time in ways that enable adaptation in uncertain settings. Such activities are enabled by slack orientations that build skills and know-how for anticipating and managing interorganizational exchanges as well as for modifying core transformation processes. Expanding task portfolios via various slack orientations conceptually resembles work by Teece (1980), Hoskisson and Hitt (1990), Chatterjee and Wernerfelt (1991), and others that considers diversification, particularly related diversification, as a consequence of deploying surplus intangible resources that have been internally developed.

Although this investigation provides a conceptual foundation for understanding how specialized operations cope with environmental uncertainty, it requires testing and validation. The propositions developed within provide a basis for empirical study. Because this study proposes various slack orientations that can be developed to cope with uncertainty, it may be possible to develop "slack orientation profiles" that picture interorganizational differences in adaptive capacities developed by specialized operations. Some profile patterns might be empirically associated with organizations that have effectively adapted to particular contexts. On the other hand, some slack orientation profiles might be linked to maladaptive cases, thereby shedding more light on conditions of overspecialization and underspecialization among operations that are unable to adapt to change (e.g., Schilke, 2014).

Several theoretical issues loom as well. For example, it is recognized that organizational slack can hinder as well as enable adaptation (e.g., Bourgeois, 1981; Cheng & Kesner, 1997; Thompson, 1967). Although it can cushion against disruption and reduce likelihood of failure in the face of uncertainty (e.g., Azadegan et al., 2013; Hendricks et al., 2009), slack can also be a costly drag on efficiency (e.g., Modi & Mishra, 2011). Further work is required to better understand the balance between the adaptive fluidities and maladaptive rigidities that various slack orientations present to specialized operations. For example, how might investment in a particular slack orientation, such as operating buffers, impair or enhance development of other orientations such as slack that builds dynamic capabilities for innovation? Are various slack orientations diametrically opposed, or are there complementarities such as those suggested by Clark and Huckman (2012) that permit adaptive capacities in specialized operations to develop in parallel?

Practically, concepts developed here help sensitize managers to external influences on their decisions to specialize. When viewed through the lens of this study, for example, outsourcing can be seen as a specialization strategy because it narrows the portfolio of tasks done in-house. As environmental uncertainty increases, outsourcing can be risky as specialized investments in narrow task portfolios are difficult and costly to redeploy. Operations engaged in outsourcing might consider the merits of building slack orientations that make their specialized workflows less vulnerable to changing markets. Awareness of the possible influences of uncertainty and of the slack orientations that help cope with uncertainties should assist managers in effectively aligning the scope of productive tasks with their operating environments.

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