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DIFFERENT KNOWLEDGE, DIFFERENT BENEFITS: TOWARD A PRODUCTIVITY PERSPECTIVE ON KNOWLEDGE SHARING IN ORGANIZATIONS

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ABSTRACT

We develop a differentiated productivity model of knowledge sharing in organizations that proposes that different types of knowledge have different benefits for task units. In a study of 182 sales teams in a management consulting company, we find that sharing codified knowledge in the form of electronic documents saved time during the task but did not improve work quality or signal competence to clients. In contrast, sharing personal advice improved work quality and signaled competence but did not save time. Beyond the content of the knowledge, process costs in the form of document rework and lack of advisor effort negatively affected task outcomes. These findings dispute the claim that different types of knowledge are substitutes for each other and provide a micro-foundation for understanding why and how a firm's knowledge capabilities translate into performance of knowledge work.

keywords: knowledge sharing, capabilities, teams, resource-based view

'The most important, and indeed the truly unique, contribution of management in the 20th century was the fifty-fold increase in the productivity of the manual worker in manufacturing. The most important contribution management needs to make in the 21st century is similarly to increase the productivity of knowledge work and knowledge workers.'

Peter Drucker (1999)

An organization's capacity to share knowledge among its individuals and teams and apply that shared knowledge to performing important activities is increasingly seen as a vital source of competitive advantage in many industries (e.g., Dierickx & Cool, 1989; Grant, 1996; Kogut & Zander, 1992; Nonaka & Takeuchi, 1995; Teece, Pisano & Shuen, 1997). Building on this premise, scholars have examined the difficulties involved in keeping the firm's knowledge within its boundaries (e.g., Brown & Duguid, 2000; Liebeskind, 1997), as well as the challenges of sharing knowledge across boundaries between firms (e.g., Helper, MacDuffie & Sabel, 2000; Inkpen & Dinur, 1998). Firms also face significant problems in sharing knowledge internally, however, including search costs and barriers to transfer that operate at the individual, group, and organization levels (e.g., Gupta & Govindarajan, 2000; Reagans & McEvily, 2003; Schulz, 2003; Szulanski, 1996; Zander & Kogut, 1995). If knowledge sharing involves costs and barriers as well as benefits, obtaining and using knowledge from other parts of the firm does not necessarily improve the performance of task units within the firm (Haas & Hansen, 2005). Because more knowledge sharing is no guarantee of improved performance, scholars need to move beyond studying facilitators of knowledge sharing to examine how a firm's knowledge resources are utilized by task units to improve their performance.

Our study seeks to address this issue by analyzing the mechanisms through which a firm's different types of knowledge resources affect task-level outcomes—how the utilization of knowledge resources enhances the productivity of knowledge work at the level of task units. We address the following question: Why are some task units able to leverage knowledge residing elsewhere in the firm to enhance the productivity of their knowledge work, while others are not? Extending prior research on productivity in manufacturing and service organizations (e.g., Argote, Beckman & Epple, 1990; Darr, Argote & Epple, 1995), we examine three indicators of the productivity of knowledge work that are critical in many knowledge-intensive organizations: time saved by leveraging the firm's knowledge resources (cf. Eisenhardt & Tabrizi, 1995; Hansen, 1999), enhanced work quality as a result of utilizing knowledge (cf. Cummings, 2004; Haas, 2006; Levin, 2000), and the ability to signal competence to external constituencies as a result of leveraging knowledge (cf. McEvily, Das & McCabe, 2000; Podolny, 1994).

To investigate the effects of knowledge sharing on these task-unit outcomes, we examine two sets of dimensions that are likely to affect the performance of knowledge work. First, we distinguish between two types of knowledge sharing mechanisms within a firm — through electronic documents and personal interactions. Prior research has tended to focus on either electronic documents (e.g., Connolly & Thorn, 1991; Sproull & Kiesler, 1991; Hansen & Haas, 2001) or social networks that tap into individual expertise (e.g., Borgatti & Cross, 2003; Reagans & McEvily, 2003; Tsai, 2001), but not both. In contrast, we consider both mechanisms simultaneously and aim to distinguish their relative contributions to different aspects of task performance.

Second, we consider both the *process* of using knowledge from other parts of the firm and the *content* of that knowledge. In this study, the process of using knowledge obtained from

outside the task unit refers to efforts to adapt and apply that knowledge to a specific task, while content refers to the inherent quality of that knowledge without reference to the specific task. While task units may benefit from using high-quality knowledge, process costs may reduce or eliminate those benefits.

By considering these two sets of dimensions, our framework seeks to unpack the "black box" of causal mechanisms that help explain why a firm's stock of knowledge in the form of a reservoir of electronic documents and a pool of experts affect task-level outcomes in terms of time savings, work quality and signals of competence.

We tested our framework in a study of 182 sales teams in a management consulting company where we collected survey data on use of electronic documents from the firm's database system and help enlisted from colleagues outside the team. We used regression analysis to predict the effects of knowledge content and processes on the three dimensions of teams' task performance.

A DIFFERENTIATED PRODUCTIVITY MODEL OF KNOWLEDGE SHARING

Although scholars have devoted increasing attention to knowledge sharing in organizations in recent years, relatively little research has focused on the performance implications for task units within firms (for exceptions, see Cummings, 2004; Haas, 2006; Hansen, 1999; Tsai, 2001). The literature on knowledge search and transfer has identified numerous barriers to knowledge sharing, including knowledge tacitness (Teece, 1986), limited absorptive capacity of knowledge receivers (Szulanski, 1996), perceptions of competition by knowledge providers (Hansen, Mors & Lovas, 2006; Tsai, 2002), and lack of trust between providers and receivers (Levin & Cross, 2003). While some researchers examine the resulting

performance of task units within firms, however, the dependent variable in these studies more commonly is the extent of knowledge sharing itself or the difficulty of transferring knowledge (e.g., Gupta & Govindarajan, 2000; Zander & Kogut, 1995; Reagans & McEvily, 2003; Schulz, 2003; Szulanski, 1996; Uzzi & Lancaster, 2003). Often, such studies do not specify the implications of barriers to knowledge sharing for the performance of the specific tasks for which the knowledge is obtained.

In contrast, strategy research that takes a knowledge-based view of the firm has emphasized performance implications, but the theoretical focus here has been on firm-level rather than task-level variation in performance (e.g., Grant, 1996; Kogut & Zander, 1992). Most empirical research from this perspective has linked knowledge resources to firm-level outcomes (e.g., Bierly & Chakrabarti, 1996; Brown & Eisenhardt, 1997) or sometimes subunit-level outcomes (e.g., Henderson & Cockburn 1994; Lord & Ranft, 2000). Such approaches do not explain why two firms or subunits with similar levels of knowledge resources might perform differently, however, or why task units that operate within subunits may benefit differentially from using the knowledge available to them. Thus, they do not address the question of knowledge work productivity because they do not investigate how task units with access to similar knowledge resources may generate different benefits from those resources.

Existing research has only partially investigated how different types of knowledge sharing may affect task performance differently. There has been considerable debate about the distinction between codified and tacit knowledge, focusing for example on the relationship between these two knowledge types or on the codification process (e.g., Ancori, Bureth & Cohendet, 2000; Cowan & Foray, 1997; Nonaka & Takeuchi, 1995). Research on codified knowledge has examined issues such as resistance to using electronic databases (e.g., Connolly

& Thorn, 1991, Sproull & Kiesler, 1991) and strategies for gaining attention in an overloaded marketplace for codified knowledge (Hansen & Haas, 2001), but usually overlooks the alternative inter-personal paths through which knowledge can be shared. Meanwhile, research on tacit knowledge has emphasized the role of social networks and communities of practice in facilitating knowledge sharing (e.g., Brown & Duguid, 2000; Hansen, 1999; Reagans & McEvily, 2003), while paying little attention to the possibility that knowledge may be shared more effectively via electronic databases. The relative effects of sharing codified versus tacit knowledge on different dimensions of task productivity remain largely unexplored.

To address these shortcomings, a productivity perspective on knowledge sharing focuses attention on the effects of leveraging a unit of knowledge obtained from outside the task unit on producing a unit of a desired outcome at the task level of analysis. In manufacturing and service settings, productivity rates can be defined in terms of changes in the unit of output per unit of input over time, where the unit of output is often a quantifiable number or cost of items produced and the unit of input is often a measurable quantity such as the number or cost of labor hours (e.g., Argote *et. al.*, 1990; Darr *et. al.*, 1995; Lapre & Van Wassenhove, 2001). In knowledge-intensive work settings, however, desired task outcomes are often multi-dimensional and difficult to quantify (Davenport, Jarvenpaa & Beers, 1996; Lev, 2001). For example, the effectiveness of brainstorming groups can be measured not only by the number of ideas they generate but also by the quality of those ideas and the extent to which they impress clients, as well as whether they serve as a source of organizational memory for the organization and skill variety for their participants (Sutton & Hargadon, 1996). Project team outcomes are often evaluated by highly developed firm-specific quality criteria (e.g., Cummings, 2004; Haas, 2006) as well as by efficiency measures such as time-to-market (e.g., Hansen, 1999). Units of input in

knowledge work are also encompassing and hard to measure, including the quality and quantity of knowledge used as well as the processing efforts required to incorporate these resources into tasks. Consequently, the standard approach to analyzing productivity in organizations does not easily lend itself to analyzing the productivity of knowledge sharing for task units, requiring explication of the distinctive inputs and outputs relevant to the knowledge work context.

Prior research has made progress toward establishing the building blocks that are needed to develop a model of knowledge work productivity at the task-unit level. A systematic parsing of these components of knowledge work can provide the basis for a productivity perspective that integrates and extends existing insights. We have identified three main components of knowledge work productivity, as depicted in figure 1: (i) two types of knowledge sharing — through electronic documents and personal advice; (ii) a content and process dimension for each type of knowledge; and (iii) three primary task performance outcomes — time savings, work quality, and signal of competence.

----- insert Figure 1 about here -----

Two types of knowledge sharing

Knowledge sharing has been conceptualized as involving two distinct ways of transferring knowledge across organization subunits. The first is through direct contact between individuals, when one person advises another about how to complete a specific task (e.g., Cummings & Cross, 2003; Hansen, 1999; Reagans & McEvily, 2003; Tsai, 2001). The hallmark of such person-to-person sharing is that the handover of knowledge requires direct contact between the provider and receiver of the knowledge, in meetings, by phone, or via e-mail. Because it involves direct contact, such sharing allows for the transmission of tacit or non-

codified knowledge, which is knowledge that has not been fully articulated in writing (cf. Von Hippel, 1988).[1] This type of knowledge sharing may be called *personal advice usage*.

The second way to obtain knowledge is from written documents that may be available in paper or in electronic format (e.g., Hansen & Haas, 2001; Werr & Stjernberg, 2003). Sharing via written documents is most appropriate for knowledge that can be readily codified (Winter, 1987). Because of the prevalence of electronic knowledge management systems in many companies, we focus on the sharing of electronic documents, which are created when employees record what they know in writing and upload those documents into databases that can then by accessed by other employees as needed. The hallmark of such document-to-people sharing is the separation between the provider and receiver: the receiver of the document does not have to contact or speak to the provider directly but can use the document as a stand-alone resource. This type of knowledge sharing may be labeled *electronic document usage*.

These two basic types of knowledge sharing are not mutually exclusive but may be undertaken simultaneously by individuals seeking to obtain knowledge from other parts of the firm. One type of sharing may also lead to another: someone accessing and reading an electronic document may decide to contact the author of that document, whereas someone obtaining personalized advice from a colleague may receive a tip about the existence of a useful electronic document. Nevertheless, personal advice and document usage represent two ways of obtaining knowledge, and it is useful to separate them conceptually and empirically because they are likely to involve different benefits and costs for task units.

Process and content dimensions

Understanding the potential value derived from using knowledge that is obtained from other parts of the firm involves both a process and a content dimension. First, by process we

refer to the efforts involved in adapting knowledge obtained for a task (cf. Huber, 1991). For electronic documents, this adaptation process involves evaluating and reworking the documents in order to incorporate the knowledge they contain into the task appropriately. For personal advice, the process of adaptation requires securing the efforts of people with useful expertise in explaining what they know and customizing that knowledge to the task. These activities involve process costs that may reduce the benefits of utilizing knowledge.

Second, to assess productivity benefits, the content of the knowledge obtained must be considered, where content refers to the *quality* of the knowledge accessed by the task unit (cf. Kane, Argote, & Levine, 2005). Quality indicates the rigor, soundness, and insight of the knowledge conveyed by a document or person irrespective of the task at hand. The process and content dimensions of knowledge use are theoretically distinct because even when the quality of their content is high, the documents or advice obtained by the task unit may still require substantial adaptation to apply them appropriately to the task at hand. Thus, process and content dimensions may differentially affect the extent to which a task unit benefits from using knowledge from other parts of the firm.

Three task performance dimensions

The performance of a task involving the use of knowledge can be assessed along multiple dimensions. We focus here on three specific task performance dimensions that are critical to teams conducting many knowledge-intensive tasks, including new product development, service improvement, and process management tasks, as well as management consulting tasks. First, we consider efficiencies by examining the *time* saved by using knowledge from other parts of the firm, since time savings can make a critical difference to productivity levels within the firm as well as competitive performance in situations where earlier completion of a task is beneficial. In

the management consulting industry, for example, time savings are critical because the work is usually very time-pressured and clients demand rapid responses to their requests. In other settings, an early launch of a new product means an early generation of new revenues (e.g., Eisenhardt & Tabrizi, 1995; Wheelwright & Clark, 1992). Also, spending extra time on a task involves opportunity costs in the form of time that cannot be spent elsewhere (Hansen, Pfeffer & Podolny, 2001). Thus, swift task completion involves both a task outcome and a by-product in the form of a "time dividend" to spend on other activities.

Second, the *quality* of the work output is usually important for knowledge-intensive tasks (e.g., Cummings, 2004; Haas, 2006; Levin, 2000). This output variable differs from the quality of the knowledge used for the task, which is an input variable. High work quality here refers to the extent to which the output of the task (e.g., a product, proposal or decision) meets or exceeds the expectations of those who receive or use it (Hackman, 1987). In the management consulting industry, for example, clients demand analyses that are creative and customized to their needs, as well as sound and rigorous, making high-quality work outputs central to meeting or exceeding their expectations. In addition to the benefits for the focal task itself, high-quality work outputs also provide useful by-products in the form of new knowledge that can be used in subsequent similar tasks.

Third, through its work and interactions with others, a task unit provides a *signal* of its competence that may be only partially related to the inherent quality of its work, especially when it is difficult for outsiders to measure that quality directly, as is the case for much knowledge work in professional services firms (Podolny, 1994). A task unit that is able to signal that it is highly competent stands to benefit because it is likely to develop a favorable reputation among its constituencies, including external customers. In the management consulting industry, for

instance, signals of competence can make an important difference to the chances of winning a new client contract. Again, this task outcome has beneficial by-products, since the firm's positive market reputation grows as customers pass such reputations along to other potential customers (cf. Fombrun & Shanley, 1990).

The three task performance outcomes — time savings, work quality, and signal of competence — can be seen as intermediate outcome variables that differ from eventual performance effects, such as revenues from a new product developed, profits from a new business launched, or a successful sale of a new service to a client. The extent to which time saved, quality and signaling are valuable to the firm depends on contextual factors, including the aspects of products and services that are most valued in the market, the extent of competition, and the rate by which knowledge can be replicated by competitors (cf. Wernerfelt, 1984; Barney, 1991; Haas & Hansen, 2005). In this sense, like other forms of productivity, the productivity of knowledge sharing is only partially related to the ultimate value derived from leveraging the firm's knowledge resources.

In summary, the three task performance dimensions are likely to be affected by the task units' use of electronic documents and personal advice. We apply this framework to develop hypotheses in the context of management consulting firms where the task units are temporary sales teams that come together for a few weeks or months to prepare a bid for a new client contract. When developing a sales proposal, these teams typically draw extensively on knowledge from the firm's databases and experts to help them save time, improve work quality, and signal competence to their prospective clients.

Hypotheses

Saving time. The mechanism through which electronic documents affect task performance is reuse, defined as the proportion of a document's content that a task unit can incorporate into its task output, such as a written sales proposal for a new client contract (cf. Cowan & Foray, 1997). In the management consulting context, electronic documents often include detailed information and well-developed analyses, such as market data, algorithms, software code, and competitor profiles. Reuse of existing information and analyses can prevent sales teams from duplicating efforts already expended by others (cf. Teece, 1986). In particular, electronic documents of high quality can help teams to save time by allowing them to complete some essential elements of their work more quickly than would have been possible otherwise. For example, obtaining a document that contains up-to-date information on market sizes enables a sales team engaged in preparing a strategy development proposal to understand and analyze the prospective client's market quickly, allowing the team members to spend more time focusing on other aspects of the proposal or allocate their resources to other projects. In contrast, a sales team that has access only to documents of relatively low quality is likely to have to spend valuable time collecting and checking basic background information and ensuring the robustness of preliminary analyses. The higher the quality of the knowledge contained in the electronic documents used by a team, therefore, the higher the likelihood that the team can save time by exploiting this knowledge (cf. March, 1991).

Adapting electronic documents that reside in the firm's knowledge management system for use in a new sales proposal often involves processing costs, however, which may reduce the benefits of using the codified knowledge. Some high quality documents might be readily applicable to the particular task at hand, whereas others that are also high in quality may be less directly relevant to that task and require adaptation (cf. Huber, 1991). For example, a document

containing a high-quality analysis of the competitors in prospective client's industry may need very little rework prior to inclusion in the team's sales proposal, while a document containing a high-quality analysis of potential strategies for competing in that industry might require substantial rework to customize it to the client situation or place it in the larger context of the bid. Since such adaptation activities are time-consuming, high levels of document processing efforts increase the time required to complete the task.

A team's productivity gain from using electronic documents therefore depends both on the quality of the knowledge contained in the documents and on the amount of rework required to incorporate the knowledge into a new sales proposal. Teams that obtain low-quality documents that need substantial reworking are likely to spend more time – not less – completing their tasks. In general, the higher the quality and the lower the amount of rework required, the higher is the expected productivity gain in terms of time saved for the team:

Hypothesis 1 (H1). Electronic document quality reduces the time a focal team spends on a task, while document rework increases it.

Even if more rework reduces time savings overall, however, it is possible that reworking documents just a little can make them much more useful, saving time for a team. In the empirical analysis, we test the possibility that the functional form could be curvilinear, such that very low levels of rework save time but higher levels of rework decrease time savings.

While the reuse argument suggests that electronic documents save time if those documents are high in quality and require little rework, using personal advice will not clearly result in time savings, even if the colleagues who provide the advice are highly experienced and

exert effort to help the team. Help from colleagues outside the team may result in the provision of basic information — such as market share numbers for a competitor analysis — that will enable swifter completion of the task. Colleagues may also be able to help the team solve difficult problems by offering crucial insights, reducing the time needed to develop solutions to thorny problems. But the suggestions and ideas offered by colleagues, especially those with rich experiences, may require additional time to absorb and assimilate. While they can improve quality, they also take time to process. Effort by colleagues additionally requires investment of time by the team members who have to convince colleagues to help them, nurture these relationships, and reciprocate the help they receive in ways that may take time away from their own task (Hansen *et. al.*, 2001). Considering these opposing benefits and costs, the net effect of personal advice usage on time savings is unclear and likely to be weak.

Improving work quality. Since the quality of a task unit's work can benefit from high-quality inputs, using personal advice from experienced colleagues can improve work quality. In the management consulting setting, colleagues who have experience in areas related to a sales proposal can provide complementary expertise (Teece, 1986) or analogous experiences that a team can draw on to generate ideas and identify possible avenues to pursue for viable solutions (Sutton & Hargadon, 1996). The relative richness of direct personal contact as a communication medium also enables such colleagues to help the team develop customized and creative products for its client, since they can tailor their advice to the situation and engage in two-way discussions to gain insight into the problem and aid exploration of possible solutions (Daft & Lengel, 1984). Such assistance is important to providing high-quality work outputs because the problems at hand can be better understood, potential issues can be surfaced earlier, and more diverse

alternatives can be considered. The more experienced the colleagues from whom the team obtains advice, the greater the benefits their advice is likely to offer for the quality of the work.

However, obtaining personal advice also involves processing costs. Once a team has identified colleagues who might be able to provide assistance, these colleagues must be willing to exert effort to help the team absorb their knowledge and adapt it to the task at hand. The effort required to benefit from a colleague's expertise thus is different from the effort required to benefit from electronic documents. While electronic documents must be reworked or augmented to adapt the knowledge they contain to the task, the benefits available from colleagues' advice depend on the amount of effort those colleagues are willing to exert to help the team. Some colleagues may be willing to take the time to talk on the phone, meet face-to-face, travel to visit the team, or meet with the prospective client. In contrast, others may hoard their expertise or be unwilling to take time away from their own activities. Without their investment of effort, the advice offered by colleagues can be easily misinterpreted or applied inappropriately by the team. Thus, lack of effort by colleagues advising the team can prove costly for the quality of the work.

In short, a team's productivity gain from personal advice usage is likely a function of both the level of advisors' experience related to the task and their level of effort in helping the team:

Hypothesis 2 (H2). Advisors' experience improves a focal team's work quality, while their lack of effort decreases it.

Teams that rely on experienced colleagues who do not exert effort to help them are not likely to improve their work quality. Moreover, relying on inexperienced colleagues who are willing to exert effort may not result in improved work quality either. Consistent with Casciaro and Lobo's (2006) observation about receiving advice from "loveable fools", greater effort by colleagues who do not know much about the task may lower work quality. We test this possibility in the empirical analysis.

While personal advice usage may increase work quality if the colleagues consulted are experienced and exert effort, electronic document usage is likely to have only an indirect effect on work quality through time saved. Teams that are able to save time on some parts of their tasks by reusing codified knowledge from documents can choose to either redeploy the time released to other parts of their tasks or assign it to other activities (including working on other client projects, for example). If the team chooses to redeploy this "time dividend" to other parts of the team's project work, electronic document usage has an indirect effect in the form of extra time that the team can devote to improving work quality.

Beyond this indirect effect, electronic document reuse does not necessarily enhance work quality directly. Clients of consulting firms usually demand creative and customized solutions, but the limited richness of electronic documents means that they are more likely to provide facts and figures than complex, nuanced insights (Daft & Lengel, 1984). Documents are best used to help with the basic parts of a sales proposal, such as providing necessary background information that can otherwise take substantial time to locate and compile. The quality of the proposal depends more on the overarching solution proposed for the client than on the basic background information included, however, implying that electronic document usage will have a marginal or negligible direct effect on work quality.

Signaling competence. Because it is often difficult to evaluate the potential value of a knowledge work output, such as a sales proposal for a new consulting contract, it can be important for task units to send signals of competence beyond their written products (cf. McEvily *et al.*, 2000; Podolny, 1994). In the management consulting context, enlisting colleagues who can directly communicate to external constituencies that the sales team is highly competent helps the team establish credibility. Consultants frequently travel to sales meetings with potential clients accompanied by experts from the firm who help them convey the message that the consulting work will be done by competent individuals. Advisors' names and credentials often are listed in the proposal documents, which identify them as contributors to the proposal and to the future project work.

Colleagues who have greater experience in the area of the task will have greater credibility themselves with external constituencies, and thus will be able to provide greater credibility in turn for the sales team they have been enlisted to support. More experienced colleagues also can help a team identify the unique competencies of the firm that are particularly relevant to the client and explain how those competencies offer potential value for that client, thus enhancing the ability of the team to communicate those unique competencies more effectively.

These colleagues also must exert effort, however, in order to assist the team. If they minimize their efforts to help by offering glib or poorly considered advice that fails to appropriately identify or adequately convey the unique competencies of the firm relative to the client's needs, the team's ability to signal competence may suffer. Additionally, if their names are listed as advisors to the team but they are not available to answer the prospective client's questions, they may inhibit the team's ability to signal competence. Effort is also required to

assist the team in critical events involving client communication. Experts are often asked to participate in important conference calls or accompany sales teams to specific client meetings. If they do not respond to requests for help until after a crucial sales pitch, they are likely to be of little value and may even undermine the team because of their conspicuous absence when the proposal was presented. Beyond their overall level of effort, therefore, the timing of their contributions also matters. A lack of effort by enlisted experts thus may impede the team's attempts to signal competence.

To summarize, the effort exerted by advisors to the team as well as their task-relevant experience can influence a team's ability to signal its competence to important constituencies.

Hypothesis 3 (H3). Advisors' experience improves the signaling of competencies, while their lack of effort decreases it.

It is possible, though, that too much effort exerted by the advisors to the team could signal that the team is incompetent and needs outside help to succeed. The effect of colleagues exerting effort thus could be curvilinear, such that their efforts have a positive effect on a team's ability to signal competence up to a point but a negative effect thereafter. It is also possible that advisors' experience and effort interact such that advisors with low level of experience but high levels of effort signal *in*competence, not competence, through their presence in front of potential clients (cf. Casciaro & Lobo, 2006).

While the experience and efforts of expert colleagues can be expected to influence the signaling dimension of task performance, electronic document usage seems unlikely to affect signaling, since the quality and rework of documents used in preparing task outputs is not readily

apparent to clients, who are not likely to see those documents or even know about their existence. One sales tactic for a consulting team could be to explicitly emphasize to a potential client that the firm possesses an impressive amount of documented knowledge in the task area, thus drawing a direct link between the stock of electronic documents available on relevant topics and the potential value the team could bring to the client. However, such a tactic is risky, as it draws the client's attention to document reuse, which might suggest a risk of copying prior work instead of customizing the proposal, undermining the signal of competence (cf. Hansen, Nohria & Tierney, 1999). These opposing effects suggest that document reuse will not be strongly related to a team's ability to signal competence. Electronic document quality thus is likely to have only a very indirect effect on the communication of competence to clients: it saves time, which may improve work quality, which in turn may improve the signal of competence to clients (see Figure 1).

DATA AND METHODS

We tested our hypotheses in a management consulting firm that provides business, tax, and audit consulting services to corporate clients in a range of industries including energy, communications, healthcare, automotive, financial services, and consumer products. The firm employed more than 10,000 consultants in over 100 offices across the U.S. at the time of the study. To understand how the work was structured and carried out, we conducted over 30 interviews with partners, consultants, and managers in the firm, including those responsible for its knowledge management programs. Project teams at the firm were involved in developing sales proposals for new client contracts and carrying out existing contracts; our study focused on those teams that were developing sales proposals with the purpose of bidding for a new client

contract. Typical client contracts focused on business strategy development, enterprise resource software implementation, or corporate tax advice.

The teams that were assigned to develop sales proposals at the firm were temporary, ad-hoc groups of consultants. They were assembled for a specific sales proposal and then dissolved once it was completed. This made it difficult to predict the future performance of a team based on its past performance. The team members typically started the project work by seeking out relevant knowledge from both colleagues and the firm's document databases. They then used this as input to drafting a written sales proposal. At the culmination of the project, the proposal was presented in a final face-to-face meeting with the prospective client. As this sequencing of activities indicates, knowledge inputs from others occurred prior to completion of the proposal, and before the team's performance was known. Our interviews indicated that the lack of established reputations for high or low team performance meant it was unlikely that expectations of superior performance drove the provision of better documents or advice to a team. Similarly, the sequencing of project activities made it implausible that the time savings, work quality, and signal of competence conveyed by the final sales proposal outputs affected the knowledge inputs obtained earlier in the project. Thus, it was improbable that the causal relationships we predict between knowledge inputs and proposal outputs could have been reversed.

Our interviews also revealed that the team leaders at the firm espoused lay theories about the potential benefits of knowledge inputs that could be characterized as an "undifferentiated" view. They expected that using electronic documents could help them not only save time but also deliver better quality work and even signal to clients how much the firm knew about a topic. Likewise, they expected that good advice from experienced colleagues could help them save time as well as deliver higher quality work and signal competencies if those advisors were put in

front of clients. In other words, they viewed electronic documents and personal advice as substitute sources of knowledge, and they expected that investments in creating and sharing electronic documents could reduce the need for more costly personal advice usage, leading to better economics in knowledge reuse. Such lay theories were a primary reason why we were granted access to the firm: senior leaders firmly believed not only that personal connections offered quality and signaling as well as time saving benefits, but also that their substantial investments in document databases were valuable for improving work quality and signaling competence as well as saving time, and they were eager to have these benefits demonstrated. Our hypotheses that different types of knowledge offer different benefits thus ran counter to their views.

Data Collection

We used the firm's database of sales bids to draw up a list of all those that began during the three months prior to our data collection and finished no later than one month afterwards, including only recent bids to ensure that their details could be easily recalled. To limit the demands imposed on the firm's sales partners, we drew a random sample from these 812 bids, creating a final sample of 259 bids in total.

In consultation with managers at the firm, we developed a customized survey instrument which was administered via the firm's internal e-mail system to the leaders of the sales teams responsible for the sampled bids. We surveyed the team leaders only both to reduce the cost and effort involved and because our interviews indicated that it would not be preferable to use aggregated team member responses, as this would require weighting the responses of marginal and central team members equally. Pre-tests of the survey with five partners at the firm indicated that sales team leaders were able to provide an accurate overview of the work of their teams,

since preparing a sales proposal usually took most of their time during the typically brief but intense preparation period of one to three months, and they were well informed about their teams' use of electronic documents and advice from colleagues during this period.

The survey response rate was 74%. We tested for potential biases in the data arising from differences between the 191 bids included in our dataset and the 68 bids that were excluded because the team leaders did not respond to the survey. The t-tests indicated no significant differences in the dollar value of the bids ($t=0.09$, n.s.), whether they were competitive or exclusive ($t=0.02$, n.s.), or their start dates ($t=-0.08$, n.s.), though included bids were shorter in duration than excluded bids ($t=2.41$, $p<0.05$). Because sales team leaders might have been particularly reluctant to respond to surveys about bids that had recently been lost, we also conducted t-tests on lost bids only, and again found no important differences between included and excluded bids. After omitting nine surveys with incomplete data on the variables of interest in this study, the sample on which we conducted our analyses included 182 teams.

Minimizing potential biases in the survey data. To minimize potential common-method biases, which may occur when variables are collected from the same source, we designed the survey so that all the questions about the sales team's use of knowledge from other parts of the firm preceded those about the eventual outcomes of the task (Podsakoff & Organ, 1986). To further decouple the responses, the survey, which was long and took 40 minutes to complete, included several sections with questions unrelated to this study in between those related to the independent variables and the dependent variables. Additionally, the electronic version of the survey automatically forwarded the respondents to the appropriate next questions based on their responses to previous questions, reducing the likelihood that their responses to later questions would lead them to amend their earlier responses, as they could not go back and change their

previous answers. The electronic format also meant that when they began entering their responses to the early questions, they did not know that questions about the task outcomes would appear later on, so they could not anticipate this in advance.

While the survey design minimized the likelihood that answers to earlier and later questions might have influenced each other, we also tested for the possibility that knowing the eventual outcome of their sales bids might have influenced the answers that team leaders gave to questions about both the knowledge resources they used and the intermediate task outcomes. The research design allowed us to compare the responses of team leaders who already knew whether their bids had been won or lost to those of team leaders who did not know the eventual outcome at the time of the survey because their bids were still active. Comparing the subset of 20 bids that were reported as still active when the surveys were returned to those reported as won or lost, we found that the leaders of active bids did not make significantly different attributions from the others about time savings ($t=-0.25$, n.s.; $t=-0.87$, n.s.), work quality ($t=-0.89$, n.s.; $t=-0.85$, n.s.), or signal of competence ($t=-0.58$, n.s.; $t=-1.22$, n.s.). Likewise, there were no significantly different attributions about document rework ($t=0.50$, n.s.; $t=0.95$, n.s.) or advisors' effort ($t=0.48$, n.s.; $t=0.23$, n.s.). Counter-intuitively, respondents reported lower document quality for active bids than lost bids ($t=1.44$, $p<0.10$; $t=1.29$, n.s. for won bids), and higher advisors' experience for active bids than for both won and lost bids ($t=-2.13$, $p<0.05$; $t=-2.76$, $p<0.01$). This analysis shows that the respondents did not make consistent positive or negative attributions across the dependent and independent variables based on known bid outcomes, indicating that a common-method bias based on self-serving attributions was not a problem in the dataset.

To further confirm that common-method biases had been avoided, we conducted a factor analysis. A common-method bias would be suspected if all the variables loaded onto a single

factor, indicating that the respondents answered all questions in the same way, and if pairs of variables that might be expected to be similarly affected by a common-methods bias loaded onto the same factors. However, the variables included in our models loaded onto three factors, using the cutoff of eigenvalue above one, and five variables did not load significantly on these three factors but instead loaded highest on three additional factors. Additionally, some important sets of variables loaded on different factors. The three dependent variables each loaded on a different factor, and other pairs that might be expected to load onto the same factor did not, such as advisor's effort and response time, and document quality and search time. The factor analysis thus indicated no evidence of a common-methods bias in the dataset.

Nevertheless, to increase our confidence that survey respondents were not simply answering questions on the basis of their attitude toward leveraging knowledge for the project, we included a control variable about their overall satisfaction with their use of knowledge in the models. A bias might arise if the underlying satisfaction or dissatisfaction of the survey respondents with the knowledge resources available in the firm affected their responses to the questions about the quality of the knowledge used by the team and the level of effort invested in applying that knowledge to their tasks. A respondent who was satisfied overall might rate both the document quality and quality of work as high, for example, thus creating a spurious relationship between these two variables. To control for this potential problem, we asked: "Overall, how satisfied are you with the knowledge programs that supported this sales proposal? (including support from the corporate knowledge center, the various databases and search engines, and documents and advice from colleagues with relevant knowledge)" (7-point scale from 1 "very dissatisfied" to 7 "very satisfied"), and included this variable in the models (knowledge satisfaction).

Dependent Variables

We asked the bid leaders to respond to three statements about the performance of their sales team, using 7-point scales as follows: strongly disagree (1), moderately disagree (2), somewhat disagree (3), neutral (4), somewhat agree (5), moderately agree (6), strongly agree (7).

Time savings. In the interviews we conducted, partners and managers at the firm often noted that using knowledge from other parts of the firm to save time when preparing a sales proposal was critical to effective task performance, since sales teams usually worked under very tight deadlines. To capture the extent to which teams managed to save time by using knowledge from other parts of the firm, team leaders were asked to respond to the following statement: "We (the sales team) were able to spend much less time on the proposal because we used existing knowledge in the firm" (time savings).

Quality of the sales proposal. Our interviews also indicated that the quality of the sales proposal was a central factor determining whether a prospective client chose to hire the firm to carry out a new contract. The team leaders were asked to assess the quality of the proposals delivered by their teams by responding to the statement: "The proposal overall (solution, methods, value, presentation, and documentation) was among the best I have seen in the firm" (work quality).

Signaling competence. The interviews further suggested that the ability to signal competence to a prospective client by communicating the firm's distinctive strengths was another important aspect of task performance, and that this ability did not depend entirely on the quality of the proposal itself. The team leaders were asked to respond to this statement: "We (the sales team) were able to communicate the firm's unique competencies in the areas of the proposal to the client" (signal of competence).

These three dimensions of task performance are likely to be related and to affect each other. First, if time savings from using documents or advice are re-invested in the sales proposal, time savings can be expected to have a positive effect on work quality. Second, if signals of competence are partially related to the quality of the sales proposal, work quality should affect signaling ability. We therefore included the time savings measure as a control variable in the work quality models, and the work quality measure as a control variable in the signaling models.

Electronic documents: content and process variables

We measured the quality of the codified knowledge that the sales team obtained from the firm's electronic databases by asking the bid leaders: "Of what quality were the documents that the proposal team retrieved from the firm's databases?" (7-point scale from 1 "poor quality" to 7 "very high quality"). This continuous variable measured the quality of the documents' knowledge content (document quality).[2]

To capture the effort that sales teams expended on processing the codified knowledge in the documents they obtained from the firm's databases, we asked: "How much rework of the documents did the sales team have to do? (rework includes rewriting parts of the slides, software, graphs etc. to use them for this proposal.)" (7-point scale from 1 "very little rework required" to 7 "lots of rework required"). This measure captures the amount of effort required to adapt the codified knowledge in the electronic documents to the team's proposal (document rework). To test for possible curvilinear effects of document rework, we also mean-centered and then squared this measure to create a second-order variable.

Personal advice: content and process variables

Teams that contacted more experienced colleagues to help them with their work were likely to receive higher quality advice. We asked the team leaders: "Did the people in the firm

who helped the team have the experience that was needed for this particular proposal?" (7-point scale from 1 "did not have the needed experience" to 7 "had all the needed experience"), and used their responses to construct a measure of the quality of the knowledge content obtained from advisors (advisor experience).

To measure lack of effort on the part of advisors in preparing the sales proposal, we asked: "How much effort was exerted by the people in the firm who assisted the team?" (7-point scale from 1 "exerted much less effort than average in the firm" to 7 "exerted much more effort than average in the firm"). We reverse-coded this item so that a higher score indicated lower effort by the colleagues who advised the team (advisor lack of effort). We also mean-centered and then squared this measure to test for any curvilinear effects of advisors' lack of effort on the team's ability to signal competence.

Control variables

Contract size. The teams in our sample were bidding for client contracts that ranged considerably in size. To control for this diversity, we asked the sales team leaders to report the first-year dollar value of the sales proposals in our sample, cross-checked their reports against similar information collected from the firm's database of sales bids, and logged these dollar amounts (contract size).

Competitive bid. While some bids for a new client contract pitted a sales team from the focal firm against sales teams from rival consulting firms, others did not. Because sales teams might place more emphasis on obtaining high quality knowledge inputs for competitive bids than for non-competitive bids, we included a binary variable coded 1 if the bid was competitive or 0 if it was not (competitive bid).

Leader experience and proposal novelty. The temporary nature of the sales teams and the sequencing of sales proposal activities made it very improbable that the causal relationships posited between knowledge inputs and proposal outputs could have been reversed, as discussed above. However, our interviews suggested that it was still possible that teams might both perform better and also obtain better documents and advice for two other reasons. First, when a team leader is more experienced in developing and selling proposals, the team might be expected to perform better and outsiders might also be willing to provide higher quality documents and advice. To capture team leader sales experience, we asked the team leaders to report the number of sales proposals that they had worked on at the firm in categories (i.e., 1 if 0 to 10 proposals, 2 if 11 to 20 proposals, 3 if 21 to 50, 4 if more than 50 proposals) (leader experience). Second, when a sales proposal is more similar in focus to past proposals on which the firm has worked, both better team performance and access to better documents and advice might be expected. To capture proposal novelty, we asked: "At the outset of the proposal, how similar did you feel this proposal would be to past firm proposals of this type?" (7-point scale from 1 "very different" to 7 "very similar"), and reverse-coded the responses (proposal novelty).

Knowledge codification. Some proposals at the firm required extensive advice from colleagues to prepare, while others could be prepared by relying mostly on electronic documents from the firm's databases. To capture the relative importance of these different types of knowledge to the proposal, we asked the sales team leaders: "What type of knowledge was used in developing the sales proposal (including documents delivered to clients and presentations given)?" (7-point scale from 1 "mainly personal practice know-how, past experience" to 7 "mainly reports, manuals, documents, pre-packaged materials") (knowledge codification).

Quantity of documents and advice. Our hypotheses concern the quality — not the quantity — of knowledge utilized by the teams. However, quantity and quality may be correlated. To control for the quantity of documents used by the teams in preparing their proposals, we asked: "To what extent did the sales team consult documents available in the firm's electronic databases for (1) the industry and company background analysis? (2) the qualifications and value statement? (3) the solution description? (4) the proposal overall? (all areas of the proposal and written output, including presentations, reports, work plans, etc.)?" (7 point scales from 1 "no documents consulted" to 7 "a great number of documents consulted'). The responses to these questions were averaged to create a measure of document use with a Cronbach alpha of 0.82 (quantity of documents). To control for the extent to which the teams used personal advice, we asked: "How many of the firm's partners and consultants outside the proposal team assisted the team? (include only people who spent more than one hour helping with the proposal)." We then asked the team leader to break down this total down by the number who provided 1-2, 3-5, 6-10, 11-20, 21-40, and 40-60 hours of assistance (anyone who worked more than 60 hours would be part of the team). We multiplied the number of people who assisted the team by the mid-value of the hours of assistance they provided, aggregated the scores, and divided by 100 to create a measure of the amount of help that the team received in hundreds of person-hours (quantity of advice).

Search and response time. Since more extensive search efforts could increase the quality of the documents the team obtained and reduce the level of rework they required, as well as diminishing time savings, we asked: "How much time did the sales team spend identifying useful documents?" (7-point scale from 1 "less than one day" to 7 "more than 10 days") (document search time). Because the ability of the team to benefit from the experience and

efforts of the experts they asked to provide advice could also be influenced by how promptly these experts responded to their requests for help, we also asked: "How time responsive were the people in the firm whom the sales team called upon for help?" (7-point scale from 1 "not responsive: took much longer time than average in the firm" to "very responsive: they helped out much sooner than average in the firm") (advisor response time).

RESULTS

Descriptive statistics are reported in Table 1 and the results of the regression analysis are reported in Table 2.

----- insert Table 1 and Table 2 about here -----

Models 1 and 2 in Table 2 report the results for the dependent variable of time savings. The control variables in Model 1 indicate that using existing knowledge saved more time for a team when the bid was non-competitive, the knowledge used was more highly codified, time spent searching for documents was lower, and higher quantities of documents were used. In contrast, using higher quantities of personal advice did not save time for the team. Teams that reported higher satisfaction with the firm's knowledge resources also reported higher time savings from using existing knowledge.

Model 2 shows the effects of the knowledge content and process variables on time savings. This model reveals that electronic document quality had a significant effect on time savings by a sales team. The higher the quality of the documents obtained from the firm's databases, the more time the sales team saved in completing the proposal. The more rework the electronic documents required, however, the lower the time savings for the proposal overall. The relative magnitudes of these two coefficients are similar (b=0.36 and b=-0.40, respectively),

indicating that high levels of rework can cancel out the benefits from leveraging average quality documents. These results support Hypothesis 1.

To test whether low levels of document rework might have saved time even if higher levels of rework reduced time savings, we also examined second-order effects of document rework, but the results (not shown) indicated no evidence of a curvilinear relationship between document rework and time savings. Model 2 further shows that advisors' experience and lack of effort did not significantly affect time savings.

Models 3 and 4 show the results for the dependent variable of work quality. Our first dependent variable—time savings—is included as a control variable in these models. Time savings had a significant and positive effect on work quality. Teams that saved time by using the firm's knowledge resources were able to deliver higher quality sales proposals to their prospective clients, implying that high-quality electronic document usage had in indirect effect on work quality through the mechanism of a "time dividend" that could be deployed to improve work quality.

Introducing the knowledge content and process variables in Model 4 shows that the more experienced the colleagues who assisted the sales team, the greater the positive effects on the quality of the proposal, as Hypothesis 2 predicted. However, lack of effort by those colleagues negatively affected work quality, also as Hypothesis 2 predicted. Moreover, the positive and negative coefficients are similar in magnitude (b=0.18 and b=-0.17, respectively), indicating that lack of effort can outweigh the benefits of inputs from colleagues with average levels of experience. In contrast, document quality and document rework did not affect the quality of the sales proposal beyond their indirect effects via time savings. Even if teams obtained high quality

documents from the firm's databases and reworked them extensively, the quality of the proposal was not directly improved.

Models 5-7 present the results for the signal of competence dependent variable. These models show that the effect of work quality on the ability of a team to signal its competence was significant and positive, indicating that a higher quality proposal served as a signal of competence to the client. Including time savings in these models had no significant effect (not shown), indicating that signal of competence was not influenced directly by time savings, though it was influenced indirectly by the effects of time savings on work quality. Teams were also able to signal competence more effectively if their leaders were more experienced in developing and selling sales proposals. Their ability to signal their competence was lower, however, when they relied more heavily on using codified rather than personal knowledge.

Model 6 presents the effects of the knowledge content and process variables on the team's ability to signal competence to the prospective client. Neither document quality nor document rework affected the ability to signal competence. However, teams that enlisted help from more experienced colleagues were able to signal their competence to their prospective clients more effectively, as predicted by Hypothesis 3. A lack of effort exerted by colleagues who advised the team had no significant effect, though, on the team's ability to signal competence to the client. Hypothesis 3 therefore is only partially supported by the results shown in Model 6, since a team's ability to signal competence was influenced by the content but not the process dimension of personal advice usage. Introducing the second-order term for advisor lack of effort (not shown) also revealed no evidence of a curvilinear relationship whereby low levels of effort were helpful for signaling competence but high levels of effort were not, or vice versa.

To further test for any possible effects of lack of effort by advisors, we examined whether the effects depended on advisor response time, and found that the interaction term between the effort and response time variables was significant and negative, as shown in Model 7.[3] With an increase in response time, an increase in advisors' lack of effort had a negative impact on the team's ability to signal competence to the client. Stated differently, an increase in advisors' effort had a more positive effect on competence signaling when response time was higher than when it was lower.

In additional models not shown here, we also examined whether there were any effects of interactions between each of the four main independent variables and the quantity of documents or advice used. The only significant result was a marginally significant positive interaction between document quality and document quantity for the dependent variable of time savings, ($b=0.23$, $p<0.10$), indicating that using more electronic documents saved more time for a team if those documents were of high quality than if they were of low quality. We also found that the interactions between advisors' experience and effort were not significant for any of the three dependent variables, revealing no evidence of a "loveable fool" effect (Casciaro & Lobo, 2006) whereby effort exerted by inexperienced colleagues was harmful.

DISCUSSION

The main finding of this study is that different types of knowledge affect task performance differently. Using high-quality electronic documents increased time savings for sales teams in the management consulting firm studied here, but did not affect work quality or the signaling of competence to clients. In contrast, drawing on advice from experienced colleagues improved the quality of teams' work and increased their ability to signal competence

to their clients, but did not save time. The results also demonstrate the usefulness of distinguishing between knowledge content and process variables: controlling for knowledge quality, greater process costs due to rework of documents or lack of effort by colleagues negatively affected task performance.

The results of the study contradict an "undifferentiated" view of knowledge sharing where different knowledge types are substitutes for each other. Contrary to commonly held lay theories, including those held by partners and managers at the firm we studied, using high-quality documents did not substitute for the effects of using high-quality personal advice, or vice versa; instead, the different types of knowledge offered different benefits for different dimensions of task performance.

This research complements the situated performance perspective on the value of knowledge in firms that we introduced in an earlier study (Haas & Hansen, 2005). The situated performance perspective draws attention to the need to examine the net effects of knowledge sharing on task performance outcomes under particular contextual conditions, rather than assuming that more knowledge sharing is always better. The findings of our earlier study revealed that in some situations, higher quantities of knowledge sharing sometimes hurt rather than helped sales teams in their attempts to win new client contracts. To explain this, we theorized that the costs of obtaining and using knowledge from other parts of the firm sometimes outweigh the benefits for a task unit, but we did not examine these costs and benefits directly. The present study unpacks these causal mechanisms by directly examining the costs as well as different benefits of using documents and advice. Thus, while the earlier study emphasized the conditions under which knowledge resources are translated into positive task outcomes (e.g., winning a sales bid), this study illuminates the mechanisms through which this translation

occurs. To accomplish this, we move beyond our earlier focus on the quantity of documents or advice used for a task to investigate the quality of the knowledge used and the processes required to incorporate that knowledge in project work. Taken together, these two studies thus contribute toward a productivity of knowledge perspective in four complementary ways: by highlighting the need to focus on task performance, by introducing the idea of context as moderating the value of knowledge (a situated performance logic), by considering how two types of knowledge (electronic and personal) affect different task outcome dimensions, and by analyzing how knowledge content as well as process dimensions affect outcomes.

The differentiated productivity framework that we develop here and the empirical analysis that supports it holds some important implications for research on knowledge sharing in organizations and the capability view in strategic management. Before discussing these implications, it is worth noting some limitations of our study. First, the empirical analysis relied on a cross-sectional design and perceptual measures. The benefit of this approach is that we obtained fine-grained measures of variables that are otherwise difficult to measure, but it also has drawbacks with respect to inferring causality and potential biases in some of the measures. Although we designed the survey to avoid these issues and performed tests to ensure the data did not reveal any common-method biases, some caution in interpreting the results is warranted. While our study is the first to empirically test a differentiated productivity framework, subsequent research can improve on our methods and measures by employing behavioral or third-party measures of knowledge utilization and task performance that were not available for this study. For example, use of electronic documents could be tracked through database usage logs, and customers could be asked for their views of the extent to which sales teams signaled their competence.

Another limitation is that this study focused on developing and testing hypotheses that address the specific context of the management consulting industry, where "knowledge management" initiatives have attracted considerable attention and investment (e.g., Hansen *et. al.*, 1999; Moore & Birkinshaw, 1998; Werr & Stjernberg, 2003). While this setting is a good one in which to study knowledge-intensive work, our findings should be tested in other settings that may differ along some important dimensions, including the critical task performance dimensions. The three dimensions of time savings, work quality, and signaling competence explored in our study are important measures of task performance in consulting firms, but other measures may be important in other settings, such as the degree of innovativeness in new product development settings.

Implications for knowledge sharing research in organizations: from knowing to performing

Addressing the task performance effects of sharing different types of knowledge contributes to research on knowledge sharing in organizations by focusing attention on the trade-offs between the costs and benefits of knowledge sharing. Prior studies have provided useful insight into the factors that facilitate flows of knowledge and the barriers to knowledge flows, but research that focuses on the extent of knowledge flows across task units as the dependent variable of interest often assumes that knowledge flows are beneficial without establishing whether they actually improve task-level performance. Yet, as our results demonstrate, knowledge sharing clearly has costs as well as benefits, including the investments required to rework documents and secure assistance from colleagues. Because the costs of knowledge sharing may sometimes outweigh the benefits, using electronic documents and personal advice from colleagues around the firm does not necessarily help — and sometimes actually hurts — task-level performance (cf. Pfeffer & Sutton, 1999). The implication is that research on

knowledge sharing must look beyond intermediate activities such as knowledge search and transfer to examine the costs as well as the benefits of different types of knowledge content and processes, and the implications for task-level performance outcomes.

To move beyond research that focuses on knowledge sharing itself as the outcome of interest, we have identified and investigated time savings, work quality, and signals of competence as three dimensions of task performance that are understudied yet often critical to the productivity of knowledge work. Our study reveals very different effects of using the same types of knowledge on these different task performance dimensions, indicating not only that it is unsafe to assume that more knowledge sharing is always better, but also that is unsafe to assume that the net costs and benefits of the same type of knowledge are always the same. For example, high quality documents offered greater benefits for saving time than for improving work quality in this study, while lack of effort by colleagues imposed greater costs on work quality than on time.

This study has also extended knowledge sharing research by examining the differential effects of two types of knowledge — electronic document and personal advice. Most prior studies have examined only document usage or only advice usage, without comparing their relative benefits and costs. Moreover, considerably more attention has been paid to the transfer of knowledge through interpersonal ties than through electronic documents, despite the importance of document usage in many knowledge-intensive firms. Beyond considering document usage and advice usage simultaneously, as in the differentiated productivity framework developed here, future research could usefully examine how they might interact. Documents sometimes point users to helpful advisors whom they did not previously know, for example, while advisors often point users to documents of which they were previously unaware.

Such interactions between document usage and advice usage might prove particularly valuable for improving task unit performance because they provide extra benefits for a given cost of knowledge sharing incurred.

Implications for the capability view: from possessing resources to performing tasks

Our study also has important implications for the issue of how firm-level capabilities are translated into performance outcomes at the level of tasks that constitute the core operations of a firm, such as preparing sales bids, developing new products, or launching new businesses. While strategy scholars have proposed that a firm's stocks of knowledge may provide a source of strategic advantage (e.g., Grant, 1996; Kogut & Zander, 1992), the question of how the stocks of knowledge possessed by a firm actually become inputs to daily activities and thereby affect task-level performance remains under-explored, both theoretically and empirically. Given that the resource-based view of the firm started gaining attention at least as early as Wernerfelt (1984), and the number of studies has exploded since then, this dearth of research on the "translation" issue is unfortunate.

Our study seeks to contribute toward filling this gap by articulating fundamental elements of a "micro-foundation" for translating firm-level capabilities into task-level performance. Specifically, our framework opens up the "black box" of mechanisms that translate a firm's stocks of electronic documents and pools of experts — what the firm possesses — into task-level activities and outcomes. Two findings are particularly important for understanding this translation process. First, the notion that different types of knowledge have different benefits is important in guiding future research and management practice. The finding that electronic document usage primarily saves time but does not improve quality or signals of competence suggests that a firm's repositories of codified knowledge can be viewed as an efficiency play:

such capabilities matter for the efficient use of resources but likely not much else. The finding that personal advice usage improves work quality but does not save time suggests that such stocks of knowledge are important in situations where performance quality matters but not in situations where efficiency is critical. This suggests that firms that primarily compete on quality can benefit most from emphasizing personal advice usage (and perhaps downplaying electronic document usage), while the opposite holds for firms relying on efficiency.

The second important implication for translating firm-level capabilities into task-level performance concerns the process dimensions in our framework. As our results show, the benefits of leveraging knowledge in the form of electronic documents and advice can quickly diminish with increasing document rework and lack of effort by advisors. This indicates how fragile the translation of firm-level capabilities into task-level performance can be: while scholars may observe and measure high levels of capabilities at the firm level of analysis, these resources may never translate into positive task-level performance because of process costs. The implication is that research on firm-level capabilities needs to incorporate a micro-foundation that illuminates how knowledge resources are translated into task-level performance, to avoid overestimating the benefits accruing to such resources and further advance the capability view.

CONCLUSION

While Peter Drucker called for a theory of productivity for knowledge workers, little has been done to develop such frameworks theoretically and empirically. This paper takes up the challenge by developing a differentiated productivity model of knowledge sharing that explicates how different types of knowledge sharing affect different dimensions of task performance in firms.

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FIGURE 1

A Differentiated Productivity Model of Knowledge Work

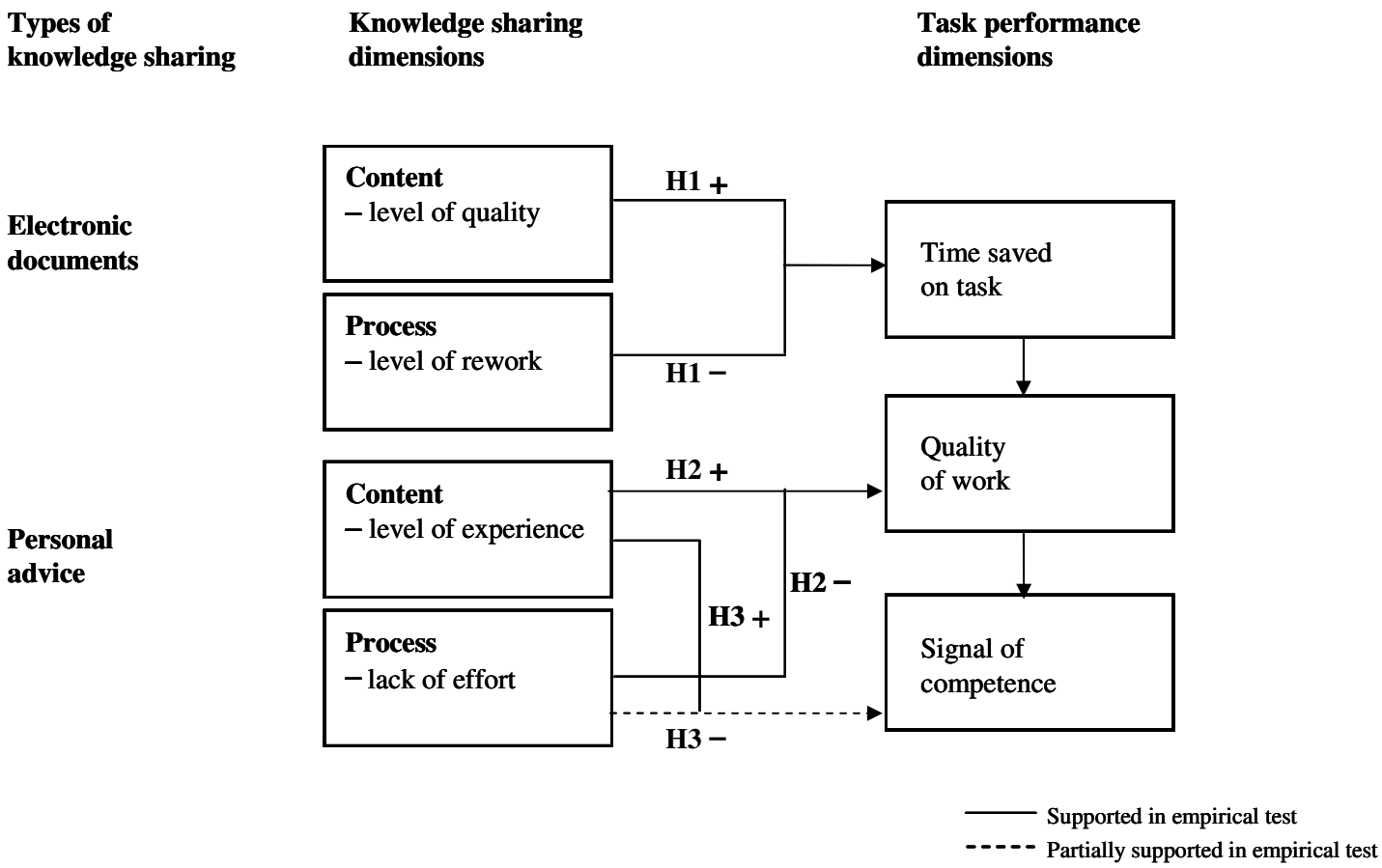

TABLE 1

Descriptive Statistics and Correlations[†]

	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Time savings	4.31	1.91	1	7																
2 Work quality	4.30	1.35	1	7	.26															
3 Signal of competence	5.91	1.21	2	7	.22	.39														
4 Document quality	4.65	1.17	1	7	.57	.32	.27													
5 Document rework	4.39	1.59	1	7	-.42	.03	-.05	-.25												
6 Advisor experience	5.31	1.32	1	7	.23	.21	.35	.26	-.10											
7 Advisor lack of effort	3.36	1.33	1	7	.02	-.27	-.07	-.07	-.35	-.13										
8 Contract size	14.56	1.08	11.91	18.13	-.02	.18	-.02	.04	.11	-.08	.12									
9 Competitive bid	0.56	0.50	0	1	-.12	.11	-.03	.03	.21	-.13	.09	.03								
10 Leader experience	2.69	1.04	1	4	-.01	.10	.21	.03	.08	.07	.04	-.02	.07							
11 Proposal novelty	3.41	1.55	1	7	-.36	-.09	-.14	-.22	.08	-.16	.05	-.06	.04	.10						
12 Knowledge satisfaction	4.41	1.21	1	7	.57	.31	.27	.60	-.26	.23	.18	-.03	.09	.01	.13					
13 Knowledge codification	3.94	1.46	1	7	.31	.15	.12	.37	-.11	.16	.05	-.04	.13	.11	.23	.33				
14 Quantity of documents	3.62	1.49	1	7	.26	.28	.15	.30	.18	-.02	.14	.14	.38	.16	.22	.26	.44			
15 Quantity of advice	1.33	1.67	0	8	-.02	.34	.11	.08	.25	.00	.50	.34	.21	.18	-.08	.07	.14	.33		
16 Document search time	3.55	1.75	1	7	-.09	.17	-.00	-.02	.25	-.18	.17	.16	.20	.13	-.05	.00	.09	.45	.44	
17 Advisor response time	5.15	1.24	2	7	.20	.20	.26	.26	-.02	.43	.10	-.07	-.10	.12	.10	.20	.02	-.02	.10	-.05

[†] N=182

TABLE 2

Results of Regression Analyses

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Dependent variable	**Time savings**	**Time savings**	**Work quality**	**Work quality**	**Signal of competence**	**Signal of competence**	**Signal of competence**
Independent variables							
Document quality		.36*** (.13)		.08 (.12)		.16 (.11)	.15 (.11)
Document rework		-.40*** (.09)		.01 (.08)		.05 (.07)	.07 (.07)
Advisor experience		-.01 (.10)		.18** (.09)		.20** (.09)	.22** (.09)
Advisor lack of effort[1]		-.14 (.11)		-.17* (.09)		.05 (.09)	.06 (.09)
Advisor lack of effort*response time							-.09* (.06)
Control variables							
Contract size	.03 (.13)	.01 (.12)	.11 (.10)	.05 (.11)	-.10 (.10)	-.10 (.10)	-.10 (.10)
Competitive bid	-.59** (.27)	-.48 (.25)	.19 (.22)	.24 (.22)	-.23 (.21)	-.22 (.21)	-.27 (.21)
Leader experience	-.10 (.12)	-.04 (.11)	-.05 (.10)	-.05 (.10)	.22** (.09)	.21** (.10)	.19** (.10)
Proposal novelty	-.11 (.09)	-.06 (.08)	.02 (.07)	.01 (.07)	-.05 (.07)	-.02 (.07)	-.03 (.07)
Knowledge satisfaction	.72*** (.11)	.39*** (.12)	.12 (.10)	-.01 (.11)	.16* (.08)	.04 (.10)	.06 (.10)
Knowledge codification	.27** (.11)	.20* (.10)	.04 (.09)	.03 (.09)	-.07 (.08)	-.16* (.09)	-.16* (.09)
Quantity of documents	.25** (.11)	.29*** (.11)	.04 (.09)	.01 (.10)	.07 (.09)	.14 (.09)	.14 (.09)
Quantity of advice	-.01 (.09)	-.04 (.09)	.16** (.07)	.11 (.08)	-.01 (.07)	-.02 (.08)	-.02 (.08)
Document search time	-.13* (.08)	-.06(.08)	.04 (.06)	.10 (.07)	-.05 (.06)	-.03 (.06)	-.02 (.06)
Advisor response time[1]	.13 (.11)	.14 (.11)	.12 (.09)	.03 (.10)	.17** (.08)	.07 (.09)	.08 (.09)
Time savings			.13* (.07)	.15* (.08)			
Work quality					.30***(.08)	.27***(.09)	.26***(.09)
Constant	-1.41 (2.09)	-.32 (2.00)	.50 (1.69)	.05 (1.73)	4.17*** (1.60)	3.72** (1.64)	3.54** (1.63)
R-squared	.47	.60	.23	.31	.26	.31	.32

*p < .10, **p < .05, ***p < .01 (two-tailed test for variable coefficients)

[1]Variables are mean-centered in Models 5, 6 and 7 to avoid high correlations with the interaction term.

[1] Although e-mail involves written communication, such informal correspondence also can be considered to be a form of direct personal contact because it is involves an exchange between individuals who know each other's identities, and it is informally tailored to meet the needs of the recipient rather than formally recorded in a style that is intended to be accessible to anyone who might happen to need it.

[2] The survey also included follow-up questions that provided greater specificity to this assessment of document quality, for example asking about the relevance of the codified knowledge they contained. However, the follow-up questions were all highly correlated with the main item and did not add further explanatory power, so we used this more parsimonious measure.

[3] The interaction between advisor lack of effort and advisor response time was not significant in the other models.