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FROM COMMON TO UNCOMMON KNOWLEDGE: FOUNDATIONS OF FIRM-SPECIFIC USE OF KNOWLEDGE AS A RESOURCE

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Although the knowledge-based view of strategy has significantly advanced understanding of the foundations of competitive advantage, less is known about how knowledge *becomes* a strategic resource. In this study, we develop an inductive, process model of the relationships among (1) top managers' beliefs about knowledge as a resource (termed *executive knowledge schemes*), (2) the ways that executives search or scan for knowledge, and (3) how they use that knowledge in practice to transform common knowledge into distinctive, uncommon knowledge as a way of achieving competitive advantage. In the course of generating the grounded model, we also uncovered a new concept, *scanning proactiveness*, and identified two distinct forms of knowledge use in practice: *knowledge adaptation* and *knowledge augmentation*.

One of the most venerable observations about knowledge is Francis Bacon's dictum that "knowledge is power." Management scholars have now firmly established the role of knowledge as one of the key competitive resources of modern times (Drucker, 1993; Penrose, 1959) and have underscored the importance of knowledge in strategic and competitive contexts by proposing a knowledge-based view of the firm (Grant, 1996; Kogut & Zander, 1992). Proponents of this view not only treat knowledge as *the* principal strategic resource, but also argue that firms supersede markets in their ability to create and harness this resource (Kogut & Zander, 1992). A central premise of the knowledge-based view is that knowledge that is largely tacit and grounded in the unique historical and social context of a firm can be a source of sustained competitive advantage, because such knowledge is difficult for competitors to imitate and acquire freely in factor markets (Barney, 1991). Although the knowledge-based view has developed rich conceptual arguments about why firms can outperform markets (Conner & Prahalad, 1996; Kogut & Zander, 1996), less is known about how firms create, acquire, and apply knowledge better than other firms. An important question therefore becomes: How do strategic leaders create competitive advantage that is rooted in the development of unique knowledge—especially in institutionalized settings in which rivals also have access to much of the same information? To address this subtle but significant question, we set out to understand the processes managers use to transform common knowledge into uncommon knowledge that can create distinctive capabilities.

Penrose offered one of the earliest arguments about the role of a firm's internal resources and the ways in which managers fashion competitive advantage from those resources when she argued, "Not only are the significance of resources to a firm and the productive services they can yield func-

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tions of knowledge, but—and this is the crucial fact—*entrepreneurs are fully aware of this*" (1959: 77; emphasis in the original). This important insight suggests a need to understand how key decision makers in organizations use what they know and seek out what they don't know to guide the creation of unique knowledge-based competencies. More broadly, it urges a more critical reading of the key literatures that are directly and indirectly related to the study of knowledge in organizational—and especially strategic—contexts to develop of a finer appreciation of the role managers play in guiding and shaping the search for, creation of, and use of knowledge. In our review of these literatures, we focus on how the cognitions and actions of key individuals in firms have been treated, especially as they are associated with higher-level organizational tendencies and outcomes.

ORGANIZATIONAL KNOWLEDGE IN A STRATEGIC CONTEXT

Research on knowledge and knowledge-related processes has a long history. Studies of learning in and by organizations have paid particular attention to processes of knowledge creation, acquisition, and dissemination as important means by which learning occurs (Cangelosi & Dill, 1965; Huber, 1991; Schulz, 2001). A key observation about learning in the context of organizations is that experience shapes potential or actual changes in personal or organizational action (Fiol & Lyles, 1985; Huber, 1991). In a related vein, Kiesler and Sproull (1982) argued that executives tend to operate more on mental representations of historical environments than those of current environments. Tracing important facets of these mental representations is therefore likely to be useful for understanding how key individuals guide learning in and by organizations. The breadth of the learning literature notwithstanding, two conflicting strands have emerged. A tenet of the first is that only individuals learn and organizations as entities are incapable of doing so (e.g., Simon, 1991). Those holding the second strand recognize and even accord precedence to collective (group or organizational) learning processes (Argote, 1999; Sandelands & Stablein, 1987; Weick & Roberts, 1993).

Bridging this divide are a few works representing attempts to identify ways in which individual ideas become collective-level knowledge (Crossan, Lane, & White, 1999; Kim, 1993; Walsh & Ungson, 1991). These authors have argued for an inclusive view in which individual-level knowledge is considered to be an essential precursor to collective knowledge. An important question emerging from these observations, albeit one that has attracted limited empirical attention, concerns the role played by key individuals—in particular, strategic leaders—in shaping and guiding learning processes.

A second stream of research, inspired by Cohen and Levinthal's (1990) concept of absorptive capacity, contains efforts to differentiate firms in their abilities to acquire and use external knowledge and suggests that future research should investigate not only the factors that create absorptive capacity, but also those that affect its nature and outcomes. Central to the notion of a firm's absorptive capacity is the idea that prior, related knowledge enhances the acquisition and use of new knowledge. It is noteworthy that Cohen and Levinthal (1990) justified this premise with insights from individual-level knowledge structures and problem-solving skills. Indeed, these authors urged exploration of the decision processes that make absorptive capacity an organizational property. Recent research shows that firms operating under similar external conditions display notable differences in the features of their organizational knowledge bases, which in turn affect their absorptive capacity (Yayavaram & Ahuja, 2008). Although theoretical developments and empirical research concerning absorptive capacity have significantly enhanced understanding of how knowledge might be a source of competitive advantage, the concept has been treated passively in most studies. Intuitively, however, the idea of absorptive capacity suggests a more dynamic organizational property that would inhere in how a firm's management and employees frame, evaluate, and adapt knowledge to create new ideas. With the exception of a few studies whose authors have sought to operationalize the underlying processes of absorptive capacity using psychometric scales (cf. Jansen, Van Den Bosch, & Volberda, 2005; Lichtenthaler, 2009; Szulanski, 1996), studies largely have utilized R&D spending, structural characteristics, or patent-based proxies for measuring absorptive capacity in firms (cf. Cohen & Levinthal, 1990; Gupta & Govindarajan, 2000; Zhang, Li, Li, & Zhou, 2010). Consequently, although scholars now know a great deal about the outcomes of absorptive capacity, much remains to be explored about the foundational processes by which key organizational leaders can make a firm's absorptive capacity better than that of its rivals.

A third stream, originating in the early work of Nelson and Winter (1982), has emphasized organizational capabilities and competencies, and identifying the processes by which firms reconfigure their resources (Prahalad & Hamel, 1990; Teece, Pisano, & Shuen, 1997). Although research in this tradition has focused most strongly on concepts

such as routines, competencies, and knowledge stocks, in doing so it has perhaps inadvertently underemphasized the study of "knowledgeable processes" by which managers themselves influence knowledge production and utilization in the first place (Alvesson, 2004; Eisenhardt & Santos, 2002). Felin and Hesterly (2007) critiqued this approach to the study of knowledge-based capabilities in organizations as overly collective in its treatment and noted a need for empirical investigation of the individual drivers of knowledge-based value:

> Thus opening up the proverbial black box of the firm by explicating the underlying a priori capabilities and knowledge of the individuals involved provides a natural starting point and microfoundation for explaining the creation of new value. (Felin & Hesterly, 2007: 213)

These brief summaries of the dominant themes in theory and research about organizational learning and knowledge clearly demonstrate their value to the study of organizations. As yet, however, these prior works offer only limited insight into the larger questions about how leaders of organizations can obtain and employ knowledge in ways that generate competitive advantage. To more fully understand the role of knowledge in the creation of distinctive competencies, there is a need to explore the factors and conditions that *guide* the acquisition and application of knowledge in firms. Adopting a view of organizations as interpretation systems (Daft & Weick, 1984; Dutton & Jackson, 1987; Ranson, Hinings, & Greenwood, 1980) makes it evident that decisions and actions involving knowledge as a resource are likely to be influenced more strongly by top executives than has been depicted in existing literature (Reus, Ranft, Lamont, & Adams, 2009).

In a related work directly relevant to such an exploration, Emirbayer and Mische (1998) offered an expanded conceptualization of human agency, wherein they identified three different aspects: "iterational," "projective," and "practical-evaluative" dimensions of human agency. Iterational agency manifests in an individual's ability to apply prior knowledge and interpretations (and, therefore, implies an orientation toward the past—knowledge retained in the form of schemas and routines). Projective agency, however, manifests in the search for future states and therefore involves going beyond one's experience and prior learning to search for new understanding. Lastly, practical-evaluative agency inheres in the reflective work that individuals carry out while responding to emergent situations. This dimension therefore reflects pragmatic wisdom, improvisation, and creative application of experience. Emirbayer and Mische's (1998) insights suggest the need to account simultaneously for the past, the projected future, and the "situated" present in appreciating the role that key organizational agents play in identifying, acquiring, and using knowledge. We next highlight several important suggestions from the literatures on managerial cognitive structures (which retain past knowledge), scanning/search processes (aimed at seeking future knowledge), and knowledge use (which accounts for current practices) to establish a foundation for developing a grounded theory that might describe how managerial agency can transform commonly available knowledge into uncommon or uniquely useable knowledge.

THE MANAGERIAL UNDERPINNINGS OF ORGANIZATIONAL KNOWLEDGE[1]

Daft and Weick (1984) argued that strategic-level managers scan for information, assign meaning to that information through interpretation, which then guides action. Action, in turn, recursively influences subsequent interpretation and scanning. In addition, however, Weick (1979) argued that "believing is seeing" (i.e., belief structures affect what information is searched for or noticed), which implies that existing interpretations often precede and, therefore, guide scanning. Daft and Weick (1984) also convincingly argued that organizations differ systematically from each other in their modes of scanning, interpretation, and action, and their framework points toward the need to develop a fuller understanding of relationships among managerial interpretation, search, and action (see also Thomas, Clark, & Gioia, 1993).

[1] In setting up the theoretical overviews, we employ the concepts that actually emerged from the inductive study that follows. In interpretive research, the concepts and framework are grounded in and emerge from the data (Glaser & Strauss, 1967; Strauss & Corbin, 1990), rather than deriving from prior theory that circumscribes data collection and analysis. Typical interpretive research reporting, however, involves a complex data presentation before revealing the major theoretical dimensions, so the theory normally appears *after* the data presentation (Daft, 1985). We instead employ the more traditional presentation and provide a theoretical overview first, to preview the major findings and grounded model. It is important to keep in mind, however, that these concepts actually emerged from the study itself (in the context of repeated consultations with relevant literature that were guided by the emerging thematic analysis).

The Role of Managerial Knowledge Structures

Schemas, or knowledge structures (terms used interchangeably hereafter), are frameworks of tacit knowledge that allow people to impose structure upon and impart meaning to ambiguous situational information (Gioia, 1986). Research on the use of schemas has shown that the cognitive frameworks of executives affect strategic choices made for their organizations (Axelrod, 1976; Barr, 1998; Calori, Johnson, & Sarnin, 1994; Porac, Thomas, & Baden-Fuller, 1989; Thomas et al., 1993). Gioia and Chittipeddi (1991), for instance, studied how the "sensemaking" (meaning making) and "sensegiving" (providing meaning for others) activities of a university president affected a change process in that university. Despite the research on this topic, important questions remain. Walsh (1995: 306) called for research to identify the nomological nets relating managerial knowledge structures to organizational effects. In addition, scholars interested in the microfoundations of organizational capabilities and competitive advantage have called for a better understanding of the role played by managerial cognition and search behaviors in the development of routines and capabilities (Gavetti, 2005; Salvato & Rerup, in press). These works emphasize the importance of understanding how managerial schemas relate to the interpretation, search for, and utilization of knowledge as a strategic resource.

Executive Scanning as Knowledge Acquisition

A related, but different, stream of research has emphasized the need to appreciate executive scanning as a key knowledge-search/acquisition behavior. Aguilar defined scanning as the "activity of acquiring information about events and relationships in a company's outside environment, the knowledge of which would assist top management in its task of charting the company's future course of action" (1967: 1). Managerial scanning is generally seen as the amount of knowledge search conducted in a given domain—commonly operationalized as the amount of time and effort managers invest in information search (Hambrick, 1982; Sutcliffe, 1994). The existing environmental scanning literature, however, shows rather limited attention paid to the influences on scanning and actual information acquisition behaviors of top executives, focusing instead primarily on their perceptions and/or the objective conditions of a firm's environments or strategies (Boyd & Fulk, 1996; Garg, Walters, & Priem, 2003; Hambrick, 1982).

Recent studies concerning knowledge acquisition have offered some rich insights into conditions under which groups or organizational units acquire knowledge and have also looked at the outcomes of such processes (Darr, Argote, & Epple, 1995; Schulz, 2001; Zellmer-Bruhn, 2003). Schulz's (2001) study of knowledge flows in multiunit organizations, for instance, notes the importance of knowledge acquisition as a transformative link between individual, localized knowledge and organization-level knowledge. His study introduced the concept of knowledge relevance as a precursor to knowledge acquisition processes. Most notably, he argued that what is considered relevant knowledge is influenced less by rational analysis and more by the sentiments and beliefs of organization members. The present study, therefore, accounts for the need to consider how the understanding of knowledge (and its sources) influences efforts to acquire it.

Zellmer-Bruhn (2003) conceptualized acquisition as active search for knowledge (in her case, via routines) that involves concerted efforts on the part of team members. She found that certain types of interruptions in routine work prompt efforts to search for knowledge but do not necessarily lead to knowledge acquisition. The implication of this finding for our purposes is a need to focus on actions that represent efforts to search for knowledge and to differentiate those actions from knowledge acquisition as an outcome. In a related vein, Daft, Sormunen, and Parks (1988) found that executives of successful firms scanned more broadly. They argued that executives in these firms maintain "information flexibility"; that is, they adapt their scanning approaches to the perceived uncertainty of an environmental sector. These authors called for future research to examine information flexibility as an important scanning attribute and also to see if this attribute correlates with pertinent CEO characteristics. A key upshot from the Daft et al. (1988) study is the need to expand the conception of managerial scanning beyond the narrow sense of routinized information collection activity to the view that scanning is a set of actions that can provide a manager with qualitatively better information than her/his counterparts have. For this reason, it is important to investigate whether differences in the ways that managers scan for information might lead to the acquisition of different kinds of knowledge that might be useful in practice.

From Knowledge to Knowledge-Use-in-Practice

Empirical work on how knowledge confers competitive advantage has largely focused on the quantity and quality of knowledge possessed by a firm

(cf. Dierickx & Cool, 1989; Hargadon & Fanelli, 2002), as well as on objective characteristics of knowledge, such as tacitness and complexity (Simonin, 1999). This "possession" view of knowledge has recently been complemented by a view in which knowledge is more an organizational property *in action* rather than something that resides in various repositories in an organization (Cook & Brown, 1999). Knowledge, in this view, is treated more as an active and emergent property that inheres in the situated, meaningful actions of organization members (Nag, Corley, & Gioia, 2007).

Building on the early works of Dewey (1922) and Ryle (1949), scholars such as Brown and Duguid (2001), Carlile (2002), Dougherty (1992, 2004), Orlikowski (2002), and Pentland (1992) have developed a "practice" perspective on knowledge wherein it is seen as localized and embedded in the performance of day-to-day activities. Although the early works of Dewey and Ryle were framed mainly at the individual level, their extension to the collective level has been well demonstrated. For example, Weick and Roberts (1993) built on Ryle's concept of mind as the "heedful interrelating of actions" in developing their notion of a collective mind in organizations. Pentland (1992) employed Ryle's (1949) argument that "knowledge" refers to certain kinds of individual performances and showed that organizational knowledge refers to certain kinds of *organizational* performances.[2] The practice view of knowledge provides an approach that spans the traditional schism between individual and collective levels (Brown & Duguid, 2001; Felin & Hesterly, 2007). Our study builds on calls best summarized by Cook and Brown:

> There is a need for more case studies of knowledge-creating organizations, knowledge work, and knowledge management that focus not only on the body of knowledge that an organization acquires, stores, and transfers. Equally important are the ways organizations can dynamically afford, within the situated practices of organizational daily work, the productive inquiry essential to ongoing innovation. (1999: 398)

Taken together, these observations from the schema, scanning, and practice literatures suggest the need for a more concentrated focus on the beliefs, knowledge-seeking orientations, interpretations, and actions of key agents in firms—and specifically, a more integrated consideration of processes by which they identify, search for, and use knowledge as a basis for attempting to create competitive advantage. Because little research has explicated these microfoundations, we adopted an inductive, interpretive research approach in this study. Interpretive research gives a major voice in the interpretation of experience to the people actually living that experience. We took advantage of the knowledgeability of our informants to investigate the research question, How can managers create uncommon knowledge when rivals have access to similar, commonly available knowledge?

RESEARCH CONTEXT AND METHODOLOGY

The metal-casting industry is one of the more mature industries in the U.S. It is composed primarily of small foundries[3] (< 100 employees) that melt metals such as iron, steel, aluminum, and alloys, to create castings that form components for use in products ranging from the most basic door hinges to the most advanced aircraft components. As an old industry, metal casting has a large body of institutionalized, common knowledge and "best practices." The possibility of studying managerial beliefs about knowledge and their relationship to firm practices and outcomes is greater in an industry in which best practices and dominant designs are well institutionalized and widespread, because such an industry provides a homogeneous external context that enables the isolation of firm-specific sources of heterogeneity in the interpretation and use of knowledge as a resource.

Research Procedures and Data Sources

Research approach. Consistently with our interpretive research approach, we relied primarily on how knowledgeable executives of 22 metal casting firms in the northeast and midatlantic United States described how they make sense of foundry work in addressing strategic challenges. Although an interpretive approach gives voice to informants, it does not diminish researchers' judgment. Rather, we as researchers assumed the task of further interpreting and structuring the statements of the informants in light of both contextual factors and prior theorizing (Strauss & Corbin, 1990) and casting them in theoretical terms to develop an emergent, inductive model. Given our main research question, we concentrated on understanding the content of executives' schemas (belief structures) about

[2] It is important not to confuse this concept of performance with the more commonly studied measures of organizational outcomes (e.g., financial or strategic performance).

[3] We use the terms "foundry" and "metal-casting firm" interchangeably.

knowledge, their scanning tendencies, and the implications of each for their meaningful actions.

Sampling. We followed a purposeful sampling approach in selecting the foundries in the study. As we proceeded, our sampling took a form of seeking "maximum variation" (Lincoln & Guba, 1985; Patton, 1980). This form of sampling is different from random sampling in the sense that the persons/firms selected as informants represent not only the general trends of the population but, more importantly, also include contrasting cases (Lincoln & Guba, 1985: 201). In this sampling approach, the recruitment/selection of new cases proceeds simultaneously with data collection, which enhances the possibility of assessing the emerging theoretical relationships with cases that either support them or offer divergent examples.

Of the 22 foundries in our sample, 16 were from a single northeastern state, 5 were from midatlantic states, and 1 was from a southeastern state. We developed a close working relationship with a state foundry association and, at our request, the association sent an e-mail to its members with a description of the study, depicted to potential participants as aimed at understanding how foundries compete, as well investigating sources of innovation in the foundry industry. We took steps to ensure that our sample represented the broad segments of this industry in terms of ferrous (iron-based), nonferrous (copper- and aluminum-based), and steel foundries.

Interviews. Over six-month period, we carried out 53 interviews involving 22 different foundries. Forty-two interviews were with foundry CEOs and other senior managers and key members; the remaining 11 interviews included university metal-casting experts and senior executives of metal-casting trade associations and industry suppliers. We used the interviews with the industry experts and trade association executives to develop an understanding of the strategic and technological issues facing the industry and to gain a historical perspective on the evolution of the industry. We conducted on-site interviews in 12 of the 22 foundries and carried out the rest by telephone or off site (at trade association meetings). Table 1 provides a breakdown of the foundries and the informants in them. Almost all of our informants were senior executives playing key roles in the strategic activities of their foundries, but we also interviewed other employees identified by a foundry's senior executives as beneficial to interview and perceived as playing important roles in the success of their foundry. We also spent extensive time on foundry shop floors observing the flow of work and engaging in impromptu talks with employees. In addition, we also organized two group discussion sessions with foundry CEOs and senior managers during metal-casting trade association meetings. We used such discussions as a form of "member checking," wherein we discussed our findings with informants and sought their feedback on them (Lee, 1999: 52). These discussions also helped us refine our understanding of the data and achieve a richer understanding of the second-order themes and aggregate dimensions.

We treated the 22 foundries as multiple sources for assessing similarities and differences among metal-casting firms, which enabled the generation of emergent theoretical concepts and their interrelationships (i.e., the bases for an inductive theory). We followed a semistructured interview protocol that began with general questions about an informant and about trends in the industry, focusing particularly on challenges that foundries face (see Appendix A). We also asked questions concerning the informants' beliefs about the sources of competitive advantage and innovation in the foundry industry and the role of know-how and expertise in developing these sources. Lastly, we asked how they made decisions and took actions pertaining to daily work in the foundries and the role that know-how and expertise played in these decisions and actions. During data collection, to bolster the credibility of the data our informants were providing to us, we encouraged them to provide concrete examples to support their commentary about the role of know-how and expertise in the creation of competitive advantage. In addition, when an informant recounted a certain event, we made it a point to discuss that event with another source in the firm. This approach allowed us to achieve confidence in ascribing trustworthiness to the informants' claims, which was particularly important for information pertaining to specific actions and action patterns.

Post hoc innovative outcomes assessment. As our process framework took shape, we concluded that it would be useful to assess the impact of the main emergent dimensions in the study (executive knowledge schemes, scanning orientations, and knowledge use modes) on meaningful outcomes for the firms in our sample. To do so, we contacted the same firms approximately six months after the initial study to obtain a description of any innovations they had made and an assessment of the success of these innovations. To develop a standard assessment scale, we consulted relevant management literature on organizational innovation outcomes and sought the opinion of industry experts and foundry executives to develop a list of five innovation outcomes that were most relevant to the industry. We then developed a semantic differential scale (rang-

ing from "not significantly better than competition" to "significantly better than competition") for each of these outcomes wherein a key informant from each firm assessed the value or success of these innovations in comparison with their closest competitors.

Archival and other sources. In addition to the interview data, we also collected archival data in the form of published news and magazine articles and research articles published in the American Foundry Society's primary journal. As noted, we also attended several trade association meetings to develop an understanding of the key issues and trends in the industry. We used the archival data primarily to get an in-depth understanding of the strategic challenges affecting the metal-casting industry and to gather additional information about the foundries in our sample.

Analytic approach. As we collected interview data, we also began to analyze them, adhering to guidelines specified for methods of naturalistic inquiry and constant comparison techniques (Lincoln & Guba, 1985; Strauss & Corbin, 1990). These steps helped to guide the focus of further data collection via theoretical sampling (Glaser & Strauss, 1967). We also cycled between data analysis and consultation with relevant literature as guides to theme development and subsequent data collection. Drawing on Miles and Huberman's (1984) suggestions for analyzing data from multiple sites, we first analyzed each foundry in detail, via within-site analysis. We coded each interview separately[4] on the basis of in vivo terms or phrases used by the informants (i.e., first-order categories [Van Maanen, 1988]), based on the categorization and theme analysis techniques suggested by Miles and Huberman (1984). As the within-site analysis proceeded, we also began cross-site analysis, aimed at comparing emergent categories from different foundries. We read each interview several times to discern similarities and differences among informants and sites. We relied on constant comparison across multiple informants and over time to detect concept patterns (Glaser & Strauss, 1967).

As we discerned codes that were similar, we collated them into first-order categories, employing language used by the informants whenever possible. To achieve theoretical saturation (Glaser & Strauss, 1967), we continued coding interviews in this manner until we could not ascertain any more distinct, shared patterns among informants. Concurrently with the development of the first-order categories, we started discerning linkages among the categories that could lead to the development of second-order themes (theoretically distinctive, researcher-induced concepts, formulated at a more abstract level, albeit with an attempt to apply informant labels if those labels represented theoretical concepts). We then assembled the second-order themes into aggregate dimensions, which enabled us to develop a grounded theoretical framework that linked the various concepts that emerged from the data. Although our initial unit of analysis was individual managers, it soon became apparent from the interviews that we were capturing phenomena and processes that spanned multiple levels. The emergent model thus depicts knowledge work as work performed by key individuals that eventually attains an organization-level character. Taking a cue from recent work on charting the emergence of knowledge-based structures and practices in organizations (Anand, Gardner, & Morris, 2007), we paid particular attention to the linkages and relationships among our concepts while analyzing the data. The main outcome of the analysis is a process model that shows how managers use their knowledge schemes and scanning orientations to transform common knowledge through uncommon knowledge use practices.

OVERVIEW OF THE FINDINGS

Our analysis indicates that executives of firms operating under similar exogenous conditions display distinct variations in how they identified, searched for, and used knowledge in uncommon ways to address strategic situations. The emergent theoretical model comprises three core concepts and their relationships: *executive knowledge schemes* (belief structures about the nature of valuable knowledge), *executive scanning* (knowledge search and/or acquisition patterns) and *uncommon knowledge use* (modes of using knowledge to create unique advantages). First, the executives displayed patterns of variation in their beliefs about the significance and sources of knowledge useful in managing their foundries. These belief structures, the executive knowledge schemes, represent the content of a firm's senior managers' interpretive frameworks about knowledge as a strategic resource. Second, executives employed two distinct approaches in scanning/searching for knowledge. Their scanning not only involved extensive time searching for knowledge in a given domain (*scanning intensity*)

[4] To keep track of coding agreement, we two authors jointly coded randomly selected interviews and compared our coding schemes. We also shared written and verbal notes to compare general patterns in the data. Where we found discrepancies, we reconciled them and arrived at a common understanding that generated a standard coding scheme.

but also, and more importantly, a high level of resourcefulness (*scanning proactiveness*). Lastly, uncommon knowledge use involved two notable modes: *knowledge adaptation* entailed using knowledge to develop novel solutions to specific problems; *knowledge augmentation* entailed using knowledge to reflect upon a problem to develop new understandings and principles for future action. We first explicate the three main dimensions that constitute the core of the overall process model. We then present a second layer of findings explicating relationships among these three core dimensions, followed by the complete emergent model. We present the findings in some detail, but it is important to note that the main contribution of the work is the generation of a grounded process model of how commonly available knowledge can be converted into distinctive, actionable knowledge.

FINDINGS: THE CONSTITUTIVE ELEMENTS OF A GROUNDED PROCESS THEORY

To study beliefs about, the search for, and the use of knowledge in organizations, it is first necessary to understand the key domains to which relevant knowledge applies, because most knowledge is context-specific (Carlile, 2002; Cook & Brown, 1999). In all the studied foundries, executives consistently deemed three domains of knowledge to have high strategic importance: *knowledge for technological effectiveness, for ensuring operational efficiency*, and *for maintaining responsiveness to customers*. In a similar vein, to investigate knowledge search/acquisition and knowledge-use-in-practice, it is first necessary to understand the cognitive basis for managerial interpretations about knowledge—that is, to describe the content of managerial knowledge structures. For that reason, we first articulate the content of such structures in this industry. Figure 1 shows the data structure, including first-order concepts (those meaningful to the informants) and second-order themes (induced by the researchers), that led to the generation of the aggregate dimensions.

Executive Knowledge Schemes

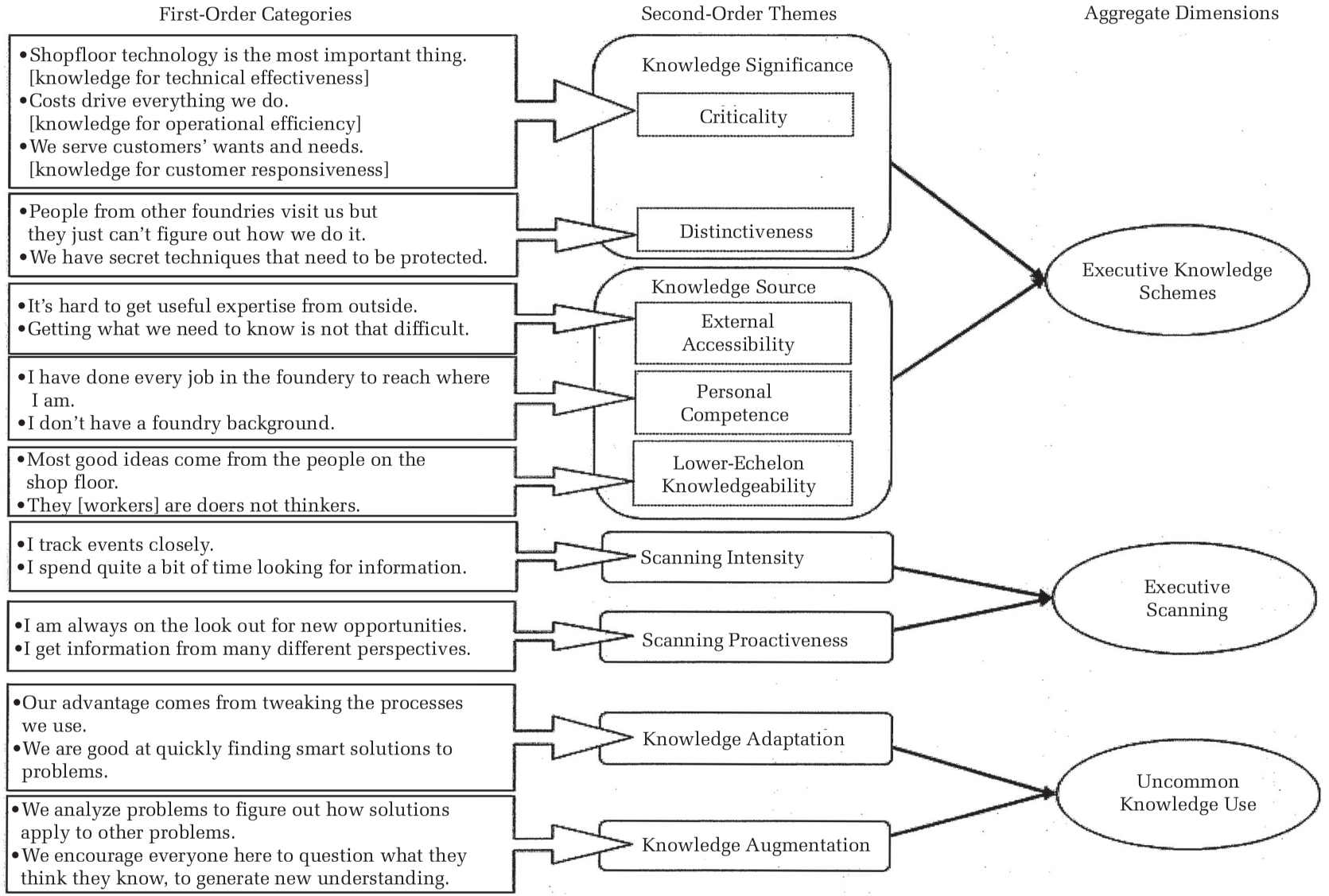
We found clear patterns of variation in how executives understood and evaluated the role of knowledge in managing their foundries. These executive knowledge schemes had two main themes: (1) *knowledge significance* (beliefs about the importance of knowledge to the strategic performance of a firm) and (2) *knowledge source* (beliefs about the usefulness or quality of the origins and/or locations of knowledge; see Figure 1). We discuss each of these elements of the executive knowledge schemes and their underlying second-order

TABLE 1
Informants[a]

Firms	Number of Informants	Number of Interviews	Mode
A	2: CEO; production manager	2	Phone
B	2: CEO; VP manufacturing	4	Site
C	2: CEO; production manager	3	Site
D	1: CEO	1	Site
E	1: Chief technical officer	1	Phone
F	2: President; VP manufacturing	3	Site
G	1: CEO	1	Phone
H	2: Production manager; marketing manager	2	Site
I	2: CEO; VP accounting	3	Site
J	3: CEO; VP manufacturing; foreman	3	Phone
K	1: CEO	1	Site
L	1: CEO	1	Phone
M	1: VP manufacturing	1	Phone
N	1: VP manufacturing	1	Site
O	1: VP	1	Phone
P	1: President	1	Site
Q	1: CEO	1	Site
R	2: President; production manager	2	Phone
S	3: VP; marketing manager; works manager	4	Site
T	1: VP technology	2	Off-site
U	2: CEO; works manager	2	Site
V	2: CEO; works manager	2	Site
Total: 22		42	

[a] A total of 11 interviews were carried out, with three university experts, two trade association directors, and one senior manager of a large metal-casting industry supplier firm.

FIGURE 1
Data Structure



subthemes. Table 2 shows additional first-order data that led to the development of all the second-order themes and aggregate dimensions in the data.

Knowledge significance. This element of the executive knowledge schemes subsumes two constituent second-order subthemes, criticality and distinctiveness. *Criticality* reflects the degree of importance that a given senior manager ascribes to a particular knowledge domain (i.e., technology, cost control, or customer service) in terms of its effects on the success of his or her enterprise. Executives varied in their ascriptions of the domains of knowledge important to their firms. Some believed that attaining technological effectiveness was critical to success. Others also valued technology but ascribed more importance to attaining operational cost efficiency and process control. The difference in these emphases is evident from the quotes from CEOs of two iron foundries operating in the same market segment and geographical area. The CEO of Foundry G, who emphasized the importance of technological effectiveness, commented:

> What we are being faced with everyday are increased engineering and design specs. Design engineers (of customers) today are making some very unusual demands and we as producers of ductile iron and castings must respond to those demands. That is why it is crucial that we stay on the cutting edge of technology.

On the other hand, the president of the nearby Foundry R emphasized the importance of efficiency as an avenue to controlling costs:

> Controlling production costs is central for us. One of the things that we have emphasized is actually knowing your processes and being able to reduce scrap and control it. If you come into the foundry on a Monday morning and there is a disaster there, you could have a lot of management people tied up for a lot of hours working to resolve it. I believe that by following processes, by documenting processes and costs down to extreme details, we have taken all of those fire fights out of there. We are very predictable.

Finally, we also encountered foundries where executives' main concern was to maintain current customer expectations of price and delivery deadlines (even at the expense of foundry profitability). Customer service and retention was a critical outcome for these foundries.

Distinctiveness, as a facet of knowledge significance, represents executives' beliefs about their foundries' ability to maintain or protect a unique competitive advantage within a given knowledge domain. Across foundries, we found notable variations in the perceived bases of distinctiveness. Executives of some firms, for example, viewed operational capabilities as key strengths:

> We think it goes back to the philosophy of how you run your business. . . . We like to say we have many other foundries in the same business, but as far as competitors, very few. We invite people from foundries to visit us. We've let them walk through and see everything. And we have not had them make any inroads into our customer base. (CEO, Foundry J)

Information we gathered from published industry sources confirmed that this foundry was, in fact, known for its technical capabilities. Because this CEO viewed his foundry's technical expertise as superior and inimitable by competitors, he allowed competitors to have access to information about his tangible equipment, raw materials, and supplies, while treating his firm's intangible expertise as distinctive and not easily copied. On the other hand, other foundry executives perceived their distinctiveness as grounded in a specific technique or method that the foundry had developed over time and that gave it an edge over its competitors. When talking about this basis for their distinctiveness, informants used terms such as "trade secrets," "proprietary techniques," "special methods," and "tricks." The CEO of Foundry D had this to say about his understanding of the keys to competitive advantage in the industry:

> I think there are too many variables in the process itself to come up with a situation where you can say one size fits all. Our shell is, again, we're using materials that are readily available to everyone and it's not a problem of training people in what those materials are. How we use them, how we control them, and what percentages we have is where it is proprietary.

Knowledge source. Whereas the first element of executive knowledge schemes represents the significance of knowledge in the strategic and competitive context of the firm, this second element, knowledge source, represents beliefs about the usefulness and trustworthiness of the origins and/or locations of useful knowledge. If the significance theme represents *what* domains of knowledge are important, then the source theme involves conceptions about *where* such knowledge comes from. Three distinct subthemes emerged concerning managerial beliefs about the value of various sources from which useful knowledge could originate.

The first subtheme, *external accessibility*, refers to beliefs about whether foundry knowledge from external sources could be easily acquired. A number of informants noted that although it was easy to get access to many sources of information in the

TABLE 2
Representative Quotes Underlying Second-Order Themes[a]

First-Order Categories	Second-Order Themes	Aggregate Dimension
	Knowledge Significance—Criticality	**Executive Knowledge Schemes**
Shop floor technology; that's what matters today [knowledge for technical effectiveness].	I think one of the critical factors is the awareness of the technology that's out there. *VP manufacturing, Foundry F*	
	You have to stay on top of automation and the latest technology in the foundry to succeed. *VP manufacturing, Foundry M*	
Costs drive everything we do [knowledge for operational efficiency].	A critical point in the foundry business is the knowledge with which you can put a quotation together. If you are too low on your quotation you will get the work, but not be profitable. If you were too high then you will not even see the work. *CEO, Foundry K*	
	Well, it [consistency in production] is important for everybody because if you have variation you have scrap [rejects]. We document the process for every casting that we make. *President, Foundry P*	
We serve customers' wants and needs [knowledge for customer responsiveness].	When the order shows up, we aim to put in the sand as quickly as we can. We tell our customers very confidently that whatever they need us to do, we're going to do it for them, and we've been able to do it and they appreciate it. *CEO, Foundry Q*	
	Our strength is offering a wide range of castings to our customers. In other words, our costs will be higher, but as long as we are within range, we'll give you [the customer] that broad range of service. *CEO, Foundry D*	
	Knowledge Significance—Distinctiveness	
People from other foundries visit us but they just can't figure out how we do it.	We don't have much competition in the market because there is nobody else out there who wants the kind of jobs that we know how to handle. *CEO, Foundry U*	
	Just because we can do the job at a certain cost doesn't mean that the other foundry down the road can. This is a knowledge-based item of what you are accumulating from your own operations. *CEO, Foundry K*	
We have secret techniques that need to be protected.	Well, I mean, as far making those things [castings], I would not tell him [the competitor] about the tricks or what metal grades we use. That is a secret. *CEO, Foundry C*	
	I think there are some things, like I said, that I would not want to share with them because that is something that we see as our competitive advantage. *VP manufacturing, Foundry N*	
	Knowledge Source—External Accessibility	
It's hard to get useful expertise from outside.	The biggest difficulty is to find that person who has that expertise because if you contact someone who says, "Oh, I can do it." It often turns out that they can't. *President, Foundry P*	
	If we have a job that's really giving us trouble, we have tapped into American Foundry Society (AFS). Their record is about 1:3 right now. We had this job and we called them for help and did exactly what they told us. Well, it didn't work. *Works manager, Foundry V*	
Getting what we need to know is not that difficult.	It's not that big of an industry anymore. You hire engineering, as there are some good engineering firms. You can get competitive advantage through external help. *CEO, Foundry D*	
	Oh yes, the AFS, Cast Metals Institute. You can go on the internet and get published research articles You can buy books. The *problem* we have in our industry is that the knowledge for metallurgy and for design of castings, the basic knowledge for process control in foundries has been out there for many, many years. *Works manager, Foundry U*	
	Knowledge Source—Personal Competence	
I have done every job in the foundry to reach where I am.	I groomed myself into a foundryman you know. I did it the painful way of taking me twenty years to get my first degree. That is not to blow my own horn, but that is the best kind of manager that you are going to get. *VP, Foundry S*	
	Like I said, I am very quick with customers. Like an old saying, if it walks like a duck and quacks like a duck, you have a duck. I have been down this road too many times and I just pick up on it very quickly. *CEO, Foundry I*	
I don't have a foundry background.	See, there is no substitute for brains. What makes a successful foundry vs. an unsuccessful one? One that's performing and one that isn't. Ninety percent of the time it's the "principal" who matters. I might not have a lot of foundry experience, but I'm smart enough to figure out what needs to be done. *CEO, Foundry D*	
	I am not a degree metallurgist and nor do I pretend [to be one] as my competitors are. I got in the metals business years and years ago, but it was not foundry, it was tubing. I lost my position there, which I won't get into why. *CEO, Foundry U*	

Continued

TABLE 2
(Continued)

First-Order Categories	Second-Order Themes	Aggregate Dimension
	Knowledge Source—Lower Echelon Knowledgeability	
Most good ideas come from the shop floor.	Most of what you find is that our good constructive ideas come from the shop floor. *VP manufacturing, Foundry J*	
	The ideas that they [workers] come up with helps our foundry stay at the edge of technology. *President, Foundry F*	
They (workers) are doers not thinkers.	It is not easy to keep people [workers] on course. I mean, you can train them and they know what to do, but you have to be on guard all of the time. It is like the old saying that the price to freedom is eternal vigilance. The price of good quality and performance in the foundry is also eternal vigilance. *Production manager, Foundry R*	**Executive Knowledge Schemes**
	We keep them [shop floor personnel] on track by putting everything on paper. They don't need to think much. We actually went to the point in our charts to tell a guy how much alloy to put in. I have one of these for every alloy. The casting weight is 1,000 pounds and for every step of the process, it tells them what they need. *Works manager, Foundry S*	
	Scanning Intensity	
I track events closely.	I spend a close watch on my customers, especially track how well or poorly they are doing, so if anything happens, I get to know it first. *CEO, Foundry I*	
	I stay abreast of what's happening in the industry locally and then also worldwide in the global market. Current events naturally you have to be abreast of. *CEO, Foundry J*	
I spend quite a bit of time looking for information.	I am always out talking to customers and trying to get intelligence of what our competitors are doing, what is going on in the marketplace. *CEO, Foundry G*	
	I pay a lot of attention to costs. First, I look at the hourly cost rates annually. Other parts of the database, I also pay a lot of attention to rejection rates. So just about every job, its cost, rejections, timeliness, I keep track of them regularly. *President, Foundry R*	
	Scanning Proactiveness	
I am always looking for new ways to collect information.	You need to network. One of our competitors, to a small degree of overlap, is a company down in Frisco, North Carolina. I've been down on my vacation to Wrightsville Beach to drive by their front yard and get a tour. I was down at Asheville, NC in an accounting seminar in September. I made a swing by a foundry just for a customer that we are trying to get into . . . to take a peek inside to see if they do anything we ought to know about! *VP, Accounting, Foundry I*	**Executive Scanning**
	I might hear that foundry X is having trouble or foundry X's customer or is looking or not happy. . . . I might think, well, maybe I should check this out. I might hop in my car and I will take a personal trip to the foundry or the customer. *VP, Foundry S*	
I get information from many different perspectives.	My view of melting and technical knowledge would be different from a person (another CEO) that did not come through engineering and specifically metallurgy. I am always looking for things that I am sure are not considerations in other peoples' minds. *CEO, Foundry K*	
	I have this friend in England who owns a foundry there and things are quite different there. But I always discuss my foundry's problems with him and he provides an angle that is always fresh and un-American. I also stay in close touch with my friends in China who look at things even more differently. *CEO, Foundry D*	
	Knowledge Adaptation	
Our advantage comes from tweaking the processes we use.	The basic is the same. You are melting iron and steel and you are pouring into the sand molds. That concept is the same in every foundry. What you do along the way, the little things to refine the process, is what makes the difference. *Works manager, Foundry S*	
	We are good at developing little advances by tweaking of the equipment and process. That is an in-house competitive advantage. *CEO, Foundry D*	
We are good at quickly finding smart solutions to problems.	About three years ago we went to a wire injection system for treating our ductile iron. What we do is we wire feed ferrous silicon and magnesium into the bath and we get a more consistent ductile iron with much better properties. A small trick that has led to major reduction in rejects. *CEO, Foundry G*	**Uncommon Knowledge Use**
	We have a ladle that is covered so that you reduce the magnesium flare. We were following standard procedures and we would fill it up with molten metal and then distribute that molten metal to the different floors. Now what we are doing is leaving that ladle completely upside down so that any of the slag silicates or the sulfides can drain completely out. This has increased our magnesium recovery by 15% by just doing that simple thing. *Works manager, Foundry U*	

Continued

TABLE 2
(Continued)

First-Order Categories	Second-Order Themes	Aggregate Dimension
	Knowledge Augmentation	
We go deep into the problem to see if solving it will tell us something for the future.	When we get a request for quotation, we look at it not just from a standpoint of what that finished casting is going to cost, we go back and we analyze the best method of constructing a tool, too . . . like a wax pattern. A wax pattern, a very complex part. In a real sense it is a marriage of a bunch of very simple parts that are complex but nonetheless reduce down to basics. We use what we learn from analyzing these kinds of things to apply to other challenges. *CEO, Foundry I* In one of the first projects that we worked on with technology A [name withheld for propriety reasons] without adding new equipment, we doubled our heat-treat capacity through a better understanding of the technology that we were studying at the time. That helped out in so many other projects we do. *President, Foundry F*	
We encourage everyone here to question what they think they know, to generate new ways of understanding.	I want my employees to be creative and I give them some freedom as to the decisions that they make and they are responsible for those decisions. So if anybody buys in, it works fine for everybody. We involve everybody in the decision-making process. As a new job comes onboard it may have only been seen by engineering to start with, but before that job is released to tool construction, many other disciplines of the organization are involved in it. This process makes the whole plant better because everyone who knows something useful is involved. It leads to everyone using what someone else knows. *VP manufacturing, Foundry J* We do not show them how to run to first base, we teach them concepts and understanding of why it is imperative that they run to first base faster than anybody else. All of our people in the melting operation do their own spectrographic work. They do their own alloy additions relative to the job cards. They take personal responsibility for their decisions. The individuals in our pouring processes do their own programming in each of those respective areas. But everyone knows that the other people know what they're doing, which improves the entire operation. *VP manufacturing, Foundry F*	**Uncommon Knowledge Use**

[a] Because of space limitations, we display only two representative quotes for each first-order category. Additional quotes are available from the authors.

industry (e.g., the American Foundry Society, technical associations, consultants, and research universities), more often the problem was one of getting *useful* information—that is, know-how that their foundries could actually use to solve their problems. As the CEO of Foundry Q lamented, "University X has done work with beneficial reuse of foundry sand and so forth, but we can't take advantage of any of those kinds of things at this point. We have tried to build ties with them, but have been unable to do so."

The second subtheme under knowledge sources, *personal competence*, refers to the manager's level of conviction about his or her own personal know-how as a source of valid and useful knowledge (e.g., from experiential expertise and trust in personal skills). Some of our informants expressed a high level of confidence in their roles as leaders of their firms, in their own competence as "foundry men," and in their abilities to influence events—a tendency reflected in a forthright statement by the CEO of Foundry I: "I don't think the same as my competitors. I have no qualm about telling people that I know what I'm doing and that we should be going in *this* direction." Others showed notably less confidence, either in their competence or ability to influence events (e.g., dealing with increased "unfair" government regulations). For example, the CEO of Foundry L was candid about his weakness in not being a foundry man:

> I have a bachelor's degree in economics and although I have had exposure to foundries, it has never been terribly hands on. I am not a born and bred foundry man of multiple generations like many other people in the industry are. Sometimes that's a real disadvantage.

The third subtheme, *lower-echelon knowledge-ability*, refers to executives' beliefs about the value of knowledge coming from lower-level members of their organizations. In some foundries, senior managers viewed lower-echelon employees as little more than rule followers. For example, Foundry R's president, when asked about the sources of innovation in his company, commented:

> When we got into austempering 15 years ago, it was a type of innovation, and that came from the top down. It was not some guy on the floor that decided

> to do that; it was management. That is a good thing in terms of innovation if it comes that way. . . . There is no question that our innovation is coming more from the top than it is from the guys down on the floor.

Other CEOs saw their employees as knowledgeable, capable individuals willing to learn and experiment with new things. Managers of these foundries were facing similar external and internal conditions but viewed their lower-level employees as potential idea generators. We interviewed a foreman who was somewhat of an "all-hands" person working in areas such as fire safety and development of new casting alloys who, without formal training, had quickly learned most of the significant operations in the foundry. When asked to describe what was different in the current foundry from others at which he had worked, he said:

> There is nobody above anybody here. Even our supervision, that's the main thing right there. There is nobody higher than anybody else in this shop when it comes to knowing things. They may have a title, but they treat us like we know stuff. Here, power goes to the person who knows what he's doing. (foreman, Foundry J)

Similarly, other CEOs showed a marked tendency to value the inputs of lower-level employees, often depending on them to solve the company's operational problems. Foundry B's vice president (VP) of manufacturing, for instance, saw his employees as having knowledge akin to "black magic" (his term), which alludes to tacit understanding of the metal-casting process.

Executive Scanning

Our analysis indicated that beliefs about knowledge as a strategic resource contained in the executive knowledge schemes were associated with differences in both the amount and character of scanning/search aimed at acquiring additional knowledge. In keeping with existing conceptions in the literature, our data affirmed the importance and prevalence of the "intensity" with which scanning/search was conducted (a mode of scanning that pertains to the frequency or effort devoted to search by executives). A second mode of scanning/search also emerged from the data, however—the degree to which executives proactively and resourcefully sought information. Our analysis, therefore, suggested an expansion of the basic scanning notion into two distinct concepts, scanning intensity and scanning proactiveness. Figure 1 includes the data structure for the scanning dimension. Table 2 contains additional first-order informant data that led to the development of these second-order themes and the executive scanning aggregate dimension.

Scanning intensity. As noted, this aspect of scanning refers to the amount of knowledge search conducted in a given domain, usually operationalized as the amount of time and effort managers invest in information seeking and knowledge acquisition. Comparisons among the foundries showed that senior executives—even those working in foundries of similar size and in similar strategic contexts—differed in the intensity of their scanning. For instance, the CEO of Foundry L said, "Up until a year or two ago we were never that active in the AFS [American Foundry Society] activities; we weren't that interested in picking up what they were putting out," suggesting a low level of scanning. On the other hand, the VP of Foundry S characterized his search behaviors as intensely following developments that might be relevant to his foundry: "I read everything. I don't just read foundry material. I read business journals. I read technical magazines. I spend a lot of time looking for that next new product or process."

Scanning proactiveness. This mode of scanning/search behavior captures the tendency of an executive to be a critical observer, to use multiple sources to "triangulate" information, and/or to experiment with innovative ways of collecting information. Scanning proactiveness thus represents not just time and energy devoted to information search and acquisition, but the tendency to actively seek qualitatively different or better knowledge than one's rivals. For example, the CEO of Foundry I discussed his close relationships with managers in a client organization, which was much bigger than his own foundry. He had built these linkages over the years and used them to "keep tabs on the health and direction" of the client company. He said that he would not be averse to "firing" a client if it was not performing well, explaining that when a client company faces financial pressures, it has a relay effect on his foundry in terms of requests to lower casting prices and offer longer credit periods, all factors that harmed his bottom line. Similarly, a senior executive in another foundry described his tendency to engage in occasional "competitive espionage"—even analyzing rejected parts and scrap materials of close competitors to see what kind of castings they were making. On the other hand, some informants showed clear passiveness in their information search tendencies. As the chief technical officer of Foundry E candidly observed, "Most people here don't want to ask for [external] help. So they don't. They don't want to look dumb, so they keep trying to solve problems on their own." On this scanning dimension, then, our data suggested

that information search and acquisition could not be adequately captured by assessing only the intensity of scanning and that scanning proactiveness constituted a distinctive approach to using knowledge as a resource.

Uncommon Knowledge Use

Our data and analyses suggested a prominent focus on how knowledge was actually used (via actions taken to address challenges or opportunities) to try to create uncommon knowledge and therefore competitive advantage. This dimension is exemplified by the following observation:

> It is one thing to know something, but that doesn't make you successful. *Applying* what you know is what makes you successful; the application of knowledge is what actually makes the difference. A lot of people in this industry just don't get that, and it just might be the key to the whole business. (VP manufacturing, Foundry B)

We chose "uncommon knowledge use" as the label for this dimension because our informants so consistently referred to "wise" or "smart" application of knowledge in day-to-day foundry operations. This phrase also captures the idea that the performance of meaningful actions and practices is what most matters in making a foundry more "knowledgeable" than its peers, thereby helping to develop unique insights and abilities that could give it a competitive advantage of some kind. The specific term "knowledgeable" came from an interview with a VP of manufacturing. We quote the actual sequence of our conversation.

> VP: There are many, many software programs that are set up that will duplicate the metal solidification process from liquid to solid, which gives us a picture of how the inside of the casting solidifies. It's there, but how do you know, except by experience and/or hands-on skill, how to use that knowledge to make a casting?
>
> Researcher: I've heard that word *experience* from other foundry men as well. Do you mean that the key is to have experienced people?
>
> VP: No! Not just experienced. "Experienced" doesn't mean they're *knowledgeable*. They have to be knowledgeable. [Emphasis in informant's voice]

Throughout the interviews, a consistent pattern emerged showing that these informants viewed knowledge as embedded in practices that represented how well knowledge was *used* or *acted upon* in a given strategic or operational situation. As the study progressed, we came to define uncommon knowledge use as the meaningful actions in which a firm's key leaders engage to use knowledge in ways that generate novel solutions and/or broader insights to deal with strategic and operational issues. Two distinct forms of uncommon knowledge use were evident in the data, knowledge adaptation and knowledge augmentation. Table 2 contains more first-order data in support of the uncommon knowledge use theme.

Knowledge adaptation. This mode of uncommon knowledge use captures those activities that confer an ability to apply knowledge to modify and improve specific operational activities. The emphasis here is on finding solutions to local problems using ingenuity and creativity. In some firms, this mode of knowledge use was seen as the ability to "tweak" a standard technology, as exemplified in the following vignette:

> Chuck [a new engineer] was running some tests on the machine. He ran all the jobs that were rigged the way the book says the machine is supposed to be rigged. One day he said, we don't have any work because we don't have anything rigged per specifications. We went to the pattern shop and got scrap materials and masking tape. We just taped the blocks of wood together and made it the width and height that suited our jobs. Chuck didn't learn that in college. He told me the book does not say that's what you are supposed to do. We said, "But now we're going to teach you some more education. You learned from the prof for four years. Now we're going to teach you what he didn't teach you." That's hands-on. (CEO, Foundry B)

In this vignette, the new engineer was facing challenges in using his college education to guide him in resolving the rigging problem when the CEO showed him a creative, practical way to accomplish the same task. On one level, what the CEO did could be seen as a normal problem-solving tactic, but at a deeper level the action represents the adaptation of knowledge gained from years of shop floor work to craft new ways to address a problem. The engineer himself cited this creative solution when he noted that the specific incident helped him to "fit my formal engineering education into a different perspective." In a related but different example, another foundry engaged in a more sophisticated example of knowledge adaptation,

> See the wax that we put in there, the vent wax, you put it right within the core itself. When you bake the core, the vent wax melts out which leaves a void within the core itself. So in other words, the gas follows those voids out away from the casting to vent it out. . . . Instead of venting it out right into the sand, I will punch down where the vent comes out in the mold so that it's like a chimney right straight out of the mold. I can vent the gas out of there. This small change has really improved the speed with

which we clean out molds and slashed our process costs. (production manager, Foundry A)

Knowledge augmentation. This second mode of uncommon knowledge use concerns actions that involve problem solving with an orientation toward reflecting upon, critiquing, and questioning, in a fashion that generates new understandings by members of a firm. The emphasis here is less on solving a particular problem resourcefully and more on using the firm's existing expertise and skills to go beyond a given problem to generate new insights, reframings, and enriched understandings that lead to principles for future action that can benefit the firm's competitiveness, as represented in the following description:

> I think Joseph Gladville back in 1896 said iron is an easy material, but in its history are many mysteries. It is the only metal known to mankind that is denser in the liquid state than it is in the solid. So there is net expansion. What you do with expansion is going to determine how much quality you get in your casting. . . . There has to be a balance between experience and understanding and also theory. You have to know what ratios in your gating are necessary to clean the metal before it goes into the cavity. You have to understand what effects pouring (of molten metal) temperatures have. You have to be able to see the big picture. I mean, we are in a big experiment every day. When we pour 35 or 36 tons of metal, you know the next day we are out there looking to see how our experiment turned out. (Works manager, Foundry U)

An essential facet of knowledge augmentation was the creation of a social context wherein organization members were actively encouraged to critique current knowledge of things, explore new ideas, and become involved in efforts to improve the collective understanding of the organization on a particular problem or issue. For instance, in Foundry J, the foreman, who had started with a firm as a truck driver and within a span of four years had developed into a foreman and safety compliance coordinator, shows this aspect of knowledge augmentation:

> Foreman: We are an aluminum foundry and we wanted to get into magnesium, which has somewhat different properties. Everyone outside the foundry was saying that this can't be done, but Jack [the CEO] said that there's nothing that can't be done and we went after it.
>
> Q: Tell me more about your experiences with this magnesium initiative.
>
> Foreman: I was sort of the project leader although there were three of us who worked as a team. The senior guys were always there as a sounding board and let us take this challenge as far as we could go. We starting getting deep into the chemistry of the whole thing, working with the silica, the carbon, making the pours and then evaluating and saying, "Okay, this is how this metal [magnesium] is behaving differently from aluminum." The magnesium we found flows a lot smoother compared to the aluminum, so we were able to take those differences and do something with them. Now, we (the foundry) know that these are really two different animals, yet similar.
>
> Q: So how successful were you in this?
>
> Foreman: Well, we've won three industry awards.

In sum, both these forms of uncommon knowledge use amounted to ways of employing knowledge that led to the creation of something *new*, whether it was a new, particular procedure or new rules for action. The key difference, however, was that knowledge augmentation involved reflective reexamination to generate new, enhanced ways of understanding problems in principle, whereas knowledge adaptation resulted in the creation of new methods of resolving specific problems.[5]

A GROUNDED MODEL OF KNOWLEDGE AS A STRATEGIC RESOURCE

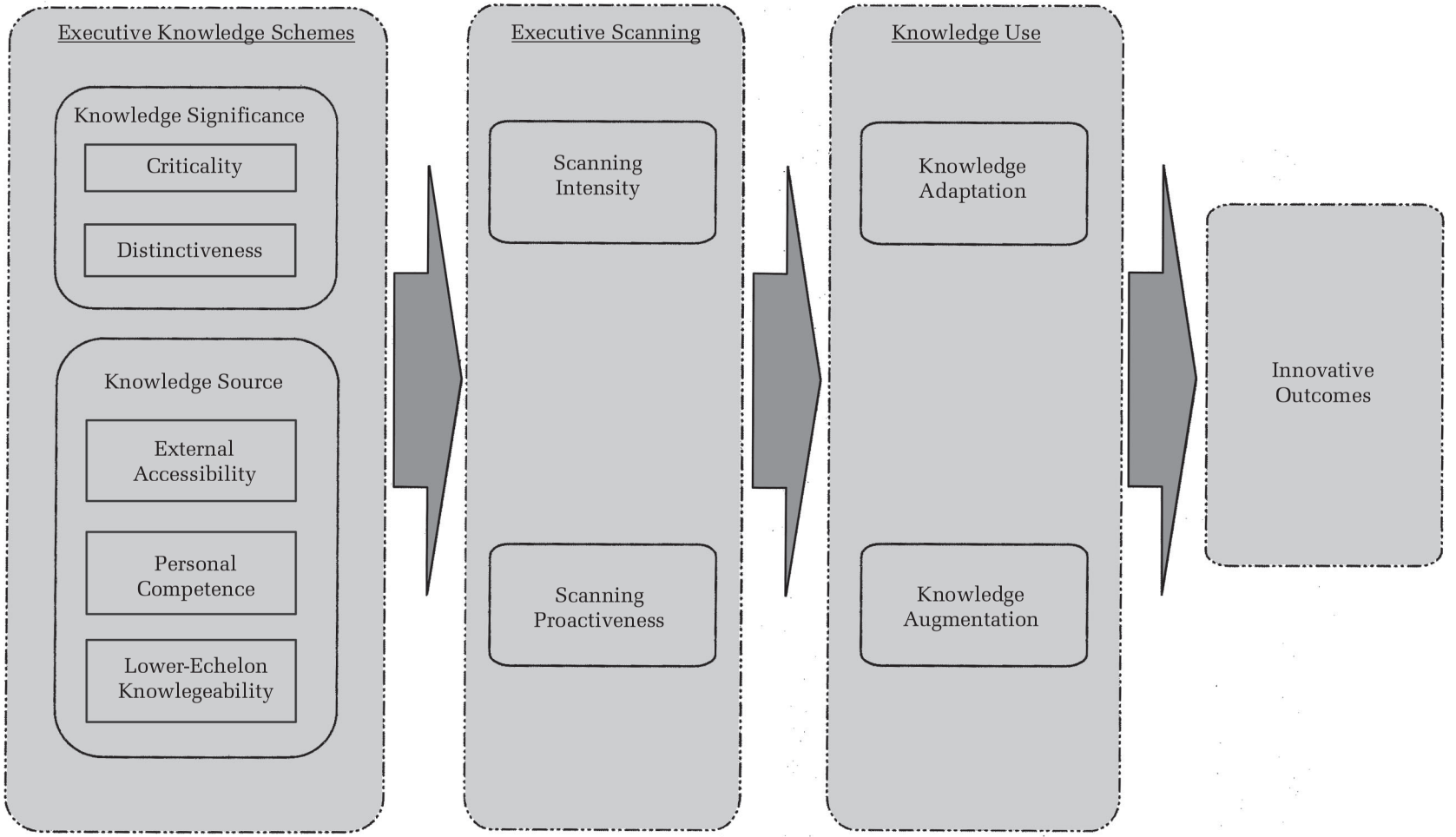
A developing grounded theory must specify not only constituent concepts, but linkages or relationships among those concepts in describing or explaining a phenomenon (cf. Corley & Gioia, 2011; Dubin, 1978). By assimilating the dimensions and themes displayed in Figure 1 (the data structure), in combination with the findings narrative to this point, a skeletal process framework that suggests the dynamic quality of the relationships among the emergent concepts becomes apparent. Figure 2 displays these major concepts and their relationships in general form. Most notably, it suggests that executive knowledge schemes relate to subsequent executive scanning behaviors, as well as to uncommon knowledge use in firms. To explore these relationships in more depth, we next present another layer of findings that show how specific elements of the model are linked.

LINKAGES AMONG THE KEY CONCEPTS

To recap, two main elements of executive knowledge schemes were germane—first, beliefs about

[5] Not all foundries engaged in uncommon knowledge use, of course. A number of our sample foundries showed little tendency to develop unique approaches. Knowledge adaptation and augmentation were the two knowledge use modes employed by those foundries that actually attempted to transform common knowledge into distinctive competencies.

FIGURE 2
Emergent Organizing Framework of the Linkages among Executive Knowledge Scheme, Scanning, and Uncommon Knowledge Use



knowledge significance (significance to a firm's strategic health) and second, beliefs about the value of knowledge sources (judged as useful for the firm). Knowledge significance comprised two subthemes, that is, knowledge deemed to be critical and/or distinctive constituted important knowledge in the eyes of key decision makers. Valuable knowledge sources comprised three subthemes; these were beliefs about the external accessibility of knowledge, a focal manager's personal competence in retaining relevant knowledge, and/or the worth of knowledge from lower-echelon employees. Differential emphases on these subthemes tended to be associated with the amount (scanning intensity) and quality (scanning proactiveness) of subsequent knowledge search, as well as with how knowledge was then used in a firm (either via knowledge adaptation or knowledge augmentation). Because the uncommon use of knowledge is the outcome of most interest, in this section we trace the pathways to either knowledge adaptation or augmentation via linkages with elements of executive knowledge schemes (knowledge significance and source) and the two scanning modes.

The Knowledge Adaptation Pathway

Figure 3A shows the typical pathway for foundries displaying knowledge adaptation as their dominant mode of uncommon knowledge use.

Linkages among knowledge significance, scanning, and knowledge adaptation. Our data indicated that in firms showing a tendency for knowledge adaptation as the preferred mode of uncommon knowledge use, strategic leaders generally emphasized the criticality of knowledge for operational efficiency (achieving better control of production costs and processes). The main focus of these senior managers was on intense, frequent scanning (nine of the ten firms showing a tendency to adapt knowledge), rather than seeking qualitatively different information than competitors. Leaders in these firms also tended to view their distinctive knowledge-based advantage as residing in specific, novel techniques, with a marked concern for protecting that novelty from competitors (seven of the ten firms). On further inquiry we found that such executives were very attentive to issues pertaining to their own foundries, while tending to insulate themselves from other foundries. A conversation with the president of Foundry P exemplified this tendency:

> Q: How often do you find your foundry working or interacting with other foundries?
>
> President, Foundry P: Almost never. We always kind of go out on our own. I mean, we've tried to do some things cooperatively and we found that for the most part we were kind of wired into our own traditional ways.

This president was as a keen observer of processes inside his own foundry. He had developed an information-reporting system that provided him with up-to-date information about his foundry operations, which he used to scan intensively, but mostly internally. Furthermore, such executives often extolled their firms' abilities in operations—many having developed a unique/secret practice that they wanted to protect, whether a solution to a vexing metal-casting problem faced by other foundries or a clever, low-cost solution to an otherwise expensive problem. The chief technical officer in Foundry E, for example, said that, "If somebody comes in and sees who my customer is and what kind of jobs I'm doing, people here have concerns about that. They don't tell other people or let other people come and see." Such beliefs about operational distinctiveness most often were associated with the adaptive knowledge use. When we asked this manager to talk about instances of innovation in the foundry, he said:

> Innovation? We don't innovate. . . . People here don't want to look at dramatic change. They're not inclined toward it. They want to take something that they are doing now and tweak it so that it is a little bit better, helps melt metal a little bit faster or more consistently, and those kinds of things.

These data and other linkages from our analyses thus suggest that organizations showing a greater tendency to create uncommon knowledge via adaptation have leaders who tend to ascribe greater value to knowledge for operational efficiency, to scan intensively (mostly internally) and to locate their firms' source of distinctiveness in novel solutions to specific problems.

Linkages among knowledge source, scanning, and knowledge adaptation. The relational analyses of our data also suggested that beliefs about the value of a particular source of knowledge were related to how executives scanned for knowledge and how their organizations tried to create uncommon knowledge in practice. As also shown in Figure 3A, senior leaders who believed that useful external knowledge was difficult to access (seven of the ten firms) tended to scan their internal operational environment more intensively and engage in knowledge adaptation as a way of creating uncommon knowledge. The following testimonial displays this relationship between external accessibility and scanning intensity:

> A lot of people think that you can always look at the American Foundry Society manuals about how to melt iron and always look at a machine manual to operate that machine, and that's how you take care of problems. That's usually just not so. What do I do if I am getting pinholes in my castings? Who do I seek help from? You have to draw from something, usually your own experience. You have to have seen it before and you had to have struggled through it. One time I had wet sand. I needed look at my sand mixing to solve it. Another time my cores were not cured right, so I needed look at that . . . . You just have to fall back what you have experienced in the past. (VP, Foundry S)

Foundries showing greater tendencies toward knowledge adaptation also tended to have strategic leaders who perceived their own skills and knowledge to be superior to those of their counterparts in competing foundries (eight of the ten firms). This belief in personal competence and its association with scanning and knowledge use also was aligned with beliefs about the (lack of) knowledgeability of other employees in the organization. Our analysis suggested that beliefs that lower-level employees were not very knowledgeable (nine of the ten firms), when coupled with this greater level of perceived self-competence, tended to encourage managers in these firms to take on most of the knowledge- and learning-related work. This combination is reflected in the following observation:

> Someone has to say, "These are the things that we need to know and the things we need to do to, number one, break even, number two, be profitable, and number three, meet customer demands." So you do not say [to the workers], "Okay, you do what you want." If you do that, you are diluting the whole thing and compromising your ability to succeed. What you want to do is maximize what they can do. Their job is to get good molds and good castings out. Period. You don't need to burden them with other issues. It is like a game of chess basically. You need to make the move and the people have to follow the path. (VP, Foundry O)

These patterns in our data and analyses suggested that senior managers who (1) did not find external sources of knowledge to be useful, (2) believed themselves to be competent, and (3) did not treat lower-echelon employees as good sources of knowledge tended to be associated with greater levels of knowledge adaptation in developing uncommon knowledge. Overall, those firms employing knowledge adaptation tended to have largely inward oriented managerial beliefs about knowledge and a greater tendency to scan intensively, rather than proactively.

Table 3A provides further evidence of the patterns noted above for those foundries that emphasized knowledge adaptation as a pathway for trying to develop competitive advantage. It displays linked, representative quotes from senior managers, all from a given foundry (and for three different foundries) that show the knowledge significance and knowledge source themes, their association with scanning intensity as the preferred mode of knowledge search, and the prominence and prevalence of knowledge adaptation as a favored mode for using knowledge in uncommon ways.

The Knowledge Augmentation Pathway

We also identified a second key pathway that firms used to develop uncommon knowledge via knowledge augmentation. Figure 3B shows this prototypical pathway.

Linkages among knowledge significance, scanning, and knowledge augmentation. We found that executives who considered knowledge for technological effectiveness as the primary domain for their firms tended to emphasize knowledge augmentation as their mode for developing uncommon knowledge (five of the eight firms displaying a tendency for knowledge augmentation). For some, ascribing greater importance to technological expertise enabled them to develop a richer understanding of customers needs:

> It is absolutely critical to have a deep sense of technology and match it with what your customer asks for. A lot of foundries operate as tonnage centers, just filling volume orders. We go after work others don't want—work for which there are no shortcuts and which requires a lot of thinking and planning to do something different that we can learn from to use in the future. (VP manufacturing, Foundry F)

Executives in some other firms believed that new technical knowledge enabled them to find unique insights about existing metal-casting methods that they used as a way of extending their abilities:

> What's crucial for growth in the foundry business is manufacturing increasingly sophisticated parts. We're not afraid to try new ideas. Not just come up with them and discuss them, but actually put them in practice and see if they will work. When we casted our first exotic metal part it was an attempt to produce a quality investment casting. People said it was impossible, but we overcame that through knowledge of all the things we did in the past that *didn't* work. We looked at them and said, "Okay, why weren't they successful?" We have brought it to the point where we are capable of consistently producing different quality parts out of that metal today. (CEO, Foundry J)

FIGURE 3A
Knowledge Adaptation Pathways

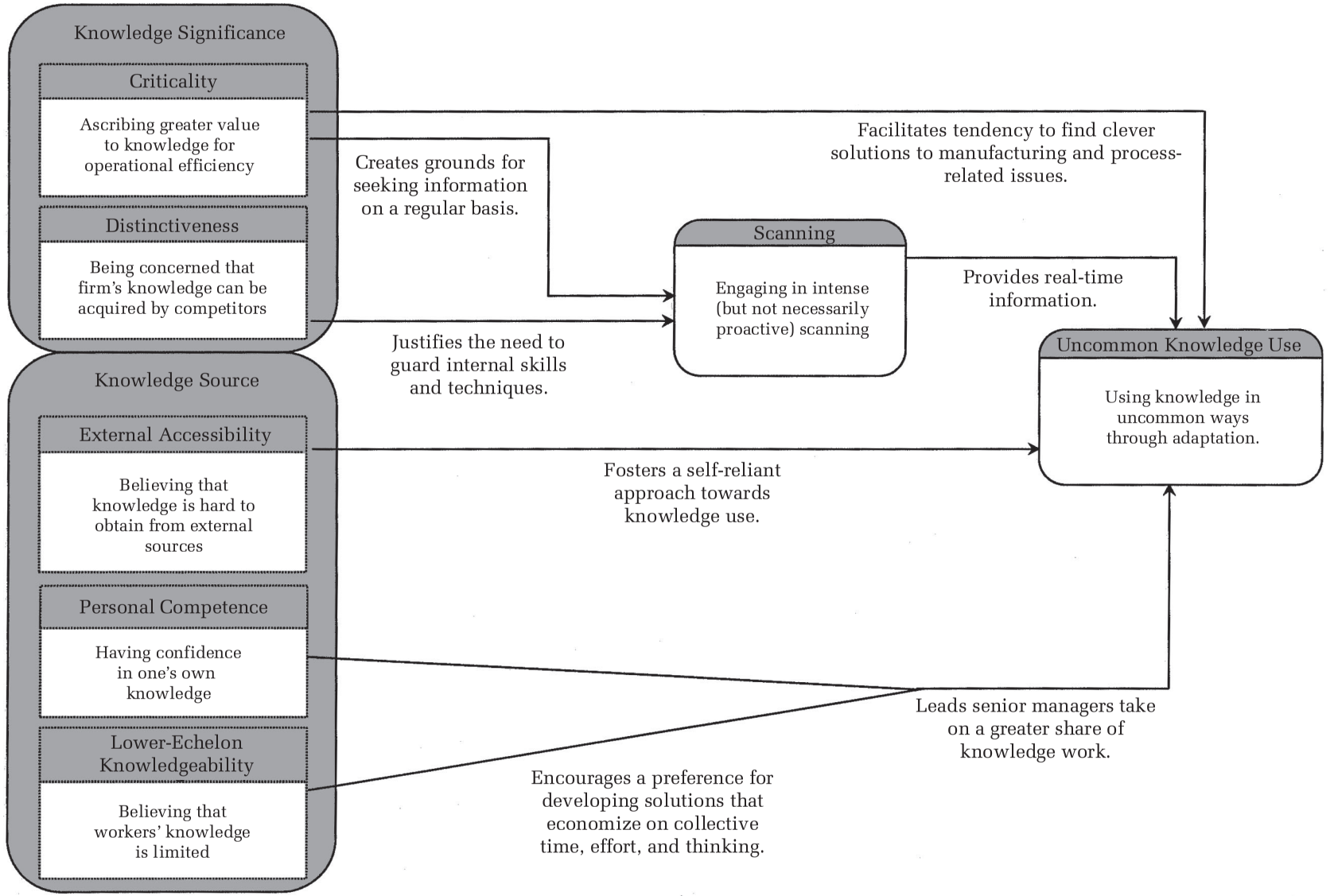


TABLE 3A
Representative Quotes Underlying Knowledge Adaptation Pathways

	Knowledge Significance		Knowledge Source				
Foundry	**Criticality**	**Distinctiveness**	**External Accessibility**	**Personal Competence**	**Lower-Echelon Knowledgeability**	**Scanning Intensity**	**Knowledge Adaptation**
O	Number one is knowing your [production] costs. This is the main factor and then come the other factors. Is your [casting] quality good? those things will start playing in.	Every foundry has it own idiosyncrasies. There are important differences and variables in the processes of a foundry that affect their outcomes.	I think other foundries are reluctant to talk. I used to do it when I ran another foundry. Now, I have a competitor in town and I guess I can figure out why they don't want to talk.	One day, my chairman said, "You're going to run this foundry. I will give you three months to turn it around." so I came and I turned things around the very first month.	What do you expect when you pay a guy $9/hour? Unfortunately, you have a group of people whose only source of income is doing menial jobs. The only way you can help them is to try and enforce and supervise them.	I monitor certain markets really closely. I always try and keep my eyes open, but I can't say that for others around here.	If you have a part to be made, you think about clever ways of making it with the least costs to maximize what you can get out. You are trying to beat the market price and to be successful with it.
R	I think you need to drive quality. I am a firm believer in [operational] statistics. I run almost my whole foundry on statistics. This is not a dog-and-pony show. Getting those things right matters.	We are running a metal mix not too many other foundries know how to run. We will not share that information too much since it is one of our advantages.	There might be new ideas being developed out there but whether we can get the information and whether they will fit our foundry is completely another matter.	I worked my way up from accounting and currently I am VP of finance. A good accountant in the foundry is worth his weight in gold.	It is not easy to keep workers on course. I mean, you can train them and they know what to do, but you have to be on the lookout all the time.	We pay a lot of attention to our costs. We put a lot of time and effort into monitoring it all the time.	Our innovation comes through small steps rather than giant leaps. If a worker comes up with a better way of grinding a part, he doesn't just do it on his own. We share that new technique.
V	The main basis of our [low-price] sales to customers is the cost at which we can make the casting. Quality is a very important part of it, and also the metallurgy has to be within specifications. So those are factors too, but they are a little bit lesser than cost.	No data available.	I think a lot of it, the information we're after, industry sources have not experienced. And they may tell you to do this or that. If it was that easy everybody would do it.	I have made a lot of new improvements in the foundry since I've been here. Nobody until I came along had a real interest in pursuing what we should be doing.	As long as we have one or two [workers] that know why we are doing it, we are fine. Monitoring, measuring, policing takes a lot of time, so we depend on a few to set an example for the others. We still need to make sure everyone is on board though.	We probably have ten core customers that we work closely with. I probably talk to everyone at least once a week. I keep track of things by staying on top of things.	It's a little finesse after that—how to do this; how to cut corners; know what you can get away with. No great principles here. We don't have time, expertise, resources to sit down and study this thing to death.

FIGURE 3B
Knowledge Augmentation Pathways

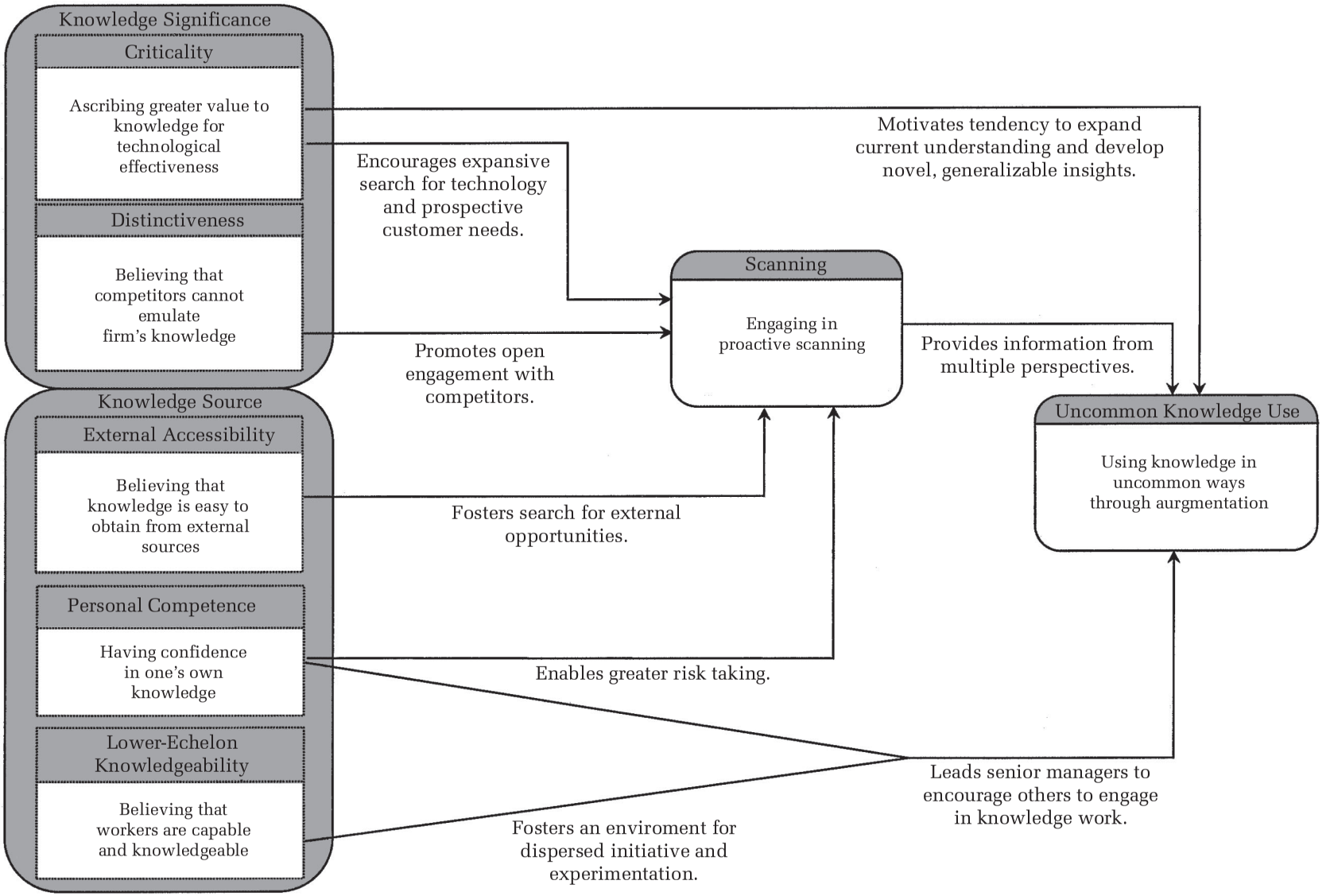


TABLE 3B
Representative Quotes Underlying Knowledge Augmentation Pathways

	Knowledge Significance		Knowledge Source				
Foundry	**Criticality**	**Distinctiveness**	**External Accessibility**	**Personal Competence**	**Lower-Echelon Knowledgeability**	**Scanning Proactiveness**	**Knowledge Augmentation**
A	We most value our knowledge of working with technological challenges that customers offer us.	I mean, we don't really give away anything to each other, but we do understand each other's unique capabilities. We certainly have ours.	We work a lot with suppliers and other foundries. We have a very open relationship with them.	I have a machinist background as well as being a patternmaker, so I try to bring all that together to do my job well.	My employees are very good, and they really understand their jobs, right from the core up. They understand why they are doing what they are doing.	I have been very active in finding unusual information. I am the type of person that if I want some information, I will pick up the phone and call whoever I need to get it.	When we got into new filters, we put in a lot of research before it started to help us. All the reading you do, you got to apply it to your particular situation, but also try to apply it to a bigger picture.
B	Great shop floor technology—that is what is missing in the industry today. Too many managers do not want to meet technological problems head on.	So yes, come into our shop and see what we do. But good luck trying to copy it. There is, to my knowledge and from what I have been told, five or less foundries in the country that do what we do.	The technology is not a secret. Everybody can get it. It is available to everybody.	I started as a janitor here. I have done about every job in the shop. That is how I have come to where I am today. I got good at whatever job I was doing.	I use a lot of other brains that are here. There are certain people out in our shop floor that I know would be a better supervisor than their supervisor. So those people have a wealth of knowledge.	I talk to people, I listen to people. . . . I ask myself what is that guy doing? What is that guy doing? I watch everybody and try to figure out if something different is happening out there.	It's enlightening when you take what a guy knows about doing the job and add the science and he understands the why. We have gained a lot from that process that we use throughout the plant.
T	If we are able to get involved with the customer's design people, their engineering team then we can be better in tune with their tech requirements.	I do not even look at the foundry industry as our competitors. I look at our competitors as being the people in powdered metals, sheet metals.	We participate in the foundry society. We freely communicate with each of those organizations—the ICI, the AFS. They have valuable information.	My first excitement was watching liquid metals solidify. I mean, that just really attracted me to the foundry industry. I learned what I know from just being interested.	I think one of the big realizations to me was that in the executive officers the average IQ was 100. Then I went on the foundry floor and found that it was the same. I think great ideas come from people on the floor.	What matters is being in tune with the changes in these industries and taking advantage of those changes. You have to be sharp in picking up the subtle things that are going on.	I am not talking about tweaking things. I am talking about major ways that we make castings. Do we create a new process that puts less stress on the mold? That leads to new ways to deal with the alloy.

FIGURE 3C
Pathways for No Uncommon Knowledge Use

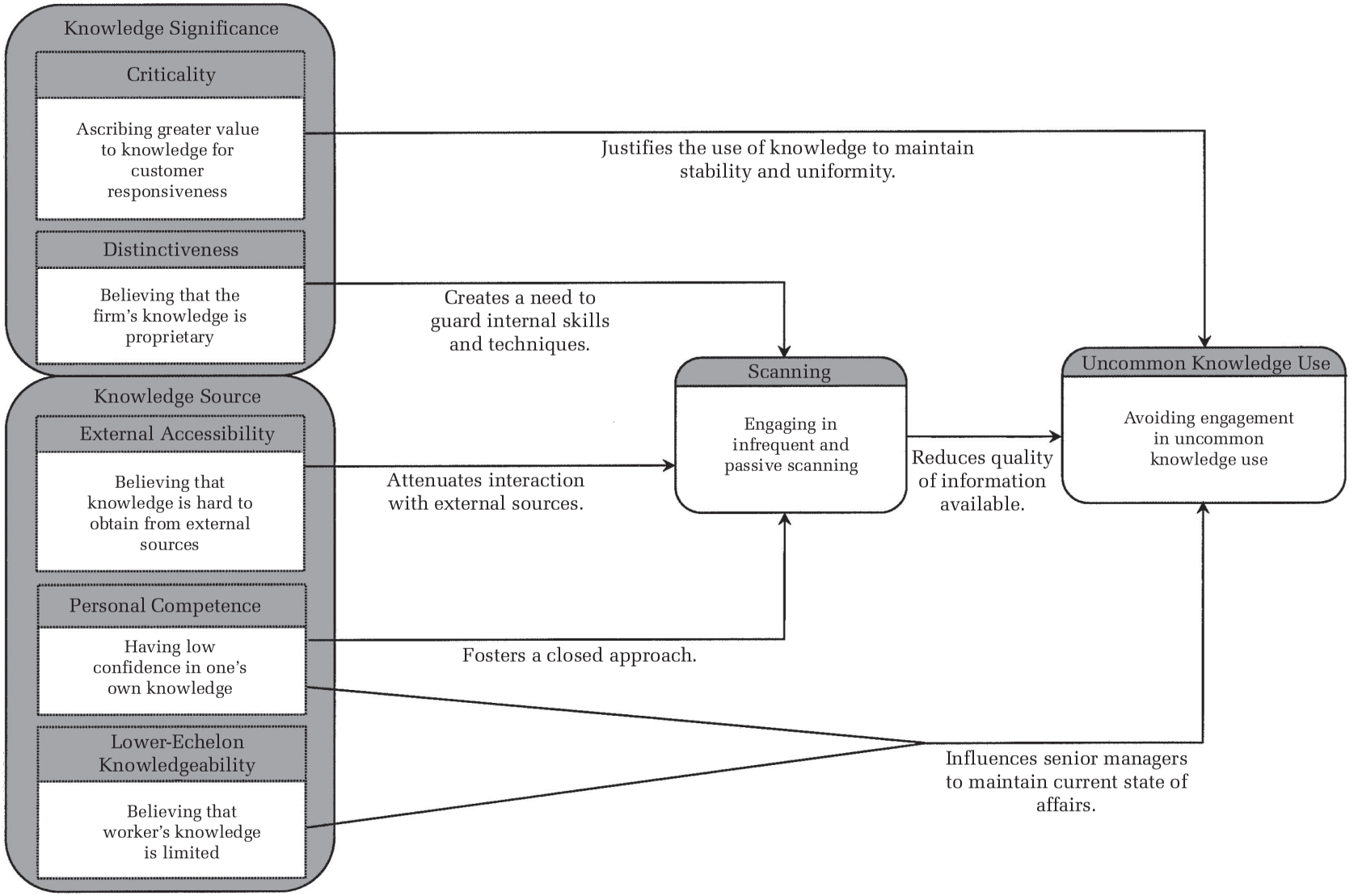


TABLE 3C
Representative Quotes Underlying No Focus on Uncommon Knowledge Use

	Knowledge Significance		Knowledge Source				
Foundry	**Criticality**	**Distinctiveness**	**External Accessibility**	**Personal Competence**	**Lower-Echelon Knowledgeability**	**Scanning**	**No Uncommon Knowledge Use**
C	Top management's job is eliminating [casting] rejections. Making your product sell more—that is the bottom line.	If you were running a foundry and you are my competitor, why would you want me in there to see your operation? It is all about trade secrets.	I don't see a whole lot of input or value coming from universities.	I was not the brightest guy in college, but I do OK. As far as education there is only one other fellow that has a four-year degree here.	Work in a foundry is hard; it is dirty, and doesn't pay much. We do not get rocket scientists or a lot of engineering types as far as the workers out there, so we have to be satisfied with what we get.	We, the top managers inside here, would love nothing better than to visit other foundries we are kind of locked in here, though, so we don't.	Our experimentation, if any, is customer driven. If it is not dictated by them, then we just do not have the manpower to do that. So we don't.
L	What is important for any foundry is to be able to understand the basics. It all has to translate into lower prices for your customers.	No data available.	This tends to be an organization that rejects outsiders. I can think of three individuals that we brought in from outside and all three of them one way or another failed.	I have never had much hands-on foundry experience. I am not a born and bred foundryman like many other people in the industry are.	The lower people are not making decisions or impacting what kind of changes we need to make in equipment or processes. They are merely implementing them.	I mean, our external information processes are weak. We have had top management here who are pretty controlling and basically were in the dark.	We're basically working on things like tough-to-fill pinholes in castings. Our guys either scrap it or say "Oh yeah, you throw a little putty on it and throw some paint on it and nobody can tell the difference." That's how we keep customers happy.
Q	If you can establish yourself with a customer, and assuredly you can provide on-time delivery, and if there is something you can do to save them money, then that is the basis of our business.	We avoid having relationships with direct competitors. They say they are cooperative, but I don't think they are. We do our own thing now and we've gotten pretty good at it.	We've been to seminars and plant tours. We haven't been able to do more than that. What works there does not necessarily work in our foundry.	To be honest I'm not really too sure how we got into this business. Actually, most of our current customers are ones with whom my grandfather made ties back around 1915.	I think when you are dealing with the hourly people on the floor you need to be able to really direct things there.	Obviously, it's one of those things. You don't know what you don't know, so I don't know how much I'm not hearing.	We don't want to run out and spend a lot of money and effort in areas where we don't really know what's going to go on. We don't want to get into designing and other services.

Concerning knowledge distinctiveness, we found that those firms whose executives believed that their firms had distinctive technical and operational abilities tended to be more proactive in scanning for knowledge (all of the eight firms), as exemplified in the following quote:

> I keep a keen eye on [our competitor] foundries, to see what jobs they're doing. Our knowledge gained by working closely with customers gets us our jobs. We make sure that when they put our products on their machines it works right the first time. They don't have lost machine time because of porous castings or other problems because we worked those problems out ahead. . . . So when we get a new job we dig right into it and we take everything we know, and we try to find similar things that we've done and apply it to see if we can find better ways to do that job. That's how we outperform other foundries. (production manager, Foundry A)

In summary, these trends in the data suggested that organizations displaying knowledge augmentation as an avenue for developing uncommon knowledge tended to have leaders who (1) ascribed greater importance to knowledge for technological effectiveness, (2) believed in the technical capabilities of their organizations, and (3) engaged mainly in proactive scanning.

Linkages among knowledge source, scanning, and knowledge augmentation. Some foundry leaders believed that it was easy to access high-quality information and expertise from other foundries, trade associations, key suppliers, and so on. It became evident, however, that beliefs about good external information accessibility in a given domain led senior executives to put greater emphasis on scanning proactiveness (all of the eight firms displaying a tendency for knowledge augmentation), because they believed that competing foundries, including those overseas, could easily gain access to knowledge and, therefore, that the source of competitive advantage lay in ensuring that their firm's quality of information was better than their competitors'—implying a need for senior executives to be more creatively involved in their scanning activities. Indeed, the VP of manufacturing of Foundry J wanted to "challenge" a belief in the industry (as he perceived it) that it was hard to get high-quality information in the foundry industry. He remarked that "the information is all around us . . . people just have to look in the right places!" When we asked him to elaborate, he said that he believed in building extensive contacts with people in key supplier companies and actively participating in industry workshops to receive early information on technical advances. This orientation, then, suggested that when managers perceived information in a given domain to be widely available, they tended to scan more resourcefully. The relationship between external knowledge accessibility and uncommon knowledge use was straightforward. In those cases in which the senior executives said that it was easier to access knowledge from industry sources, we found enhanced levels of knowledge augmentation.

Our analysis also suggested that senior executives displaying strong beliefs about their own personal competence in a given domain were more proactive in their search behaviors (seven of the eight firms). In other words, senior executives who saw themselves as having expertise in, for example, a production technology, were likely to devote more energy to ensure that they stayed at the forefront of knowledge development in that domain, so that they could continuously improve their understanding. For instance, the CEO of Foundry I said:

> I am extremely . . . I don't know, maybe observant on a lot of things. You have to focus much more on your what information you really need. A lot of it is nice to have, but it costs you money to do it, money to store it, and it may slow things down. I go for information that is usable and simple. A lot of my competitors get information that really is not necessary.

Also, of particular note, we found that all foundries whose executives manifested a belief in lower-echelon knowledgeability also tended to emphasize knowledge augmentation.

In sum, these patterns in the data suggested that perceptions of greater external accessibility of knowledge, greater levels of perceived personal competence, and beliefs in the knowledgeability of lower-level employees all were associated with proactive scanning and knowledge augmentation. Table 3B provides further evidence for our conclusions concerning those foundries that emphasized knowledge augmentation as a pathway to competitive advantage. It displays examples of linked, representative quotes from managers from within each of three different foundries, and shows the knowledge significance/source subthemes, their association with scanning proactiveness as the dominant mode of knowledge search, and knowledge augmentation as a favored mode of uncommon knowledge use.

No Pursuit of Uncommon Knowledge Use

As noted, a number of firms displayed no obvious attempt to develop uncommon knowledge, so we present the prototypical pathway associated with a focus on neither knowledge adaptation nor

augmentation. Figure 3C shows the roles of executive knowledge schemes and scanning associated with this pattern.

We found that leaders in such foundries tended to value knowledge mainly for attaining customer responsiveness (all four firms that showed no uncommon knowledge use), and displayed a rather disinterested approach to knowledge work, in general. These foundries focused on maintaining the status quo and were averse to making changes in their processes. We found that strategic leaders in these foundries exhibited some lack of confidence in their own abilities (in three of these four firms), which resulted in a passive approach to scanning (in only two of these firms did the informants scan intensively and none scanned proactively). These tendencies were exacerbated by a general view that lower-echelon workers had little useful knowledge (in all four of the firms). The lack of belief in their personal competence, coupled with a view that lower-level workers were not capable, suggested that these foundries avoided meaningful knowledge work beyond what was needed to meet the immediate requirements of customers. Table 3C provides linked, representative quotes from within three different foundries that showed no engagement in uncommon knowledge use practices.

In sum, the analysis of linkages among executive knowledge schemes (i.e., how managers understood knowledge, especially in terms of its significance and its source), scanning, and the uncommon use of knowledge indicated differing patterns of association depending on whether firms were pursuing an adaptation or augmentation approach to knowledge use. The knowledge adaptation mode was associated with executive knowledge schemes emphasizing an inward orientation (high personal competence, limited use of external knowledge sources, and lower value for lower-echelon employees as a source of knowledge). These features also were associated with a greater tendency to scan intensively, rather than proactively. The knowledge augmentation mode was associated with executive knowledge schemes displaying stronger beliefs in the external accessibility of knowledge, in personal competence, and in the knowledgeability of lower-level employees. Furthermore, these features were associated with proactive scanning as it related to knowledge augmentation. Lastly, those firms not displaying an inclination for uncommon use of knowledge tended to have leaders who valued knowledge for maintaining responsiveness to current customers and who also showed a marked lack of personal competence in key areas of foundry management. These factors together were associated with firms emphasizing maintenance of status quo and adopting a passive posture to knowledge work.

Postscript

As a follow-up step, we wanted to gain some assessment of whether these pathways had effects on innovation outcomes for these firms. Such outcomes could range from incrementally innovative achievements such as attaining new reductions in production costs to those involving radical changes, such as adopting new technologies and developing new products. Accordingly, we matched the dominant knowledge use mode in each of our sampled firms with the innovation outcomes each firm reported for the six months following the completion of our original data gathering. Table 4 provides a tabulated summary of these innovation outcomes.

Overall, analysis of these post hoc innovation assessments showed that most firms that pursued uncommon knowledge use (of either mode) achieved significant reductions in production costs, an important outcome in the industry given the continuous pressures on costs from foundries operating in low-labor-cost countries such as China and Mexico. In contrast, those firms that did not emphasize either of the two knowledge use modes tended to have limited innovation outcomes. We also observed some deeper differences among firms that engaged in adaptation or augmentation. Our analysis showed that those firms that pursued knowledge augmentation had greater success in achieving innovation outcomes that tended more toward the radical end of the spectrum, whereas those firms emphasizing knowledge adaptation tended to innovate more incrementally. Although these trends suggest the importance of uncommon knowledge use in generating competitive advantage for firms, they also show that the different modes of knowledge use are associated with differences in the character of that advantage.

DISCUSSION

Organizational research has often treated knowledge as essentially a tangible economic asset whose value and attributes are assumed to be widely available and readily apparent to the people or firms being studied. Although scholars have argued for the need to recognize the influence of CEOs and other leaders on strategic decisions, actions, and organizational outcomes (e.g., Donaldson & Lorsch, 1983; Hambrick & Mason, 1984; Priem, 1994), investigation of the specific processes by which managers affect value creation for firms has been inad-

TABLE 4
Post Hoc Perceived Innovation Outcomes[a]

Foundry	Knowledge Use Mode	Achieved Production Cost Reductions	Gained Additional Work from Existing Customers	Gained New Customers	Adopted New Technologies	Developed Substantially New Castings/Products
D	Adaptation	X	X			
E	,,	X				
G	,,	X		X	X	
H	,,			No data available.		
K	,,	X	X	X		
O	,,	X	X	X		
P	,,			No data available.		
R	,,	X	X			
V	,,	X	X	X		
S	,,	X	X	X	X	
A	Augmentation		X	X		
B	,,	X		X	X	
F	,,	X	X	X	X	X
I	,,	X		X	X	X
J	,,				X	X
M	,,			No data available.		
T	,,	X			X	X
U	,,	X	X	X	X	X
C	None		X	X		
L	,,		X			
N	,,	X				
Q	,,		X			

[a] We asked informants to compare their firms' innovative outcomes with those of the firms that they saw as their closest competitors/counterparts.

equate (Nickerson, Silverman, & Zenger, 2007). We therefore adopted an approach capable of accounting for the likelihood that knowledge as a resource can emerge from the ways in which executives understand, search for, and use knowledge in a manner that might create unique advantages for their firms. Our findings suggest that it is not simply that some firms operating under the same industry conditions necessarily possess better knowledge than other firms, but rather that managers can help to create better knowledge when they influence commonly available information to be used in uncommon ways.

The main outcome and contribution of this work is an inductive process model that not only shows that senior managers differ in their beliefs about available information, but also shows how those differences relate to ways in which knowledge resources are acquired via different scanning orientations and how they are used in practice to create distinctive competencies. In the course of our developing the grounded model, several new concepts with theoretical implications emerged—especially the notion of scanning proactiveness, as well as those of knowledge adaptation and knowledge augmentation as relevant modes of uncommon knowledge use.

Insights from the Grounded Model: Executive Knowledge Schemes and Processes Associated with Generating Uncommon Knowledge

Good evidence exists in the relevant literature that managerial cognition is consequential in a firm's strategic context (e.g., Barr, Stimpert, & Huff, 1992; Tripsas & Gavetti, 2000). There is less (empirical) evidence about how managerial schemas are related to subsequent cognitive processes (e.g., information search) and actions—and especially, to actions with consequences for developing competitive advantage. Although it is important to consider the effects of managerial schemas on organizational outcomes such as the speed and magnitude of strategic change (e.g., Nadkarni & Barr, 2008) and performance (Priem, 1994; Thomas et al., 1993), this study identifies and explicates key managerial actions and practices that have largely been treated as implicit in conceptualizing relationships among managerial schemas, strategic actions, and organizational outcomes. In particular, our findings suggest that action patterns that involve proactive search for information, and the adaptive or augmentative use of knowledge in dealing with strategic situations, form a substrate on which organizational competencies can develop. In

particular, the notion of scanning proactiveness emerged as an important catalyst in the relationships between managerial schemas and actions. Managerial scanning, and especially proactive scanning, then, is not just an information- and knowledge-acquisition activity, but also a crucial interfacing activity that connects others in an organization to facilitate collective knowledge use practices. Scanning thus not only shapes incoming information but might also be seen as "amplifying" that information for subsequent adaptive knowledge use in practice and/or augmenting knowledge use for wider, more generative application.

Overall, the grounded, emergent model depicted in Figure 2 and the explication of the linkages in the model depicted in Figures 3A–3C (and supported by their companion Tables 3A–C) present a processual view of how structured managerial knowledge is linked to subsequent cognitive and behavioral activities that constitute microprocesses underlying organizational competencies. Our findings are consistent with a more complex conceptualization of human agency by Emirbayer and Mische (1998), in which they posit three different concertive abilities that people use to achieve desired outcomes: applying past knowledge and interpretations retained in the form of schemas (iterational agency); searching for future ways of understanding (projective agency); and engaging in thoughtful reflection while responding creatively to problems (practical-evaluative agency). This study therefore portrays managers as quite knowledgeable agents, capable of accounting for the past, the projected future, and the situated present in identifying, acquiring, and using knowledge.

Our analysis of linkages among executive knowledge schemes, scanning, and knowledge use practices indicated different patterns associated with firms employing adaptation or augmentation as ways of facilitating the conversion of common knowledge into uncommon outcomes (cf. Table 4). This study provides some answers as to how and why firms (even those operating in largely similar environments) emphasize and develop different organizational capabilities. The overall pattern of findings shows how higher-level differences in strategic outcomes of firms can be guided by micro-level processes that involve how key individuals understand and search for knowledge in their daily contexts. Firms whose leaders emphasized knowledge adaptation as a pathway for developing competitive advantage tended to understand and scan for knowledge quite differently than firms whose leaders emphasized knowledge augmentation. Our findings provide some new insights about the importance and need for identifying deeper managerial antecedents of knowledge-related processes and structures that result in significant organizational outcomes such as innovation and performance (cf. Anand et al., 2007; Smith, Collins, & Clark, 2005).

Our findings also lend support to the assertion that managerial schemas do not act merely as filters, but, perhaps more importantly, act as active guides for information search and actions that underpin organizational resources and capabilities (cf. Gavetti, 2005; Glynn, 2000). Overall, these findings concerning executive knowledge schemes could expand research on the origins of organizational resources and capabilities. Barney (1991) identified four characteristics to evaluate resources (value, rareness, cost of imitation and nonsubstitutability). Research taking the resource-based view usually treats these attributes as exogenous to the decision-making process (or belief systems) of organizational leaders (Priem & Butler, 2001). The roles of knowledge significance and source, in this study, however, lend credence to the growing awareness that the factors influencing the choice of organizational capabilities are driven not only by rational, economic considerations but also by the cognitive and behavioral tendencies of an organization's leaders (Adner & Helfat, 2003; Kaplan, 2008).

Executive scanning as an enabler of uncommon knowledge use. Starbuck and Milliken argued that a primary reason why "executive values have a strong influence on actions is that they influence what executives notice" (1988: 47). Our findings expand on this observation, suggesting that it is not just how frequently executives scan and notice, however, but also how they go about getting better information than their rivals that create the context for actions that confer competitive advantage. Our findings offer two potential contributions to the scanning and knowledge acquisition literatures. First, the emergence of the notion of scanning proactiveness expands understanding of the scanning concept itself and contributes to a recent line of research in which managerial attention in organizations is seen as involving mindful and richness-generating search efforts (Rerup, 2009; Weick & Sutcliffe, 2006). The notion of executive scanning as an information acquisition activity usually has been conceived as the frequency or amount of search, and our data, too, affirmed the relevance of this conceptualization. Scanning proactiveness (the tendency to actively pursue new and different information, perhaps in new and different ways) has received only limited consideration, however. The traditional focus on scanning intensity seems to have concealed a path that acknowledges scanning proactiveness as a promising means for devel-

oping generalizable knowledge (via knowledge augmentation)—a form of knowledge use that would seem to hold more potential for a firm's creating new competencies. As is evident from considering Appendix B, the usual approach is for studies to look at the amount or frequency of scanning, rather than its quality. The presence of scanning proactiveness among managers might be one reason for some of the ambiguous findings about executive scanning. Hambrick (1982), for example found that firms pursuing different strategies did not differ in the amount of scanning in a given sector. It is likely, however, that there are systematic differences among executives in *how* they search, regardless of how much they search. Our findings suggest that researchers should look beyond assessing only the amount of effort devoted to scanning and devote more attention to the specific search activities in which managers engage.

Second, by identifying relevant features of executive knowledge schemes that relate to the two scanning modes, these findings enrich the set of antecedents that can be investigated in the future to better explain the drivers of executive scanning. Hambrick and Mason (1984) argued that "executive orientations" influence a manager's "field of vision," representing areas in which they are likely to engage in search/scanning. Despite these arguments, scanning researchers have paid rather limited attention to the deeper cognitive foundations of executive scanning behaviors. A further consideration of Appendix B shows that much of the existing work has focused either on objective or exogenous drivers of scanning. Those studies that have accounted for cognitive bases of scanning have tended to consider only a few dimensions such as perceived environmental uncertainty. An exception is Dollinger (1984), who looked at tolerance for ambiguity and integrative complexity as drivers of scanning. Our empirical support for the proposition that executive knowledge schemes are associated with scanning behaviors offers some insight into the factors that lead to differences in managers' scanning emphasis. On a related note, this study responds to Schulz's (2001) call for research that can help explain not only how managers recognize and construe the relevance of knowledge (as a precursor to knowledge acquisition), but also how existing understandings of relevance influence organizational capabilities. By explicating the linkages between conceptions of the significance and sources of useful knowledge and subsequent acquisition and use processes, this study achieves the key outcome that the ways in which managers perceive and understand knowledge and its sources also are associated with how they go about searching for and acquiring knowledge.

Uncommon knowledge use: Knowledgeable practice as a resource. The emergence of uncommon knowledge use as a way to understand and conceptualize how leaders of firms meaningfully apply, adapt, and enhance knowledge in their strategic practices offers some informative insight into the foundations of knowledge as a competitive resource. Our analysis showed two plausible pathways by which uncommon knowledge was created—knowledge adaptation and knowledge augmentation. Knowledge adaptation manifested in efforts to devise clever, improvisational solutions to particular problems. Knowledge augmentation manifested when problem situations were seen as occasions to challenge, change, and/or expand organizational knowledge, and it took the form of new insights and understandings that altered the scope of the problems and afforded the organization an ability to enter into new areas of expertise.

The concept of uncommon knowledge use and its two constituent modes, adaptation and augmentation, can help to bridge insights from the micro level of analysis (e.g., about different styles of individual creativity, such as incremental vs. radical [see Madjar, Greenberg, & Chen, 2011; Mumford & Gustafson, 1988]) with those from more macro or collective/organizational levels of analysis (such as the concepts of single- and double-loop learning [see Argyris & Schön, 1978]). Knowledge adaptation and augmentation can also be related to the notions of exploitation" and exploration (March, 1991), and yet they are also different from both these concepts in important ways. In a recent *Academy of Management Journal* special research forum on exploitation and exploration, Gupta, Smith, and Shalley (2006) called attention to problematic ambiguities regarding the definition and scope of the exploitation and exploration concepts. They noted an apparent dualism in the literature about whether the concepts represent different forms of acquisition and use of knowledge and learning, or if one mode represents learning and the other does not. In our view, part of this definitional ambiguity occurs because of the wide net cast in conceptualizing exploitation and exploration—a tendency that often results in conflating the processes underlying the concepts with their outcomes. Mom, Van Den Bosch, and Volberda (2007) called for a clarifying focus on the specific managerial activities that lead to exploitation and exploration outcomes in firms. Similarly, although significant attention has been focused on the social and organizational conditions that encourage creative behaviors in individuals

(Drazin, Glynn, & Kazanjian, 1999), relatively less is known about how different types of creative behavior influence organizational tendencies and outcomes. The current study addresses that call by exploring the microprocesses of knowledge search and use that lead to important innovation outcomes in firms. The pathways associated with the uncommon knowledge use modes uncovered in this study provide an empirical basis for improving theoretical precision concerning the links among knowledge schemes, knowledge acquisition, and knowledge use that can be viewed as presaging learning or as foreshadowing differing purposes to which knowledge can be applied (thus improving existing capabilities via exploitation or creating new capabilities via exploration). For these reasons, knowledge adaptation and augmentation are not merely alternative labels for related concepts but are more elemental processes that lead to important outcomes, such as learning and innovation.

We might also note that these findings suggest that the ways in which knowledge is adapted or transformed in the practices of an organization are related to the mode of scanning (which suggests that executive scanning has implications beyond its usually assumed association with knowledge acquisition only). Some scholars have viewed executive scanning as a crucial precursor to organizational adaptation and performance (Danneels, 2008; Ghoshal, 1988; Priem, 1994), and this study enriches that view.

Future Research Directions

This study offers potentially important areas for future research. Although a body of research on knowledge-as-social-practice exists (Brown & Duguid, 2001; Tsoukas, 2009), this literature has seen relatively little research directed toward a systematic inquiry of whether firms differ in their practices in important ways and whether these differences are associated with the development of competitive advantage (Dougherty, 2004). By identifying two modes of uncommon knowledge use, this study helps lay a foundation for expanding the conversation around the resource- and knowledge-based views of competitive advantage, by shifting from a focus on "resources" only to include "knowledgable and resourceful practices" that key members of organizations engage in when dealing with strategic and operational issues. Future research can benefit by bringing insights from research in creativity (Amabile, 1996; Drazin et al., 1999; Madjar et al., 2011), improvisation (Miner, Bassoff, & Moorman, 2001; Weick, 1998), and managerial resourcefulness (Ganz, 2000; Kanungo & Misra, 1992) into the study of executive scanning and knowledge use practice to help provide deeper insights into the microprocesses underlying the development of competitive advantage.

Future research can also utilize the concepts of executive knowledge schemes and the different modes of executive scanning and knowledge use practices to study a range of important phenomena. For instance, as noted, the literature on absorptive capacity has advanced understanding of the conditions under which knowledge imparts strategic advantages to firms (Cohen & Levinthal, 1990; Zahra & George, 2002). Lane, Koka, and Pathak (2006: 857) recently noted the need to appreciate the role of managerial cognition in the recognition, transformation, and application of knowledge within firms as a primary internal factor driving absorptive capacity. This study addresses some of these needs, by providing a process model suggesting various pathways to the production of absorptive capacity, but it remains for future research to explore such relationships and transformations in more detail.

Implications for Practice

Finally, this research has some useful implications for practicing managers. Our study shows that even in a mature industry—one threatened by increasing international competition and populated mainly by small firms—managers, through their meaningful actions, can create sources of distinctive advantage from seemingly common inputs. The grounded theory offers informative concepts and relationships that managers can use to make deeper and richer assessments of the ways in which they understand, seek, and use knowledge in ways that are similar to or different from their competitors' ways. A useful insight for practicing managers, therefore, might be that given the complexity of their work and daily routines, they can focus on developing unique ways to scan for and acquire information without having to spend an inordinate amount of time doing so (i.e., by scanning more proactively). In simple terms, the idea "scan smarter, not harder" (a linguistic play on the more commonly used phrase) might prove to be a useful suggestion.

Research on small firms in the manufacturing sector (e.g., McEvily & Zaheer, 1999) has found that such organizations tend to vary in their propensity for seeking knowledge from suppliers and outside agencies. Our study builds on this observation and notes that there are firms that increase their efforts to acquire knowledge from external sources, but also other firms that effectively acquire knowledge in ways that differ markedly from how other firms

do so. Our findings also suggest that so-called best practices can differ among firms, depending on the underlying beliefs and actions of strategic leaders. This study can, therefore, also be useful for agencies and trade associations that have a mandate to disseminate technologies and best practices within an industry. Leaders in these organizations can use our findings to develop a better appreciation of why some firms seek out more knowledge from them and perhaps use that knowledge in better ways than others.

Limitations

This study, of course, has some limitations. One limitation is our focus on informant accounts via interviews as our main source of data. Where possible, however, we made it a point to engage our informants in situ; that is, if they were talking about a manufacturing issue, we made efforts to actually see the process in action or the solution implemented. Or, if they were talking about the importance of customer quotations, we made it a point to review the actual quotation documents and asked our informants to explain them to us. We attempted to study uncommon knowledge use *in action* to the extent possible—that is, by spending time observing real situations that managers faced and dealt with. A follow-up to this study would perhaps involve fewer firms and a longer time spent inside those firms more systematically observing the micro-level actions and interactions in which managers and other organization members engage when facing situations in real time. As a corollary to this observation, we note that it also would have been desirable to engage with a firm's suppliers, competitors, and customers to get an exogenous view of the processes that we were trying to study, but we delimited the scope of this study to more closely study managers' and firms' internal processes. Although we did carry out interviews with leaders of industry trade associations and university experts (as external sources of knowledge), we probably would have benefited from spending more time with other outside sources. Our focus on a single industry could also be seen as a limitation, but the single-industry focus does allow us to gain an in-depth understanding of the drivers of competitive heterogeneity with many contextual factors held more or less constant, which would be difficult to accomplish in a large, multi-industry study. Finally, the fact that all but one of our informants were male does pose a limitation in terms of representativeness among other industries in which the percentage of females in senior management positions is likely to be higher.

We might also note that relationships between executive knowledge schemes and scanning, as well as relationships between scanning and knowledgeable practice, are probably not unidirectional. For simplicity and clarity of exposition, however, we limited the description of our findings to unidirectional associations. Longitudinal studies might cast some light on how knowledgeable practice might be recursively associated with changes in executive knowledge schemes and scanning behaviors. Studying the evolution of such schemas over time, and how such changes might affect patterns of resource choice, acquisition, and use offers rich opportunities for better understanding how managers shape the foundations of sustained competitive advantage.

Conclusions

Scholars seem to know quite a lot about competitive advantage. It is known, for instance, that developing competitive advantage has a great deal to do with the right choice of industry and strategic positioning within that industry (Porter, 1980) and with the development of resources that are valuable, rare, inimitable, and nonsubstitutable (Barney, 1986, 1991), and so on. In the age of the knowledge worker that has now fulfilled Drucker's (1993) predictions, it is also now recognized that crafting competitive advantage has a lot to do with developing distinctive knowledge as a strategic resource (Grant, 1996; Itami & Roehl, 1987). Research on the origins of competitive advantage is beginning to evidence a deeper appreciation of managers as active, knowledgeable agents (Augier & Teece, 2009; Smith et al., 2005). Organizational scholars have long assumed that knowledge is a critical resource in modern day organizations. This study has helped to uncover some of the specific pathways by which knowledge *becomes* a resource that can transform common knowledge into uncommon knowledge.

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APPENDIX A[a]

Interview Protocol

1. Background information:
   a. Information about the firm
   b. Information about the executive—functional experience, experience in the industry, experience with the firm
2. Brief introduction of the research project: We are investigating factors involved in innovation and performance in US foundries. We are trying to get a sense of how your foundry works and achieves its strategic goals.
   a. How does a foundry such as yours try to create competitive advantage? What are some of the factors that separate better performing foundries from others?
   b. For these factors what is the role of know-how or expertise?
   c. How do you make sense of innovative outcomes in the foundry business? Can you share some instances where you saw innovative occurrences in your company? Who was involved in these instances?
   d. What areas of knowledge and skills are important to innovate and succeed in the foundry industry?
   e. Where does this knowledge or these skills reside? In what form?
   f. How does your firm acquire or create new ideas? Who is most responsible for the acquisition or creation of new ideas?
   g. How often do you as a top manager of your firm feel that the knowledge base of your firm needs to be updated, changed, or modified? How is this process carried out? Who most often carries out this process? Can you provide examples of when you have tried to update or modify your knowledge base?

[a] Format and items are verbatim.

APPENDIX B

Empirical Research on Antecedents of Managerial Scanning[a]

Empirical Study	Antecedents of Scanning	Scanning Activity
Hambrick (1982)	Firm strategy	Scanning frequency, scanning interest, scanning hours
Culnan (1983)	Task complexity (objective) Source accessibility (objective)	Information search behaviors
Dollinger (1984)	Integrative complexity Intolerance of ambiguity	Number of search hours in a sector Number of external contacts
Ghoshal (1988)	Mimetic isomorphism (institutional forces)	Types of information acquired, scanning modes, information sources
Daft, Sormunen, and Parks (1988)	Strategic sector uncertainty	Scanning frequency, scanning sources
Boynton, Gales, and Blackburn (1993)	Role uncertainty (objective), role threat (objective)	Amount of search activity
Sawyer (1993)	Perceived environmental uncertainty	Scanning frequency, scanning interest Scanning sources
Boyd and Fulk (1996)	Strategic importance, perceived environmental complexity and variability	Scanning frequency, level of interest
May, Stewart, and Sweo (2000)	Perceived strategic uncertainty	Scanning frequency, scanning sources
Garg, Walters, and Priem (2003)	Perceived environmental dynamism	Frequency of use of various scanning devices

[a] The breadth of the scanning literature precludes exhaustive listing. Efforts here are aimed at displaying maximum variety in antecedent factors.

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