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Operational Capabilities: The Secret Ingredient

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ABSTRACT

We develop a theoretical definition of operational capabilities, based on the strategic management and operations management literature, and differentiate this construct from the related constructs of resources and operational practices, drawing upon the resource-based view of the firm as our foundation. We illustrate the key features of operational capabilities using the illustration of a restaurant kitchen. Because the traits of operational capabilities are distinct, they create a barrier to imitation, making them a potential source of competitive advantage. However, operational capabilities are particularly challenging to measure, because they emerge gradually and are tacit, embedded, and manifested differently across firms. In solving this measurement conundrum, we draw upon similar situations experienced by Schein (2004) and Eisenhardt and Martin (2000) in operationalizing organizational culture and dynamic capabilities. A taxonomy of six emergent operational capabilities is developed: operational improvement, operational innovation, operational customization, operational cooperation, operational responsiveness, and operational reconfiguration. A set of measurement scales is developed, in order to measure each of the operational capabilities, and validated using two different datasets. This allows replication of the psychometric properties of the multi-item scales and helps to ensure the validity of the resulting measures.

Subject Areas: Capabilities, Competitive Advantage, Competitive Strategy, Dynamic Capabilities, Operational Capabilities, Operational Cooperation, Operational Customization, Operational Improvement, Operational Innovation, Operational Practices, Operational Reconfiguration, Operational Responsiveness, Operations Strategy, Resources, Resource-Based View, Strategic Decision Making, and Survey Research.

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INTRODUCTION

The need to develop and maintain a sustainable competitive advantage is at the foundation of operations strategy, which draws on a number of intertwined yet distinct elements, including organizational capabilities, practices, and resources. Seminal strategic management research (Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Peteraf, 1993) provides a well-developed theoretical framework for understanding how a sustainable competitive advantage arises from the unique and heterogeneous resources of a firm, and operations management researchers have long focused on various operational practices for performance improvement (Flynn, Sakakibara, & Schroeder, 1995; Kotha & Swamidass, 2000; Cua, McKone, & Schroeder, 2001; Gupta & Whitehouse, 2001; Shah & Ward, 2003). Yet, there is considerable disagreement regarding what constitutes an organizational capability and what does not (Zahra, Sapienza, & Davidson, 2006; Schreyogg & Kliesch-Eberl, 2007; Lee & Kelley, 2008). The literature is "riddled with inconsistencies, overlapping definitions and outright contradictions" (Zahra et al., 2006, p. 917), and the term "capabilities" is sometimes used interchangeably with terms such as "resources" and "competencies" (Hayes, Pisano, Upton, & Wheelwright, 2005; Größler & Grübner, 2006). In this article, we focus on operational capabilities, which are a subset of the broader construct of organizational capabilities, in order to establish tangible bounds for clearly differentiating operational capabilities from related constructs.

The resource-based view (RBV) of the firm (Penrose, 1959; Barney, 1991; Peteraf, 1993) provides the foundation for our work. Based on the assumption of heterogeneous resources across firms, RBV emphasizes the organizational capabilities that underlie a firm's ability to excel in achieving its competitive priorities (Coates & McDermott, 2002). Critical to this is a firm's unique combination of resources and organizational capabilities; the potential for competitive advantage is related to the extent to which they are valuable, rare, inimitable, and non-substitutable (Dierickx & Cool, 1989; Barney, 1991, 1995). RBV suggests that operational capabilities are particularly relevant because internal resources and capabilities are the foundation for a firm's strategy; they are the primary source of profit and provide a stable basis for defining a firm's identity (Colotta, Shi, & Gregory, 2003).

Operational capabilities are the "secret ingredient" in explaining the development and maintenance of competitive advantage. However, they are often overlooked because they are tightly embedded in the organizational fabric of an operations system. Decision makers' attention tends to be drawn to more obvious assets, such as resources and operational practices. In addition, there is confusion regarding what an operational capability is and what differentiates operational capabilities from resources or practices, because they are closely related. Consequently, much of the impact of operational capabilities is often attributed to resources or operational practices. Because they emerge gradually and are tightly associated with a firm's distinctive features, operational capabilities tend to blend into the background. Yet, the traits of operational capabilities are distinct and create a barrier to imitation, making them a potential source of competitive advantage.

There is a need for research that provides a sound theoretical foundation of operational capabilities. Without understanding their role, we risk having an incomplete understanding of the process by which competitive advantage is developed. Specifically, this study will:

- Provide a theoretically based definition of operational capabilities and use it to highlight the major differences between operational capabilities and related concepts.
- Develop, validate, and empirically test a measurement instrument for operational capabilities.

We draw on the strategic management literature on organizational capabilities, applying it to the context of operations management to develop a definition of operational capabilities. We then illustrate the key features of operational capabilities using the illustration of a restaurant kitchen. We develop a set of measurement scales, which we validate, using two different datasets. This allows replication of the psychometric properties of the multi-item scales, helping to ensure the validity of the resulting measures.

THEORETICAL FOUNDATION

Organizational Capabilities: The Broader Construct

We begin by reviewing the literature on the broader construct of organizational capabilities and discussing their key traits. We view operational capabilities as a subset of the organizational capabilities construct, and believe that insights gained from research on organizational capabilities can be readily applied to the study of operational capabilities. Several researchers define organizational capabilities as a higher level construct that builds on the interaction of resources. For example, Amit and Schoemaker (1993, p. 35) define organizational capabilities as "information-based tangible or intangible processes that are firm specific and are developed over time through complex interactions among the firm's resources," and Winter (2000, p. 983) states that, "an organizational capability is a high-level routine or collection of routines that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type." Others focus on the competitive potential of organizational capabilities, describing them as anything that can be thought of as a firm's strength (Wernerfelt, 1984), "potential behavior modes of a plant with which it can support and shape corporate strategy and help it to succeed in the marketplace (Größler & Grübner, 2006, p. 458)," and "a bundle of aptitudes, skills and technologies that a firm performs better than its competitors, that is difficult to imitate and provides an advantage in the marketplace" (Coates & McDermott, 2002, p. 436). Thus, organizational capabilities provide the means for configuring an organization's resources (Eisenhardt & Martin, 2000; Lee & Kelley, 2008), and there is consensus that they deal with a firm's capacity to deploy resources and achieve specific goals.

In contrast, resources are stocks of factors that are owned or controlled by a firm (Amit & Schoemaker, 1993) and which are the inputs into the production process. Resources can be tangible (financial and physical resources), intangible (technology, reputation, and culture), or human (specialized skills and knowledge, communication, and motivation). Grant (1991) describes resources as nouns, because they can lie dormant, like an idle plant or unused knowledge, until they are needed, and can be defined independently of their use. Thus, a resource is something that a firm has access to, rather than something that it can do (Größler & Grübner, 2006).

Organizational capabilities, on the other hand, represent a distinctive and superior way of deploying, allocating, and coordinating resources (Amit & Schoemaker, 1993; Cavusgil, Seggie, & Talay, 2007; Schreyogg & Kliesch-Eberl, 2007). Grant (1991) describes organizational capabilities as verbs, because they focus on the way in which resources are used (Penrose, 1959); without organizational capabilities, a resource may lose its value over time (Coates & McDermott, 2002). Although organizational capabilities focus on the aptitude for managing a process or managing intellectual property, resources are the actual factory, brand, or patent (Coates & McDermott, 2002).

Organizational capabilities can be purposely built by focusing on the complex interactions between a firm's resources (Dierickx & Cool, 1989; Amit & Schoemaker, 1993), deeply rooted within its idiosyncratic social structure (Schreyogg & Kliesch-Eberl, 2007), and spanning functions and hierarchical levels (Grant, 1996; Zeitz, Mittal, & McCauly, 1999). As such, organizational capabilities become embedded into the fabric of a firm through managers' deliberate decisions over time (Grewal & Slotegraaf, 2007). Specifically, organizational capabilities are embedded in organizational processes focused on coordination, learning, and transformation (Harreld, O'Reilly, & Tushman, 2007). They are complex in nature and involve both internal and external processes (Hofer & Schendel, 1978; Dosi, Nelson, & Winter, 2000; Schreyogg & Kliesch-Eberl, 2007). The relevant knowledge and abilities are held collectively, supported by social networks, rather than residing in a single individual (Pandza, Polajnar, Buchmeister, & Thorpe, 2003b). Because they cannot be transferred to other firms the way that some resources can, the embeddedness of organizational capabilities in a firm's processes and routines provides a potential source of competitive advantage. Narasimhan, Swink, and Kim (2005) emphasize that, although organizational capabilities are the "exploitation of specific practices to attain performance gains," investment in practices, per se, does not constitute organizational capabilities. It is possible for two plants to invest equally in the same practices and not be capable to the same degree, in terms of manufacturing performance outcomes.

Thus, organizational capabilities are tacit social processes that emerge gradually over time, so gradually that participants may not even be aware of their existence and ultimately take them for granted (Leonard-Barron, 1992). As social processes, organizational capabilities are path dependent, influenced by factors such as firm history (Teece, Pisano, & Shuen, 1997), actions of decision makers (Rothaermel & Hess, 2007), and the firm's learning process (Schreyogg & Kliesch-Eberl, 2007). Furthermore, these paths are unique to a firm (Teece et al., 1997), described by Eisenhardt and Martin (2000) as "equifinality"; there are multiple paths to achieving the same organizational capability. Thus, the paths to a specific organizational capability can arise from very different starting points (Mosey, 2005). Organizational capabilities are not necessarily independent, however; in fact, an organizational capability may be more valuable when it is combined with other organizational capabilities (Ordanini & Rubera, 2008).

Organizational capabilities provide a collective process of making sense of the environment (Schreyogg & Kliesch-Eberl, 2007), providing a firm with a means of configuring its resources at various levels (Lee & Kelley, 2008). Organizational capabilities facilitate problem-solving decision making under conditions of uncertainty (Dosi, Hobday, & Marengo, 2003), allowing managers to deal with ambiguous and ill-structured tasks (Schreyogg & Kliesch-Eberl, 2007). They are empirically validated through a process of identifying problems, applying embedded skill sets and verifying that the desired results have been attained.

To summarize, organizational capabilities:

- Are firm specific,
- Emerge gradually over time,
- Are tacit; participants may be unaware of their existence,
- Are path dependent, influenced by a firm's history and the actions of its decision makers, and
- Are empirically validated, through their application to problems faced by a firm.

Operational Capabilities: Defining the Construct

Operations management researchers have long been intrigued by RBV and its potential implications for operations strategy (Amundson, 1998), particularly the concept of organizational capabilities. The "introverted orientation" (Pandza, Horsburgh, Gorton, & Polajnar, 2003a) of RBV enables it to "emancipate the neglected strategic importance of operations." However, operations strategy research has focused primarily on defining operational capabilities or prescribing how they should be built. Although the strategic management literature focuses primarily on paths to competitive advantage, there has been less research related to processes that enable coordination/integration, learning, and reconfiguration (Teece, 2007), which lie squarely in the domain of operations management (Mosey, 2005). Operations management researchers have found the application of the organizational capabilities construct to operations strategy challenging:

> While this is undoubtedly of value, academics are less willing to confront those attributes of RBV that make the perspective less operational, such as the idiosyncrasy, path dependency and context dependency of a capability. They recognize the dynamics of capacity accumulation, yet do not explore it (Pandza et al., 2003b, p. 823).

We believe that the concept of organizational capabilities is directly relevant to operations strategy. Resources form a plant's foundation, consisting of the plant's capacity and all of its stocks (Wang & Ahmed, 2007). In contrast, operational practices such as just in time are fairly standardized activities, programs, or procedures that have been developed to address the attainment of specific operational goals or objectives (Flynn et al., 1995). Operational capabilities provide unity, integration, and direction to resources and operational practices. They encapsulate both explicit elements (e.g., resources, practices) and tacit elements (e.g., know-how, skill sets, leadership) for handling a variety of problems or dealing with uncertainty. That is, operational capabilities draw on resources and operational practices to generate outcomes consistent with desired results, helping a plant develop solutions that make sense. Based on the perspectives of organizational capabilities in the strategic management literature, we apply their essential traits to the functional domain of operations management, offering the following definition:

> *Operational capabilities are firm-specific sets of skills, processes, and routines, developed within the operations management system, that are regularly used in solving its problems through configuring its operational resources.*

Operational Capabilities: An Illustration

It is crucial to differentiate the operational capabilities construct from interrelated constructs, particularly operational practices, which are emphasized in the operations strategy literature, and resources, emphasized in the strategic management literature. However, this has proven to be challenging for operations strategy researchers over time. “Any discussion of capabilities is . . . open to criticism of its ambiguity and its inability to provide clear definitions, obvious examples and straightforward prescriptions” (Pandza et al., 2003b, p. 824). We address this using the example of a restaurant kitchen.

Resources

A kitchen’s resources include both tangible and intangible assets, such as stoves and the skill level of the kitchen staff, which determine the bounds of what can and cannot be done in the kitchen. However, resources, by themselves, only define potential, because they are passive and reactive, like a stick of dynamite. Nothing happens to dynamite until it is lit; similarly, a stove cannot prepare a meal.

Operational practices

Operational practices are essentially recipes, providing generic instructions on how various resources can be combined to generate a meal. Once a process has been documented as a recipe, it becomes a standard solution. However, although many kitchens may have the same chocolate mousse recipe, there is no guarantee that the resulting mousses will all taste the same. In fact, it is not surprising to see that the creaminess of the ensuing mousses is different, because a recipe only provides basic guidance about how to combine resources; it does not capture the impact of less tangible factors, such as the freshness and quality of the ingredients or skill in setting the stove’s flame at the proper height.

Operational capabilities

A kitchen’s operational capabilities are the capacity to leverage the staff’s skill sets to deploy resources in creating dishes that reflect the restaurant’s history, style of cooking, and the preferences of its customers. Although the chef is a critical resource, he needs to customize his cooking school training to the restaurant’s specific context (menu, affordability, cuisine history, customers’ needs, etc.). The restaurant itself has a history that has shaped its character, making it unique. A kitchen's operational capabilities are firm specific (not person specific), and the chef would not be able to easily transfer them to another restaurant. Graduating from a well-known cooking school may get a new chef in the door, but he still needs to master what makes the kitchen unique, observing interactions and picking up clues from the kitchen's context. The kitchen's operational capabilities are passed on to future generations through apprenticeships, illustrating path dependence. They are developed in a system where various resources interact in a harmonious way, which takes time to develop; thus, they emerge gradually over time.

A chef can easily write down a specific recipe, for example, for roast duck. However, the chef would be hard pressed to articulate the subtleties of making roast duck, because he has taken many things for granted over the years and they seem like second nature to him. These are the necessary but intangible elements associated with the kitchen's operational capabilities. Thus, the capabilities of the kitchen are tacit and deeply embedded. The existence of operational capabilities is reflected in the kitchen's ability to solve its primary strategic problem. For example, the famous QuanJuDe (全聚德) in Beijing has long been regarded as the best Peking Duck restaurant in the world. The uniqueness of its roast duck comes from a cooking process that integrates explicit resources, practices and tacit elements (know-how, skill sets, leadership) which have become institutionalized. Over the hundred year history of QuanJuDe, neither the ingredients nor the recipe for roast duck have changed. Yet, QuanJuDe has updated its process to allow preparing roast duck faster for today's time-stressed customers, while retaining the original flavor. Its operational capability has been empirically validated through the reactions of the diners to traditional roast duck prepared using updated methods.

TAXONOMY OF OPERATIONAL CAPABILITIES

We used the literature to identify a set of emergent operational capabilities. Our starting point was the work of Swink and Hegarty (1998), who proposed seven capabilities relevant to product differentiation in an operations context. Several of these capabilities require further refinement, in terms of their dimensionality, uniqueness, and applicability to operations management; thus, we supplemented them with perspectives drawn from additional literature.

Emergent Operational Capabilities

Operational improvement

Operational improvement is differentiated sets of skills, processes, and routines for incrementally refining and reinforcing existing operations processes. Its focus is on incremental process change, creating the small wins that translate into superior performance, which requires very different processes and resource configurations than large scale, radical process changes (Peng, Schroeder, & Shah, 2008). Operational improvement applies current technical capabilities to systematically seek and develop new ways of doing work for existing customers (Benner & Tushman, 2003). Although managers have long recognized the importance of operational capabilities related to continuous improvement, many have found its management to be challenging (Anand, Ward, Tatikonda, & Schilling, 2009); thus, operational improvement capability is related to competitive advantage. Although it focuses on measurable, short-term benefits (Harrington & Mathias, 1997; Mukherjee, Lapré, & Van Wasenhove, 1998), its cumulative effect can be quite significant, benefitting future generations of products as well as existing products (Wheelwright & Hayes, 1985). Operational improvement is related to Benner and Tushman's (2003) "exploitation," which focuses on skills, processes, and routines related to refinement, implementation, efficiency, production, and selection (Peng et al., 2008). Operational improvement is path dependent, because past innovation activities play a role in future innovation (Benner & Tushman, 2003).

Operational innovation

In contrast to the routine, incremental focus of operational improvement, operational innovation is differentiated sets of skills, processes, and routines for radically improving existing operations processes or creating and implementing new and unique operations processes. Because operational improvement builds upon existing organizational abilities, it is unlikely to lead to innovations that significantly depart from existing technological or market competencies (Sitkin & Stickel, 1996). However, operational innovation focuses on searching for variance and experimentation, in order to change technology trajectories and associated organizational competencies (Benner & Tushman, 2003). The focus of operational innovation is on large scale, radical process changes through new knowledge or departures from existing skills (Benner & Tushman, 2003), which requires very different processes and resource configurations than incremental changes to existing processes (Peng et al., 2008). Operational innovation is related to Benner and Tushman's (2003) "exploration," which focuses on skills, processes, and routines related to search, discovery, experimentation, and implementation.

Operational customization

Schroeder, Bates, and Junttila (2002) found that the operational capabilities inherent in firm-specific, path-dependent learning resulted in the development of proprietary processes that confer competitive advantage. Although there are many different practices associated with the development of proprietary processes, each reflects an underlying ability to customize a process to meet the unique needs of a firm's products and target markets. Operational customization is differentiated sets of skills, processes, and routines for the creation of knowledge through extending and customizing operations processes and systems. Operational customization has its roots in the work of Wheelwright and Hayes (1985), who describe the development of proprietary processes as one of their "acid tests" for determining whether a firm has world class operations. Through the development of proprietary processes, a firm benefits in two ways. First, it develops equipment and processes that are difficult for competitors to imitate. Perhaps more importantly, it develops employees' ability to maintain and improve equipment and processes, allowing them to know more than even their equipment suppliers about all that is critical to their business (Wheelwright & Hayes, 1985).

Operational cooperation

Swink and Hegarty (1998) described "integration" as the ability to coordinate between manufacturing and the product–process design function. This is part of a broader operational capability that we call operational cooperation, which includes the ability to create and sustain healthy relationships with supply chain members, related to sourcing products (Kim, 2006). Operational cooperation is the ability to bring involved parties together to share information, converging on a shared interpretation of what needs to be done. As uncertainty increases, the need for operational cooperation capability increases, to help firms cope with the fuzziness of their environments and enact a shared vision, in order to acquire information, share views, interpret the task environment, resolve cross-functional or interorganizational conflicts, and reach a mutual understanding of a task. The rationale for operations cooperation is based on information processing theory (Galbraith, 1973, 1979; Flynn & Flynn, 1999), which focuses on mechanisms for dealing with the complexities of competing in a global environment and using advanced technologies. Sources of complexity include goal diversity (variety of products, markets served, individual product volumes) (Bozarth, Warsing, Flynn, & Flynn, 2009), customer diversity (size of customer base, characteristics of customer relationships, volumes purchased by various classes of customers, distance to customers) (Anderson & Narus, 1998), supplier diversity (number of suppliers, nature of the relationship with specific suppliers, location of suppliers) (Landry, 1998; Gonzalez-Benito, 2007; Koufteros, Cheng, & Lai, 2007; Holweg & Pil, 2008; Narasimhan & Talluri, 2009), labor diversity (number of job classifications, employee layoffs), and manufacturing diversity (shifts in monthly sales, prevalence of expediting, number of levels in the bill of materials). In response to this increasing complexity and equivocality, firms seek coordinating mechanisms (Koufteros, Vonderembase, & Doll, 2002; Bozarth et al., 2009), which allow them to process more information and to do so quickly.

Operational responsiveness

Operational responsiveness is the differentiated skills, processes, and routines for reacting quickly and easily to changes in input and output requirements, so that a process can consistently meet customer requirements with little time or cost penalty (Swink, Narasimhan, & Kim, 2005). Underlying this capability is the ability to manage production resources such as machine, labor, materials handling, and production sequencing in light of uncertainty. This capability is closely related to technological and production expertise in the current operations system (Zhang, Vonderembse, & Lim, 2003), which lay the foundation for flexibility performance. Specifically, operational responsiveness allows a plant to operate at various batch sizes or produce at different production output levels (i.e., volume flexibility), based on differentiated skills, processes and routines for flattening a firm's cost curve over a wide range of production volumes. Operational responsiveness allows a firm to produce different combinations of products (mix flexibility), given its fixed capacity (Martinez Sanchez & Perez Perez, 2005), based on differentiated skills, resources, and routines for quickly responding to changes in inputs or output requirements. Thus, operational responsiveness enables a firm to produce both the volume and the kinds of products that customers want, in a timely manner.

Operational reconfiguration

Although operational responsiveness focuses on using existing operations resources to deal with change, operational reconfiguration focuses on reshaping (investing and divesting) operations resources to catch up with environmental changes. Operational reconfiguration is based on the concept of dynamic capabilities. Pioneered by Teece et al. (1997) the dynamic capabilities approach (DCA) builds upon RBV's foundation (Pandza et al., 2003b), focusing on the dynamic process of how firms develop capabilities in response to shifts in their business environment (Pandza et al., 2003a). Where RBV focuses on durable performance differences between firms due to asymmetric resource endowments and productivities, DCA describes firms' differing abilities to accumulate, deploy, renew, and reconfigure resources in response to changes in their external environment (Pandza et al., 2003a). Dynamic capabilities are "the firm's processes that use resources—specifically the processes to integrate, reconfigure, gain, and release resources—to match and even create market change" (Eisenhardt & Martin, 2000, p. 1107). Dynamic capabilities are thus the means by which firms achieve new resource conditions as markets emerge, collide, split, evolve, and die. Operational reconfiguration, then, is differentiated sets of skills, processes, and routines for accomplishing the necessary transformation to re-establish fit between operations strategy and the market environment, when their equilibrium has been disturbed, which is valuable when a firm is faced with a rapidly changing external environment (Teece et al., 1997). Operations reconfiguration evolves from routines that sense unexpected changes, maintain flexible responses, and implement synchronized operations. Pandza et al. (2003a) describes operational reconfiguration as the ability to invest in physical and intangible resources that provide a firm with contingencies in uncertain environments, so that it can alter its course of action in light of new information. It is illustrated by the ability to adapt manufacturing strategy to changes in market demand, increased global fragmentation, competition, rapid technological advancement, stage of product life cycle, and corporate strategy (Cagliani, Acur, & Boer, 2006; Swafford, Ghosh, & Murthy, 2006). Operational reconfiguration is important in uncertain and volatile business environments, where firms face new innovations, economic crises, production losses, political events, and so forth, such that the ability to sense and deal with change becomes a way of life.

Table 1 summarizes our initial taxonomy of operational capabilities. The next step was to refine and empirically validate the resulting definitions through the use of a focus group of experienced operations managers.

Focus Group

The focus group assessed whether the taxonomy of operational capabilities adequately reflected the perceptions of managers. The participants consisted of eight middle level managers who worked primarily in the operations area in a single firm. On average, they had worked in operations and supply chain management

Table 1: Definitions and examples of operational capabilities.

Operational Capability	Origin	Definition	Kitchen Example
Operational improvement	Swink & Hegarty, 1998; Peng et al., 2008	Differentiated sets of skills, processes, and routines for incrementally refining and reinforcing existing operations processes.	Shortcuts for making standard entrees are developed over time. For example, packages of “OLTs” (onions, lettuce, and tomato slices) are premade and stored for use on hamburgers.
Operational innovation	Swink & Hegarty, 1998; Peng et al., 2008	Differentiated sets of skills, processes, and routines for radically improving existing operations processes or creating and implementing new and unique operations processes.	The chef borrows from different recipes to create a few unique specialties for his restaurant. For example, Brennan’s in New Orleans is widely acknowledged for inventing Bananas Foster.
Operational customization	Wheelwright & Hayes, 1985; Schroeder et al., 2002	Differentiated sets of skills, processes, and routines for the creation of knowledge through extending and customizing operations processes and systems.	New pieces of equipment are developed by the kitchen staff, for example specialized molds or ovens.
Operational cooperation	Swink & Hegarty, 1998; Droge, Jayaram, & Vickery, 2004; Escrig-Tena & Bou-Llusar, 2005	Differentiated sets of skills, processes, and routines for creating healthy and stable relationships with people from various internal functional areas and external supply chain partners.	The purchasing staff works closely with suppliers to order the best quality items in a timely manner. In a Thai restaurant, papaya is a common ingredient in both hot and cold dishes. Because the freshness of the papaya greatly influences the flavor of the dishes, the staff’s communication with suppliers is crucial for obtaining the best papaya.
Operational responsiveness	Upton, 1994; Swink & Hegarty, 1998	Differentiated sets of skills, processes, and routines for reacting quickly and easily to changes in inputs or output requirements.	Daily specials are adapted, depending on which types of fresh fish were available at the market that morning.
Operational reconfiguration	Teece et al., 1997; Swink & Hegarty, 1998; Pandza et al., 2003a	Differentiated sets of skills, processes, and routines for accomplishing the necessary transformation to re-establish the fit between operations strategy and the market environment, when their equilibrium has been disturbed.	Many upscale restaurants have developed economical meal packages to attract customers during the recent economic downturn.

Table 2: Operational capabilities identified from the literature and by the focus group.

Focus Group	Literature
Collaboration and trust with partners	Operational cooperation
Intellectual property and know-how (specialized tooling, technology, equipment)	Operational customization
Specialization (service experts)	
Process customization	
Responsiveness	Operational responsiveness
Sense of urgency to meet short lead time	
Fulfillment of customers' orders	
Process improvement to make cost competitive	Operational improvement
Process standardization	
Radical process innovation	Operational innovation
Change management	Operational reconfiguration
New product testing facility	Others
Control of the supply chain	
Value creation for core customers	
Dependability and reliability	

for 14.75 (8 years minimum, 25 years maximum). Five were employed at the plant level, with three at the division level. The number of plants/divisions they had worked for varied from one to six (mean = 2.25). Thus, they were knowledgeable about their firm and its operational capabilities.

The participants were introduced to the concept of operational capabilities, and then asked to list what they believed were key operational capabilities. They listed a total of 15 items (see Table 2). There was substantial agreement between the focus group and our list of operational capabilities, with 11 items mapping directly on our taxonomy of operational capabilities. The four items that did not correspond were carefully assessed, revealing that one actually represented an outcome, whereas the other three reflected organizational, rather than operational, capabilities. "Dependability and reliability" is a process outcome, not an operational capability, because it focuses on performance and not on the way in which performance is achieved. "Control of the supply chain" goes beyond the domain of operational capabilities, potentially including factors such as channel power, brand name, and unique technology. Although this may reflect an organizational capability, it is by and large not in the domain of operations management. Similarly, "value creation for core customers" and "new product testing facility" are organizational, rather than operational, capabilities. Thus, the original taxonomy was retained.

Operational Capabilities: Operationalizing the Construct

The traits that cause operational capabilities to be a source of competitive advantage are also difficult to precisely operationalize and measure. In resolving this research conundrum, we turn to research on other constructs that have traits that hinder empirical research, specifically Eisenhardt and Martin (2000)'s research on dynamic capabilities and Schein's (2004) work on organizational culture.

In their analysis of dynamic capabilities, Eisenhardt and Martin's (2000) resolution of similar measurement issues was their recognition that dynamic capabilities exhibit "commonalities in key features, idiosyncrasy in details" (Eisenhardt & Martin, 2000, p. 1108). The common features of dynamic capabilities can be readily observed and measured. However, they noted that "the existence of common factors among effective dynamic capabilities does not, however, imply that any particular (dynamic) capability is exactly alike across firms" (Eisenhardt & Martin 2000, p. 1109). Thus, although dynamic capabilities may be manifested differently across firms, they have common features at their core. The same thinking can be applied to operational capabilities: although they are firm specific, their common core features can be identified and measured.

Schein (2004) was faced with a similar problem in his study of organizational culture: how do you measure something (in his case, culture) that is embedded in a firm, emerges gradually over time, and is highly tacit, so that the participants themselves may not even be aware of its presence? Schein's resolution was the recognition that, although organizational culture is difficult to measure directly, it is possible to observe and measure certain visible attributes associated with it. By observing these visible attributes, we can impute the nature of the underlying organizational culture. Schein (2004) identified three levels of organizational culture. Artifacts are the phenomena that one sees, hears, or feels when encountering a group, including visible organizational structures and processes, whereas espoused beliefs and values are the strategies, goals, and philosophies of a group. Underlying assumptions are the tacit, unconscious, taken-for-granted beliefs, perceptions, thoughts, and feelings that are the ultimate source of values and action. Artifacts are the easiest to observe, while underlying assumptions are the most difficult. Because we are imputing the nature of the underlying operational capabilities by capturing what are essentially artifacts, we must recognize that this approach has certain methodological implications, related to dealing with a reflective latent variable construct (Jarvis, Mackenzie, & Podsakoff, 2003). Building on the conceptual foundation provided by Eisenhardt and Martin (2000) and Schein (2004), we applied the following guidelines in developing our measurement model.

- When measuring operational capabilities, we should focus on their commonalities. Thus, measurement models will, by necessity, be incomplete, because we recognize that it is not possible to capture the idiosyncratic or firm-specific components of operational capabilities.
- When measuring commonalities, we should focus primarily on artifacts, which reflect a deeper underlying operational capability. Thus, instruments used to capture information from respondents must focus on perceptual, self-reported measures of operational capabilities.

SCALE DEVELOPMENT AND VALIDATION

Scale Development

Unlike measurement of operational practices, where a large amount of existing research provides a good pool for item selection (Li, Rao, Ragu-Nathan, & Ragu-Nathan, 2005; Shah & Ward, 2007), empirical research on operational capabilities is sparse. We created an initial tentative measurement set, based on insights from our taxonomy and the relevant literature (Teece et al., 1997; Swink & Hegarty, 1998; Sen & Egelhoff, 2000; Schroeder et al., 2002; Subramaniam & Youndt, 2005). We followed the basic principles suggested by Nunnally (1978) and Churchill (1979); that is, the items used to measure a construct should converge with each other, but diverge from the items that measure other constructs. To deal with the challenge of developing appropriate measurement items (Little, Lindenberger, & Nesselroade, 1999) and covering the construct domain with the desired reliability and validity, we followed the two-stage approach described by Li et al. (2005) and Menor and Roth (2007). The first stage involved using a *Q*-sort analysis to assess initial content validity and refine the measurement items. In the second stage, confirmatory analysis assessed the psychometric properties of the new multi-item scales. The confirmatory analysis used two distinct samples, in order to enhance generalizability.

Q-sort methodology uses experts to sort the measurement items into groups, with each group corresponding to a predetermined factor or dimension (McKeown & Thomas, 1988). Two evaluation indices are normally used to measure interjudge agreement levels: Cohen's (1960) kappa and Moore and Benbasat's (1991) hit ratio. Cohen's kappa takes into account the agreement occurring by chance (Fleiss, 1981), as well as the percentage agreement, with a score greater than .65 considered acceptable (Jarvenpass, 1999; Li et al., 2005). Moore and Benbasat's hit ratio reflects the percentage of items that were correctly sorted. Six operations management researchers (primarily doctoral students) served as judges and assigned each item to an operational capability construct, based on the definitions supplied. Cohen's kappa averaged .72 for the initial set of items, which implied good consistency. Two thirds of the experts assigned one item to the "wrong" construct, implying that it was not a good indicator for the intended construct. Consequently, it was removed from the measurement instrument, resulting in an average kappa of .77. There was also some inconsistency in classifying items related to the operational responsiveness and operational reconfiguration constructs. Three of the experts were asked to explain the rationale for their assignment of these items, which resulted in rephrasing the wording of the corresponding items. They were then asked to assign the reworded items, resulting in an average Cohen's kappa of .82 and an overall hit ratio of 90.83%, indicating a high level of content validity.

In order to validate the scales for reliability and validity, a questionnaire was drafted based on the results of the *Q*-sort. After a pilot test with a sample of 15 managers, the final questionnaire was generated. The unit of analysis is a plant, because operational capabilities are embedded in operations processes, which can be more easily observed in a plant context. Therefore, we targeted operations managers working at the plant level, because they have the necessary knowledge for responding to the research questions.

Table 3: Responses from home improvement products (HOMEIMP) and the association for operations management (APICS).

	Number of Responses	
	HOMEIMP	APICS
First round	22	103
Second round	25	57
Third round	15	–
Total responses	62	160
Response rate	30.0%	6.15%

Data Collection

Data were collected from two sources: (i) a large manufacturer of home improvement products, which we refer to as HOMEIMP, and (ii) a professional organization dealing primarily with operations management issues. These two sources were treated as separate samples that completed the same survey form. The HOMEIMP sample consisted of managers working for a Fortune 100 multinational firm that was engaged in manufacturing home improvement products. HOMEIMP has a well developed and successful operations planning and execution system committed to quality and operational excellence, and its management recognizes the strategic importance of operational capabilities. It has over 30 major manufacturing divisions, thus, its managers are exposed to a wide variety of business environments. HOMEIMP provided the research team with an e-mail list of 207 managers. The second source of respondents was supplied by APICS: The Association for Operations Management. This professional society targets the types of managers that are the focus of this study. APICS granted access to its members through a link in its semimonthly e-newsletter. Various tactics were implemented to increase the response rate in both samples (Frohlich, 2002). External support for the study and requests for participation were obtained from the management of HOMEIMIP and APICS. Several types of incentives, including a lottery and the receipt of an executive summary of the results, were also used, as well as multiple waves of contact with the HOMEIMP managers. APICS put the survey announcement in its e-newsletter, then posted a reminder two weeks later.

The primary vehicle for survey administration was an online survey, an approach that has been noted for its response speed (Sheehan & McMillian, 1999), lower cost (Weible & Wallance, 1998), and improved quality of responses (Paolo, Bonaminio, Gibson, Patridge, & Kallail, 2000). Complementing this was a downloadable hard copy. Table 3 contains a descriptive summary of respondent characteristics. Overall, we received 62 responses from the HOMEIMP sample and 160 from the APICS sample, representing a response rate of 30% and 6.15% (based on the number of members whose primary responsibility is operations), respectively. Although the APICS response rate was relatively low, it is consistent with other large-scale survey response rates, which are often in the 5% to 10% range (Roth & Van Der Velda, 1991; Stock, Greis, & Kasarda, 2000; Shah & Ward, 2003). Eight of the HOMEIMP and 20 of the APICS responses were discarded due to their high proportion of missing values. Nonresponse bias was assessed through comparisons of early and late respondents on the operational capability measures (Armstrong & Overton, 1977). There was not a statistically significant difference on any of the items. Responses in the APICS sample came from a range of industries, including food/beverage, machinery, computer/electronic products, chemical/pharmaceutical products, electronic equipment, and transportation equipment.

Assessment of Construct Validity

Construct validity was evaluated in terms of unidimensionality, convergent validity, reliability, discriminant validity, and predictive (nomological) validity (Venkatraman, 1989; O'Leary-Kelly & Vokurka, 1998; Li et al., 2005; Menor & Roth, 2007; Shah & Ward, 2007). The HOMEIMP data were used to test the construct validity of the initial instrument and modify it through item elimination; the refined instrument was then verified using the APICS data.

Unidimensionality and convergent validity

Unidimensionality refers to the existence of a single construct underlying a set of measures (Anderson, Gerbing, & Hunter, 1987), whereas convergent validity is an assessment of consistency in measurement across multiple operationalizations (Venkatraman, 1989). We used confirmatory factor analysis (CFA) because it simultaneously tests the unidimensionality of a set of correlated latent constructs (O'Leary-Kelly & Vokurka, 1998), which helps to establish both unidimensionality and convergent validity. In addition, CFA contains tests for improving the fit of the measurement model, which can be used to modify the measures, as we did based on the initial HOMEIMP results. The results of the CFA and the structural equation modeling (SEM) analysis were evaluated using a number of indices (Sila & Ebrahimpour, 2005). Comparative fit index (CFI), nonnormed fit index (NNFI), and incremental fit index (IFI) values of .90 or above (Bentler & Bonett, 1980; Bentler, 1992; Bendoly, Citurs, & Konsynski, 2007) and root mean square error of approximation (RMSEA) less than or equal to .08 (Hu & Bentler, 1999) indicate adequate model fit. The p-value associated with a given χ^2 indicates whether the hypothesized model is supported, and $p > .10$ is generally considered satisfactory (Lawley & Maxwell, 1971). The measurement instrument using the HOMEIMP data were modified based on the Lagrange multiplier test, which suggested improving overall fit indices by adding additional linkages between the items and constructs. The item that could improve the fit the most in each iteration was removed, because the addition of linkages implies that those items cross-load on multiple constructs. The CFA was then reconducted (Joreskog & Sorbom, 1989). This iterative process was repeated until all model parameters and fit indices met the recommended thresholds; five items were ultimately removed. Bootstrapping was used to estimate the sampling distribution of the estimates by resampling from the original sample with replacement. Table 4 indicates that the final CFA had a good level of fit, with NNFI = .95, IFI = .96,

Table 4: Assessment of unidimensionality and convergent validity of operational capabilities.

	HOMEIMIP Data		The Association for Operations Management (APICS) Data	
Constructs and Items	λ	*t*-value	λ	*t*-value
Please rate the extent to which you agree or disagree with the following statements in your plant.				
Operational cooperation				
Our information system facilitates cooperation across functions.	.78	5.91	.60	7.10
Our formal procedures facilitate teamwork across functions.	.72	5.38	.84	10.57
Our employees are skilled at maintaining healthy relationships with each other to diagnose/solve problems.	.55	3.91	.64	7.64
[b]Our employees are skilled at partnering with suppliers/clients to develop solutions for improvement.	–	–	–	–
Operational customization				
Our equipment has been used in unique ways that differentiate us from our competitors.	.64	4.69	.66	7.87
Our product design process has been modified and extended to better serve the needs of our customers.	.77	6.02	.57	6.62
Our planning systems have been modified and extended to better serve the needs of our customers.	.70	5.25	.62	7.31
Our production process has been modified and extended to gain unique positions in the market.	.56	3.98	.75	9.23
[b]We have introduced new, internally developed materials into our employee training programs.	–	–	–	–
[a]We stimulate teamwork to facilitate the sharing of individual knowledge throughout the organization.	–	–	–	–
Operational responsiveness				
We reduce uncertainty of equipment availability by quickly and easily changing the route of a job flow.	.73	5.53	.65	7.46
We adjust for unexpected variations in components and material inputs easily and quickly.	.81	6.20	.80	9.41
We adjust for unexpected variations in labor requirements easily and quickly.	.55	3.90	.68	7.87
[b]We adjust for the unexpected changes in shipment requirements easily and quickly.	–	–	–	–

Continued

Table 4: (Continued)

Constructs and Items	HOMEIMIP Data		The Association for Operations Management (APICS) Data	
	λ	*t*-value	λ	*t*-value
Operational improvement				
We continuously standardize production processes.	.68	5.49	.61	7.53
[b]We continuously simplify production processes.	–	–	–	–
We continuously reduce waste and variance.	.97	8.97	.81	11.17
We have learned from past successes and failures to improve processes continuously.	.78	6.53	.91	13.16
Operational innovation				
We have created innovations that made our prevailing processes obsolete.	.83	6.67	.90	12.97
We have created innovations that fundamentally changed our prevailing processes.	.70	5.38	.88	12.67
We have created innovations that made our existing expertise in prevailing processes obsolete.	.82	6.52	.67	8.64
Operational reconfiguration				
[b]We sense/ are aware of the change of the environment.	–	–	–	–
We adopted new and better practices to respond to market changes.	.70	5.53	.85	11.99
We reconfigure (combine/release) resources to respond to market changes.	.86	7.34	.82	11.32
We develop competence and skills to respond to market changes.	.88	7.51	.84	11.74

[a]Items removed during *Q*-sort procedure.
[b]Items removed from the confirmatory factor analysis.

Table 5: Assessment of reliability.

Construct	Number of Indicators	Home Improvement Products (HOMEIMP) Data		The Association for Operations Management (APICS) Data	
		Cronbach's α	ρ_c	Cronbach's α	ρ_c
Operational cooperation	3	.76	.73	.73	.74
Operational customization	4	.76	.77	.74	.75
Operational responsiveness	3	.73	.75	.74	.75
Operational improvement	3	.84	.85	.81	.82
Operational innovation	3	.82	.82	.85	.86
Operational reconfiguration	3	.85	.86	.87	.87
Cost performance	3	–	–	.88	.88
Quality performance	5	–	–	.94	.94
Delivery performance	4	–	–	.83	.89
Flexibility performance	2	–	–	.76	.78

CFI = .96, RMSEA = .05 and $\chi^2 = 153.56$ with $df = 137$ ($p < .16$). All the standardized factor loadings were above .55 and were significant at $p < .01$. These findings provide empirical evidence of unidimensionality and convergent validity.

Reliability

Although Cronbach's α is based on the assumption that all indicators are equally important in measuring the latent construct (Venkatraman, 1989; Li et al., 2005), composite measure reliability (ρ_c) captures the proportion of measure variance attributable to the latent variable (Werts, Linn, & Joreskog, 1974). A ρ_c greater than .50 implies that the variance extracted by the latent construct is more than that extracted by the error term (Bagozzi, 1981). Both reliability measures are reported in Table 5. All the Cronbach's α and ρ_c indices were greater than .73, thus all construct measures were reliable.

Discriminant validity

Discriminant validity was assessed using two-factor CFA models that related each possible pair of constructs, with the correlation between the two constructs first set freely and then constrained to one (Venkatraman, 1989; Bagozzi, Yi, & Phillips, 1991; Sethi & King, 1994; Li et al., 2005). The χ^2 value for the unconstrained model was significantly lower than that of the constrained model in all cases, establishing discriminant validity among all the constructs (Joreskog, 1971). All the χ^2 differences were significant at $p < .01$, indicating strong support for the discriminant validity of the constructs (see Table 6). We also verified discriminant validity by comparing the average variance extracted (AVE) for each pair of constructs with the squared correlation between the two constructs (Fornell & Laker, 1981). In all cases, the AVE was greater than the squared correlation, thus, each construct itself had more internal variance than the variance shared between constructs.

Table 6: Assessment of discriminant validity.

	Home Improvement Products (HOMEIMP) Data				The Association for Operations Management (APICS) Data			
		χ^2 Statistics				χ^2 Statistics		
Description[a]	Estimated correlation	Constrained model (*df*)	Unconstrained model (*df*)	Difference ($\Delta df = 1$)	Estimated correlation	Constrained model (*df*)	Unconstrained model (*df*)	Difference ($\Delta df = 1$)
OCO with								
OCU	.66*	21.06(14)	8.02(13)	13.04	.54*	74.27(14)	33.29(13)	40.98
ORS	.55*	24.66(9)	7.55(8)	17.11	.46*	65.36(9)	9.77(8)	55.59
OIM	.52*	34.31(9)	12.71(8)	21.60	.66*	57.26(9)	18.19(8)	39.07
OIN	.25	36.18(9)	5.55(8)	30.63	.47*	74.91(9)	6.25(8)	68.66
ORC	.37*	43.39(9)	16.89(8)	26.50	.67*	52.56(9)	10.41(8)	42.15
OCU with								
ORS	.47*	35.18(14)	10.02(13)	25.16	.47*	77.21(14)	18.03(13)	59.19
OIM	.17	61.64(14)	14.04(13)	47.60	.57*	76.86(14)	16.16(13)	60.70
OIN	.19	57.50(14)	10.56(13)	46.94	.51*	84.74(14)	11.20(13)	73.54
ORC	.48*	50.53(14)	16.87(13)	33.66	.66*	67.30(14)	22.45(13)	44.85
ORS with								
OIM	.54*	30.78(9)	5.65(8)	25.13	.46*	79.25(9)	10.57(8)	68.68
OIN	.37*	34.79(9)	4.64(8)	30.15	.43*	89.84(9)	14.30(8)	75.54
ORC	.56*	29.02(9)	9.11(8)	19.91	.48*	78.56(9)	9.20(8)	69.36
OIM with								
OIN	.38*	55.59(9)	6.52(8)	49.07	.72*	68.58(9)	3.99(8)	64.59
ORC	.43*	66.30(9)	2.72(8)	63.58	.78*	56.41(9)	9.10(8)	47.31
OIN with								
ORC	.21	67.74(9)	11.80(8)	55.94	.59*	140.76(9)	16.59(8)	124.17

[a]OCO = operational cooperation; OCU = operational customization; ORS = operational responsiveness; OIM = operational improvement; OIN = operational innovation; ORC = operational reconfiguration.
*Significant at $p < .05$.

Replication

A single study cannot provide "valid" measures, even when it employs a rigorous process of analysis and refinement, and confidence in a measurement instrument can only be obtained through replication (Venkatraman, 1989). Therefore, we repeated the analysis of the modified measurement instrument using the responses from the APICS respondents. The results are summarized in Tables 4–6, providing greater confidence in using these newly developed scales in future research.

Predictive validity

We assessed predictive validity using APICS sample. Predictive validity is important because the conceptual meaning of a construct not only depends on its conceptualization but also on its relationship with other variables (Bagozzi & Fornell, 1982); it is verified by a significant association between the scales and an independent measure of the relevant criterion (Nunnally, 1978). According to RBV, operational capabilities can contribute to competitive advantage (they are one of the necessary conditions to create competitive advantage, but not the only one). Operational capabilities are particularly desirable in generating positive intermediate outcomes, in terms of the way that a firm carries out an action or a series of actions. The HOMEIMP dataset contained multiple respondents from the same division; however, we were not able to verify whether they came from the same plant. To be conservative, we used only the APICS sample to test predictive validity, to avoid potentially biased results.

The predominant approach in the literature is to use cost, quality, delivery, and flexibility as the dimensions of overall operations performance (Miller & Roth, 1994; Ward, Duray, Leong, & Sum, 1995; Cua et al., 2001; Schroeder et al., 2002). Details of the test results for unidimensionality and convergent validity and reliability are reported in Tables 5 and 7. Predictive validity was assessed by the parameter estimates (γ) between the operational capabilities and dimensions of operations performance. A group of SEMs was specified and tested, where the antecedent variables were the six operational capabilities, and the outcome variables were the four performance dimensions. Table 8 reports the standardized coefficients of the γ- and t-values, revealing that 22 out of the 24 tests had significant positive results, providing evidence of predictive validity. That is, operational capabilities are not an isolated factor in an operations system; rather they are one of the critical factors and may intertwine with other factors to impact performance outcomes.

DISCUSSION

In reviewing the results, two key points are discussed: the notion of operational capabilities as the secret ingredient, and the measurement of constructs, such as operational capabilities, that are difficult to observe directly.

Operational Capabilities: The Secret Ingredient

This study provided a rationale for viewing operational capabilities as critical to success at both the operations and corporate levels. We have referred to them as the secret ingredient because, like the purloined letter of Edgar Allen Poe

Table 7: Assessment of unidimensionality and convergent validity of operations performance.[a]

	The Association for Operations Management (APICS) Data	
Constructs and Items	Standardized coefficient	*t*-value
Relative to your competition, how would you rate the performance of your plant operation on the following dimensions of performance?		
Cost		
Manufacturing unit cost	.81	11.14
Manufacturing overhead cost	.82	11.34
Total cost (acquisition, setup, maintenance, service, etc.)	.91	13.07
Quality		
Product conformance	.87	12.92
Product durability	.86	12.52
Product overall quality	.94	14.57
Product reliability	.95	15.05
Product features	.80	11.19
Delivery		
Delivery accuracy	.79	10.18
Delivery dependability	.74	9.93
Delivery quality	.83	10.78
Flexibility		
Ability to adjust product volume	.70	8.00
Ability to produce a range of products	.88	9.76

[a]Model fit indices (based on APICS data): NNFI = .93, IFI = .95, CFI = .94, RMSEA = .09 and $\chi^2 = 130.50$ with $df = 59$ ($p < .01$). All the factor loadings are significant at $p < .01$.

(2002), operational capabilities are essentially "hidden in plain view." That is, operational capabilities exist but are overlooked by both the managers who work with them and researchers. They are taken for granted and fail to generate attention because they do not seem unusual. This is due to the very nature of operational capabilities: they are tightly embedded in the organizational fabric of the operations management system. This embeddedness is the result of the interconnectness of operational capabilities with resources and operational practices, linkages between operations capabilities and the social network, and the fit with the primary problems that the firm and its operations management address. This embeddedness makes operational capabilities tacit in nature and path dependent, which creates a barrier to imitation (Grewal & Slotegraaf, 2007). As a result, operational capabilities are crucial in understanding and explaining performance variability. Thus, although resources and operational practices are important, they are not sufficient.

Operational capabilities are the secret ingredient that is hidden in plain view for several reasons. First, operational capabilities are not as obvious and tangible

Table 8: Assessment of predictive validity.[a]

The Association for Operations Management (APICS) Data	Cost		Quality		Delivery		Flexibility	
	γ	*t*-value	γ	*t*-value	γ	*t*-value	γ	*t*-value
Operational cooperation	.28	2.69*	.21	2.10*	.29	2.70*	.27	2.77*
Operational customization	.45	4.08*	.32	3.17*	.36	3.27*	.44	3.32*
Operational responsiveness	.35	3.18*	.30	2.90*	.39	3.42*	.49	4.62*
Operational improvement	.36	3.45*	.09	.92	.29	2.74*	.20	2.07*
Operational innovation	.35	3.68*	.14	1.52	.20	2.06*	.27	2.63*
Operational reconfiguration	.54	5.63*	.28	3.00*	.37	3.69*	.46	4.72*

[a]Predictive validity was assessed only in the APICS sample.
*Significant at $p < .05$.

as operational practices and resources. When trying to explain success, managers tend to focus on factors that are readily perceived and relatively easy to duplicate and implement. This is what Spear and Bowen (1999) and Spear (2004) observed when describing how others viewed the success of Toyota. Although observers saw Toyota using general purpose equipment, statistical process control, and cross-functional employees, what they did not as readily observe was how Toyota had extended and customized all of these elements to address its specific problems. They did not see Toyota's "DNA" (Spear & Bowen, 1999). A critical element of this DNA is Toyota's operational capabilities. Using this perspective, it is evident why even the most detailed and precise duplication efforts (efforts where a firm deployed exactly the same practices as Toyota) could not achieve the same level of performance. The resources and practices that worked so well at Toyota might not fit the implementing organization's culture or history or may not even be consistent with the problem that the firm was interested in solving. These elements (ensuring that the resources and practices fit the organization's history and with the problem being solved) are central attributes of operational capabilities. This observation is also supported by research reported by Westphal, Gulati, and Shortell (1997). When studying corporate experiences with TQM, they found that the high performers understood, expanded, and tailored TQM and its specific practices to their unique needs, resource profiles, and interfirm relationships. In contrast, the lower performers blindly imitated techniques and tools without any modification or adjustment. A similar explanation is provided by Wheelwright and Hayes's (1985) four stages. Stage II firms (externally neutral) strive to improve through extensive and indiscriminant imitation of competitors. In contrast, Stage III firms are more successful in their improvement efforts by screening potential new resources and practices for consistency with their operations strategy.

Second, operational capabilities are closely linked to resources and operational practices. This interconnectedness makes operational capabilities difficult to identify separately, and consequently, their existence may be overlooked. There is a tendency for both managers and researchers to confuse resource and operational practices with operational capabilities. For example, Eisenhardt and Martin (2000) and Lee and Kelley (2008) have noted that "best practices" can be viewed as a type of capability. Yet, Teece (2007) disagreed with this position, stating that, under certain conditions, best practices are not capabilities, nor does their use lead to a sustainable competitive advantage. This position was repeated by Hayes, Pisano, Upton, and Wheelwright (2005). This confusion is not surprising given the close linkages that exist between operational capabilities, resources, and operational practices.

Third, the development of operational capabilities is associated with the culture and history of a particular firm and the specific problems that it is striving to solve. There are two types of fit related to operational capabilities: fit with organizational culture and history, and fit with the specific problem being addressed. Toyota's operational capabilities were built to solve its primary problem: given its production lines, how could it be flexible enough to change product mix to accommodate changing demand (Womack, Jones, & Roos, 1990)? Although GM spent a great deal of time and money studying Toyota's success, it did not appreciate that GM and Toyota were solving fundamentally different problems. To GM, the fundamental problem was reducing cost, producing the most with a given level of resources. In contrast, Toyota was more interested in improving flexibility, minimizing the level of resources needed to satisfy a given level of demand. Unfortunately, managers from one firm, when studying another, tend to view activities through a lens built on the assumption that the firm being studied is solving the same type of problem(s) that the observers are. This myopia prevents them from seeing and assessing operational capabilities.

Measurement of Operational Capabilities

A major contribution of this study is that it conceptually develops and empirically evaluates a set of multi-item measurement scales for operational capabilities. As previously noted, operational capabilities are tacit and distinctive in their details and in the ways they develop. As a result, they tend to be overlooked, and there has been little effort devoted to measure them. While recognizing the difficulties in measuring operational capabilities directly, we argue that it is still possible to empirically and operationally measure them by focusing on commonalities across firms and on certain reflective indicators. Given the importance of operational capabilities, our measurement scales offer the potential for several promising insights.

First, our work enables researchers to identify and assess operational capabilities and their impact on organizational success, controlling for the presence of operational practices. Second, our approach facilitates research on relationships among operational capabilities, whether it is effective to develop those capabilities simultaneously or focus on a specific capability. Third, with this instrument, we are able to examine the kinds of operational practices that support the development of a specific operational capability. Finally, this study helps to address an important question that has long plagued operations strategy researchers, who have focused on commonalities when studying how operations can be used to enhance the organizational capabilities. This has led them to examine research topics involving operational practices and competitive priorities (Sakakibara, Flynn, Schroeder, & Morris, 1997; Kotha & Swamidass, 2000; Ward & Duray, 2000; Cua et al., 2001; Boyer & Lewis, 2002). Yet, in focusing on these commonalities, they have overlooked the impact and importance of differentiation. For many strategic management researchers, the key to success does not lie in commonalities, but rather in the differences between firms. In fact, this notion of differences is what underlies the concept of equifinality (Hambrick, 1984). Although operational practices promote commonality, it is operational capabilities, which are firm and problem specific, that account for some of the inherent differences between firms. In other words, strategic planning merges elements that contribute to commonality with elements that contribute to differentiation in such a way as to produce a unique solution to the needs of its critical customers. Through focusing on operational capabilities, we can see that differentiation is inherent to every firm and to every operations management system. By providing a methodology for studying and assessing operational capabilities, this study enhances the ability of researchers to view operations strategy from a richer perspective.

CONCLUDING COMMENTS

Much of the thinking about operations strategy, and in strategic management in general, revolves around three critical elements: operational capabilities, operational practices, and resources. There is a tendency for researchers to confuse them because they are very closely interrelated. However, they are separate and distinct constructs. By focusing on operational capabilities, we make three substantive achievements in this study.

First, we propose a conceptual definition of operational capabilities and an illustration which captures their essential traits. These traits help us differentiate operational capabilities from operational practices and resources and understand the process by which competitive advantage is developed. Second, we provide a framework of operational capabilities that covers six salient dimensions. We develop measures of operational capabilities and validate them using a two-stage approach. The empirically validated measurement instrument allows researchers to conduct survey research to assess the impact of operational capabilities on performance. Lastly, the concept of operational capabilities and the measurement instrument form a foundation for improved theoretical understanding of dynamic capabilities and their development process, which are imperative in today's dynamic and turbulent environment.

A strength of this study is that we use two separate datasets to validate the measurement instrument. At the same time, we acknowledge the limitations of the low response rate for the APICS data. Although the psychometric properties of the measurement instrument indicate strong evidence of reliability and validity, the low APICS response rate could still threaten the validity of the results. However, inclusion of the HOMEIMP sample helps to counteract this threat. In addition, we rely on sole respondents, thus, the accuracy of the responses could be improved if measures of predictors and criterion variables were obtained from different sources. Such data can generate more accurate estimates of predictive validity. In addition, the generalizability of our results is limited to the specific samples; however, it is noteworthy that there was substantial agreement in the findings using the two samples. Finally, although we identified the operational capabilities taxonomy primarily in a manufacturing context, we believe that it can be extended to the service operations environment. The validated instrument from this study serves as a good starting point to extend it to the service context with further refinement. [Received: April 2009. Accepted: May 2010]

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