This paper 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 used to develop various orientations proposed to offer adaptive capacity for specialized operations. Slack orientations enable specialized operations to cope with change, depending on whether volume or technological uncertainty is prevalent in the environment.

KEYWORDS: Strategic management/operations interface, Inventory management, Capacity management, Contracts, Relationship management, Innovation Process, Outsourcing, Conceptual modeling

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 empirical 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 may 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. Market taste preferences could change, leaving specialized operations with skill sets that, due to their habit forming and specific investment nature, are difficult and costly to revise (Ghemawat, 1991). The narrow scope of specialized work may limit learning capacity that can accrue from some degree of task variation (Cellier & Evrolle, 1992; Narayanan et al., 2009; Schultz et al., 2003; Staats & Gino, 2012).

A contingency-based framework helps explain and unify various empirical outcomes observed from specialized workflow. Such a 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 for high
volume repetition and associated learning effects that bolster productivity. As environments become more turbulent, however, performing a narrow range of activities becomes risky 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 their task varieties. 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 should not be revolutionary. After all, fundamental theories of evolutionary change 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 modern portfolio theory (Markowitz, 1952) suggests that task scope should vary depending on the uncertainty of estimated returns from those tasks performed in various production environments. Yet, the idea 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 argument have rarely considered environmental uncertainty as an important contingency.

This paper extends the operations management literature by applying a structural contingency perspective (e.g., Lawrence & Lorsch, 1967; Thompson, 1967) toward 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 is proposed to 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 paper contributes to research and practice in several ways. It extends calls for more contingency perspectives in operations management (Sousa & Voss, 2008) to the operations strategy context. This study also develops the concept of slack orientation and its interaction with the environment in shaping workflow structure. Testable propositions are developed throughout for future investigation. 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 narrower range of work activities results in the production of a narrower range of outputs. Various terms have been employed to reflect meanings similar to specialization such as division of labor (Smith, 1776), homogeneity, and focus (Skinner, 1974). The literature has sometimes differentiated 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. Person specialization involves mastering limited sets of knowledge requiring long periods of training (Hage, 1965). Person specialization may enable the performance of some variety of tasks to achieve relatively narrow ends. For purposes of
this study, task and person specialization are viewed as sufficiently similar. Although person specialists may employ broader task portfolios, these tasks remain directed toward a narrow outcome scope (Spaeth, 1979). Moreover, the task portfolios of person specialists are likely to be less varied than individuals who possess less professional backgrounds. On the market, both task and person specialization result in a reduction in the set of goods that agents can produce (Camera et al., 2003).

Conceptually opposite specialized producers are producers with broad, diversified task portfolios. Broader activity sets promote greater self-sufficiency as operators that perform more tasks are more capable of “doing it themselves.” However, 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). As resources are acquired, often through trade, from other entities, conditions of interdependence arise as organizations rely on each other for production of important resources (Handfield, 1993).

Specializing operating task portfolios can help organizations cope with their dependence situation to some degree. Narrowing the scope of production tasks can improve productivity as learning effects accrue from repetition and as costs of switching between tasks are reduced. If the greater quantity of goods produced from specialized operations can subsequently be traded with other producers, then it is possible for specialist organizations to acquire more resources for survival and growth than they could by broadening their task portfolios.

Although organizations strive to maintain orderly and reliable patterns of resource flows (Katz & Kahn, 1978; Oliver, 1993), 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 particularly 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 from switching tasks (Levinthal & March, 1993). Repetitive patterns of production are favorable for high fixed cost investments that enhance productivity in stable environments. 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 take full advantage of the productivity enhancing effects of specialization. Outsourcing “non-core” tasks to external suppliers represents 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 customer 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 market needs (Ford et al., 2014). Scope of work often
expands to increase capacity for processing more information about the task environment and for producing to meet changing needs (Tushman & Nadler, 1978; Flynn & Flynn, 1999). Specialized operations are not well suited for uncertain environments. Their high stocks of specific assets cannot be redeployed without significant loss of productive value (Williamson, 1975). Habits must be broken, new tasks must be learned, capital equipment must be modified or replaced, relationships must be rebuilt. Altering specialized commitments can be strategically costly (Ghemawat, 1991). Less specialized operations are better able to navigate uncertain environments. General purpose assets can be redeployed quicker and with less cost. As task portfolios broaden, economies may accrue that enable effective operation in uncertain settings (Panzar & Willig, 1981). Less specialization fosters 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.

While environmental uncertainty reduces the general attractiveness of specialized operations, type of environmental uncertainty moderates the negative relationship to some degree (see Figure 1). 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, suppliers encounter low capacity utilizations and high production costs while customers face large inventory fluctuations (Geyskens et al., 2006). Specialized operations are capable of weathering some measure of volume uncertainty. For example, inventories can be adjusted to address changes in upstream supply or downstream demand, thereby cushioning specialized operations against environmental disruptions to some degree (Azadegan et al., 2012; Hendricks et al., 2009). Inventory and other buffers permit hierarchies to better handle exceptions to the status quo and maintain smooth operations and resource flows (Galbraith, 1969). Within a certain range, specialized operations can cope with volume uncertainties that enable narrow activity sets to adapt to change with minimal alteration.

Technological uncertainty is the inability to forecast the technical requirements in a relationship (Walker & Weber, 1984). Technological uncertainty may stem for 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 customer relationships are more susceptible to changes in technological regime. Because of high costs and time periods associated with modifying operations with high asset specificities (Williamson, 1975; Ghemawat, 1991), entire facilities and customer bases of specialized operations may be rendered obsolete in periods of rapid innovation before workflow processes can be revised. Inventory and other buffers that cushion specialized operations against volume uncertainty provide little protection against technological upheaval. Because specialized workflows face greater exposure to forces of technological change, performance of specialized operations will react more to environments dominated by technological uncertainty than to environments dominated by volume turbulence.

**Proposition 2:** Specialized operations are more sensitive to changes in technological uncertainty than to changes in volume uncertainty.
SPECIALIZATION, SLACK ORIENTATION, AND ADAPTIVE CAPACITY

The adaptation problem facing most specialized operations is a dynamic one. Specialization choices have been made in past periods. Changing environments are now rendering those choices ineffective in meeting external demands. Consequently, vital resource flows from the environment are becoming labile and at risk. How do operations respond to changing environments that suggest task portfolios as being too narrow or too broad? Simply adjusting the task portfolio to a level of specialization that better matches environmental demands may be an unsatisfactory response for several reasons. Specialized task portfolios are costly to change. When asset specificities are high, productive assets may lose significant value when reconfigured and redeployed (Williamson, 1991). Specialized task portfolios may also require long time periods to revise (Ghemawat, 1991). Because of its repetitious nature, specialized work is also habit forming. Unlearning old routines and adopting new ones may take considerable time. Finally, identifying and configuring new activities for the task portfolio may be difficult. Unclear market demands coupled with bounded rationalities of decision-makers may impair selection and implementation of new tasks necessary to stabilize resource flows from external sources.

Specialized operations can cope with uncertain environments by employing 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). The
role of slack in organizational adaptation processes has evolved along various conceptual perspectives (Bourgeois, 1981; Cheng & Kesner, 1997). One perspective views slack as oriented toward providing buffers that cushion or protect the internal organization from changes in external environmental demands (Thompson, 1967). Inventory, for example, is a familiar buffer in the operations management context (Azadegan et al., 2012). Another perspective views slack as oriented toward resources for innovation and change that allows organizations to experiment with new configurations (Cyert & March, 1963). Research & development structure exemplifies the innovation perspective of slack.

The notion that slack can be developed toward various orientations provides a basis for explaining how specialized operations can develop capacity for coping with environmental change. For instance, slack that builds buffering capacity enables specialized, costly-to-change task portfolios to persist in the face of changing environmental demands while still operating effectively. Slack that builds innovation capacity enables task portfolios to be reconfigured when it is perceived that status quo operations are unable to weather changing environmental demands. But when is one slack orientation preferred over another? While slack orientations that enable the persistence of specialized task portfolios seem preferable, the nature of environmental uncertainty may render those sources of adaptive capacity ineffective. Table 1 summarizes various slack orientations available to specialized operations seeking to adapt to 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>
<thead>
<tr>
<th>Degree of Uncertainty</th>
<th>Type of Uncertainty</th>
<th>Slack Orientation</th>
<th>Task Portfolio Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Volume</td>
<td>Buffers</td>
<td>Preserve level of specializaiton</td>
</tr>
<tr>
<td>Moderate</td>
<td>Volume</td>
<td>Formal transaction governance mechanisms</td>
<td>Preserve level of specialization</td>
</tr>
<tr>
<td>Moderate</td>
<td>Technological</td>
<td>Relational governance mechanisms</td>
<td>Preserve level of specialization</td>
</tr>
<tr>
<td>High</td>
<td>Volume, technological</td>
<td>Innovation</td>
<td>Adjust level of specialization</td>
</tr>
</tbody>
</table>

**Buffers**

Although altering task portfolios to better match environmental conditions directly addresses the contingent relationship expressed by Proposition 1 above, specialization levels may be difficult and costly to change. When asset specificities are high, productive assets may lose significant value when reconfigured and redeployed (Williamson, 1991). Because switching costs are high, managers will be prone to consider other strategies that permit them to function in changing environments while preserving their levels of specialization. One approach is to build workflow
buffers. Buffers are forms of organizational slack that serve to protect or insulate the organization from external contingencies (Cyert & March, 1963; Thompson, 1967). Buffers can be seen as shock absorbers that cushion the organization from external blows that would otherwise cause workflow disruption or breakdown (Bourgeois, 1981). Buffers can also be seen as reducing information processing requirements that, during uncertain times, would otherwise overwhelm interdependent work units and decision-making hierarchies (Galbraith, 1973). While inventory is a traditional operations buffer, other potential sources include excess capacity, order backlogs, advertising, presence of extra staff that supports technical cores, lengthening promised delivery times, and lowering performance objectives (Azadegan, 2012; Bourgeois, 1981; Galbraith, 1969; Hendricks et al, 2009).

Although they can help operations cope with external uncertainties, buffers are costly (Modi & Mishra, 2011). For example, slack resources employed as buffers may take the form of inventory that must be held, capacity that has been purchased but underutilized, or additional time that customers must wait. Of course, buffers could be less costly than the cost of modifying a specialized task portfolio in the face of uncertainty. Galbraith (1973) suggested that managers find the benefit of buffers so compelling that they are seldom aware that they are employing high amounts of this type of slack, and that it is so pervasive that the associated costs are not noticed unless people 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 see more benefit in developing buffers to cope with uncertain times.

Buffer-oriented slack primarily cushions specialized operations against volume uncertainty. For example, specialized operations can produce or consume raw material or finished goods inventory to shield workflows from unanticipated changes in supply and customer markets. Buffers are less effective as safeguards against technological uncertainty. Stockpiles of finished goods can be rendered worthless when customers are drawn to innovative substitutes, thereby exposing workflows to the full force of changing marketplace demands. When technological uncertainty is high, buffers provide less assistance for specialized operations seeking to maintain their status quo task portfolio.

Proposition 3: Slack oriented toward buffers provides adaptive capacity for specialized operations to cope primarily with volume uncertainty.

Formal Transaction Governance

If buffering capacity is added beyond a certain 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 slack as a buffer might slow managerial response to market conditions demanding aggressive action (Cheng & Kesner, 1997). Because of the limited utility of buffering, specialized operations are likely to develop other slack orientations as environmental uncertainty increases. Because uncertainty threatens the flow of resources between interdependent organizations (Pfeffer & Salancik, 1978), negotiated environments that govern exchanges are likely to arise (Cyert & March, 1963; Dyer, 1997; Eisenhardt, 1989; Poppo & Zenger, 2002; Williamson, 1991). Slack resources oriented toward enabling effective governance of interorganizational transactions are desirable in uncertain environments, particularly when asset specificities are high due to costs associated with redeploying commitments to other areas (Williamson, 1991).
Slack can be oriented toward building capacity for formal transaction governance. Formal transaction governance in negotiated environments is commonly facilitated by 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 parties 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 suspects no sanctions from a customer dependent on 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 be able 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 they both preserve core workflow processes. However, while buffer-oriented slack develops adaptive capacity primarily through internal process adjustment, 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 high volume uncertainty. When volume uncertainty is high, suppliers encounter low capacity utilizations and high production costs while customers face large inventory fluctuations (Geyskens et al., 2006). To cope with volume uncertainties, interdependent organizations will build capacity for contractually managed exchanges. Practices that enable agreement establishment 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 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. Slack that enables the deployment of these practices constitutes an effective countermeasure for specialized operations experiencing volume-related turbulence in their operating environments.

Proposition 4: Slack oriented toward formal transaction governance provides adaptive capacity for specialized operations to cope primarily with volume uncertainty.

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 will build slack oriented toward relational transaction governance in technologically uncertain environments. Joint planning and steering committees, inter-organizational problem solving teams, and customer/supplier training programs involve informal associations that are often not legally enforceable. Instead, such practices promote relational transaction governance (Gray & Handley, 2011). 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 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, help stabilize resources flows and strengthen competitive positions in technologically uncertain contexts.

Proposition 5: Slack oriented toward relational governance provides adaptive capacity for specialized operations to cope primarily with technological uncertainty.

Dynamic Capabilities for Innovation

The organizational slack alternatives discussed above generally 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 buffers, formal transaction governance, and relational governance capacity before altering core work processes. Several factors may drive operations managers to reluctantly entertain the possibility of altering core workflows, however. As uncertainty increases, slack orientations that preserve task portfolios may not have 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).

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, then the capabilities associated with activities strengthen (Helfat & Winter, 2011). Capabilities can be categorized as either operational or dynamic. Operational capabilities enable present day production. They are expressed in an operation’s existing task portfolio. 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; Teece, 2007; Pavlou & El Sawy, 2011; 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 the task portfolio can be seen as funded by slack. Sensing capacity must be developed for scanning the environment 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 technologically uncertain environments. Changing technologies render products and processes obsolete. Slack oriented toward innovation funds product and process development activities necessary for specialized operations to reconfigure workflows to better meet changing technological needs of turbulent market settings. Absent slack that builds dynamic capabilities for innovation and change, specialized task portfolios appear rigid and unadjustable in the face of technological uncertainty.

Proposition 6: Slack oriented toward innovation provides adaptive capacity for specialized operations to cope primarily with technological uncertainty.

CONCLUSIONS AND IMPLICATIONS

The general framework proposed by this study appears in Figure 2. Specialized operations face adaptation challenges in turbulent environments. As uncertainty increases, vital resource flows from external entities 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 buffers such as inventory permits specialized operations to cope with relatively low 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 skill to stabilize resource exchange in 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).

By applying a structural contingency perspective (e.g., Lawrence & Lorsch, 1967; Thompson, 1967) toward the problem of determining the extent to which an operation 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 better understand the strategic response of specialized operations to different types of environmental uncertainty through the
development of various slack orientations. 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 past workflow designs.

Figure 2: Summary of Study Framework

Although this study 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 developed to cope with uncertainty, it may be possible to develop “slack orientation profiles” that reflect interorganizational differences in adaptive capacities developed by specialized operations. For example, slack orientation profiles high in buffering and formal transaction governance capacity may be more suitable for specialized operations facing uncertain volume situations, while slack orientation profiles high in relational governance and innovation-oriented slack are more relevant in technologically turbulent environments. Certain slack orientation profiles might also be associated with 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 remain as well. For example, it is well known 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 buffering, impair or enhance development of other slack orientations such as innovation? Are various slack orientations diametrically opposed, or are there complementarities such as those suggested by Clark and Huckman (2012) that accrue
from some degree of diversification in specialized operations that permit adaptive capacities 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 adaptive capacity in the form of slack that reduces vulnerability to unanticipated events that could otherwise render specialized workflows less effective in changing markets. Awareness of the possible influences of uncertainty and of the slack orientations that help cope with those uncertainties should assist managers in effectively aligning the scope of productive tasks with their operating environments.

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